Library

of the

University of Toronto

Digitized by the Internet Archive
in 2013

http://archive.org/details/modpowerengin1918toro

POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power; and to the operation of Refrigerating Machinery.

Published by The MacLean Publishing Company, Limited, 143-153 University Ave., Toronto

MONTREAL: Southam Bldg. LONDON, ENG.: 88 Fleet St., E.C. WINNIPEG: 1207 Union Trust Bldg.

Vol XI—No. 1 Publication Office, Toronto—January, 1918 Published Monthly $1.00 per Year.

30999

It's the first rule in good valve buying

Look for the Diamond Trade Mark!

JENKINS BROS.' VALVES

Have a Host of Imitators

It pays to insist upon getting the genuine. Because it is only with genuine Jenkins Bros.' Valves that you are sure of the service which has given these valves their reputation. The *appearance* of Jenkins Bros.' Valves can be copied, but the *service* goes only with the original.

There's a Jenkins Bros.' Valve for every service

Look for the Diamond Trade Mark before buying

Jenkins Bros.' Valves are approved for use in Ontario and the Western Provinces by the Departments of Public Works.

Catalogue No. 8 free on request.

JENKINS BROS., LIMITED

Head Office and Works:
103 St. Remi Street
Montreal, Can.

Agencies in all the Principal Countries of the World.

European Branch:
95 Queen Victoria St.
London, E.C. 4, England

For Better Service in Mechanical Rubber Goods

THE United States Rubber Company, on January 1st, 1918, inaugurates an improved method of marketing in its *Mechanical Goods Division.*

This division includes Rubber Belting, Packing, Fire, Steam, Water, Garden and all other kinds of hose; Rubber Tiling, Mats, Matting, Jar Rings, Toys, Plumbers Supplies; Rubber Tape, Soles, Heels; Fibre Soles and hundreds of other rubber items.

Heretofore these goods have been marketed through subsidiary companies that for years have served all classes of industries, railroads, etc. These subsidiaries include:

Revere Rubber Co.
Peerless Rubber Mfg. Co.
Mechanical Rubber Co., Cleveland
Mechanical Rubber Co., Chicago
Sawyer Belting Co.
India Rubber Co.
Eureka Fire Hose Mfg. Co.

This plan will centralize the distribution of all these companies in one organization having branches and agents all over the country. This means quicker and better service everywhere for users of mechanical rubber goods.

The subsidiaries will continue to manufacture the brands, such as

Rainbow Packing, Four Ace Belting, Giant Hose, Etc., Etc.

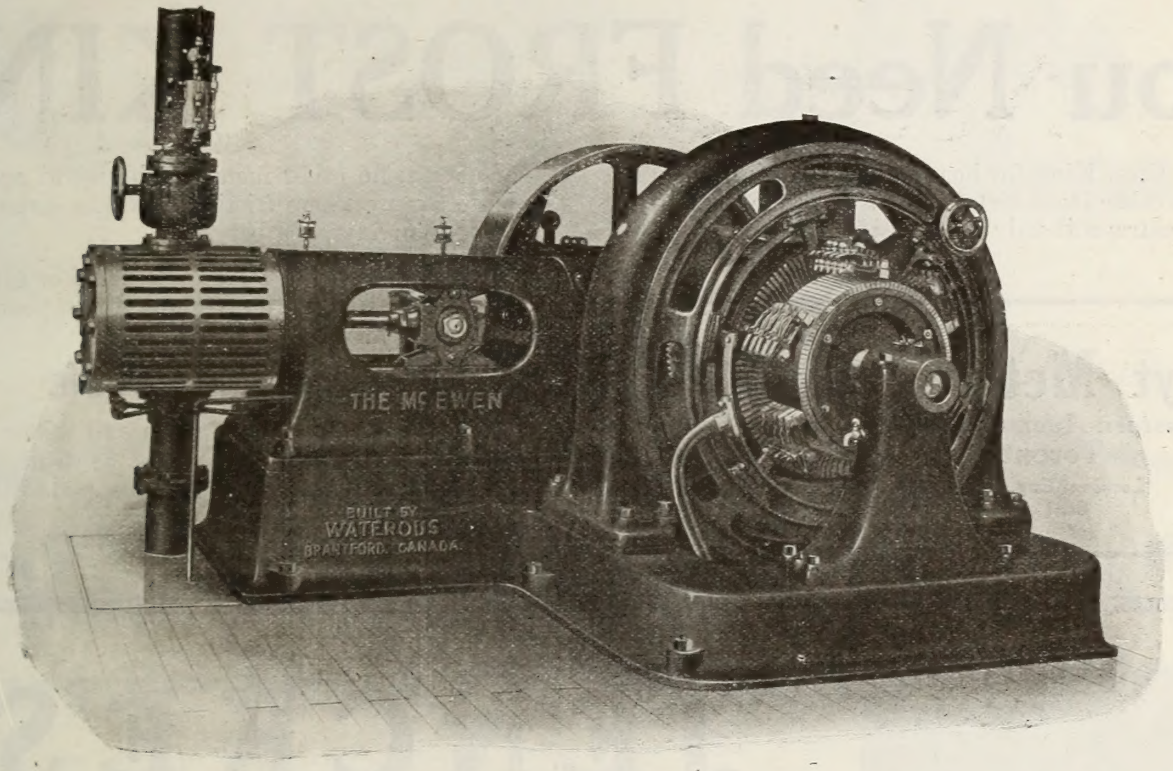
for which they are famous. The same high standard of quality and workmanship will be maintained. In addition the great seal of the United States Rubber Company, the hall mark of quality and value in rubber goods will identify these goods.

The assembling of all these well known brands in one selling organization makes the most complete line of mechanical rubber goods in the world. With distributors everywhere and factories in the large centers east and west we assure our customers the maximum in service and quality.

United States Rubber Company

HIGH SPEED AUTOMATIC

McEwen Engines



SIMPLICITY of operation, economy in steam combustion and the ability to stand up under hard usage—are features that make the McEwen Engine ideal for Isolated Plant Installation.

Both Simple and Compound types are built. Sizes range from 40 to 700 H.P. Every McEwen Engine is Canadian built throughout. It is tested and inspected before leaving the works and is backed up by a rock-bottom regulation guarantee.

Waterous Isolated Plant Equipment

McEwen Automatic Engines.
Waterous Boilers—any style.
Feed Water Heaters.
Injectors.
Steam Separators.
Circulating Pumps.
Feed Pumps.
Exhaust Heads.

Waterous

BRANTFORD, ONTARIO, CANADA

If interested, tear out this page and keep with letters to be answered.

You say, "Money Talks." Well, it does. $5,000,000, the combined annual sales of Hoyt Babbitt Metals, talk Hoyt quality.

You Need FROST KING

You need Frost King for heavy duty and high speed work. No other Hoyt Metal is so lastingly good when service is extraordinarily severe—and that is saying, of course, no other metal in the world equals Frost King for use where friction would be serious without a superlatively good babbitt.

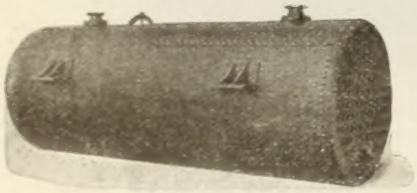
Frost King is the greatest anti-friction general purpose Babbitt we've compounded in 40 years of scientific metal mixing.

NICKEL GENUINE

is the Hoyt Metal for dynamo and motor. It is an extremely high copper alloy; as near an actual bronze, in fact, as a babbitt can be made with success.

Write for Hoyt's Catalog.

Hoyt Metal Company
Eastern Avenue and Lewis Street
Toronto, Canada
London. Eng., New York, U.S.A.
St. Louis, Mo., U.S.A.



JENCKES BOILERS

Vertical Tubular
Horizontal Tubular
Locomotive Types
Heating Boilers

All sizes to any Provincial Act

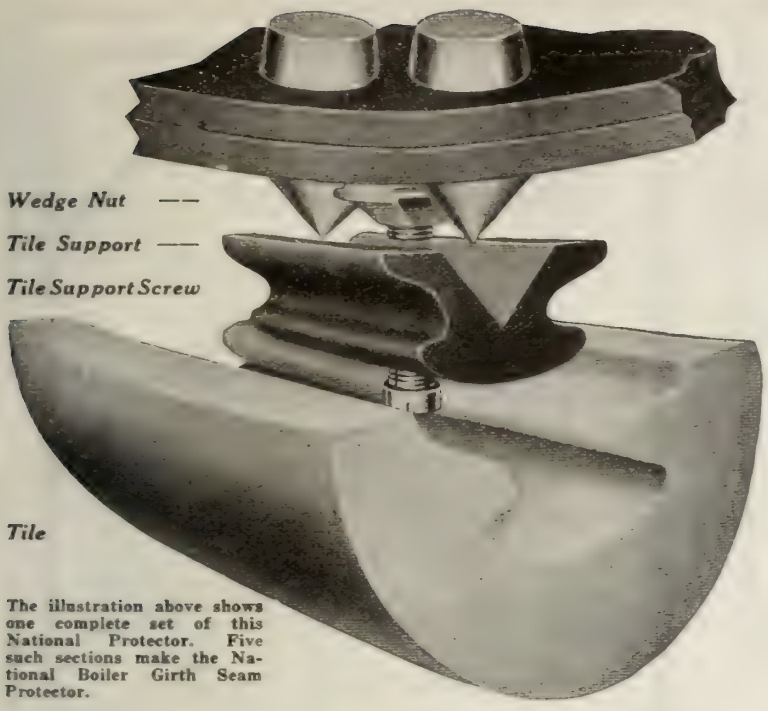
are built at the Jenckes Works, where facilities are uncommonly good for building good boilers.

They are built by men who have given many years to boiler-building work.

They pass a rigid test and inspection under high pressure before they are shipped.

A well-assorted stock of finished boilers and boilers in course of construction is on hand. **Write:**

The Jenckes Machine Company, Limited
Sherbrooke, Montreal, St. Catharines, Toronto, Cobalt, South Porcupine, Vancouver
Works: SHERBROOKE, QUE. ST. CATHARINES, ONT.



The illustration above shows one complete set of this National Protector. Five such sections make the National Boiler Girth Seam Protector.

National Boiler Girth Seam Protector

Ends Boiler Repairs

Is Your Boiler Leaking Profits? Because Fire-Cracked at the Seam.

Do not rush your boiler to scrap value by neglecting to remedy at once and permanently the fire-cracked, leaking seam just above the fire-brick arch.

If yours is a new boiler, then do not delay until crystallization and fire-cracks appear.

Permanently remedy the old fire-cracked seam, positively protect the new, by having your fireman caulk up the girth seam and attach the National Boiler Gi th Seam Protector.

In 30 minutes your own fireman can easily do the work, so simply constructed is this durable, service-proven Protector.

Frequent "patching up" is a costly waste of time and labor. Neglect lowers your boiler's efficiency and shortens its life. Profit by

What Users Say

Unstinted is their praise of this National Girth Seam Protector. Their letters sent us with second and third orders we have on file, and we can show you copies or the originals.

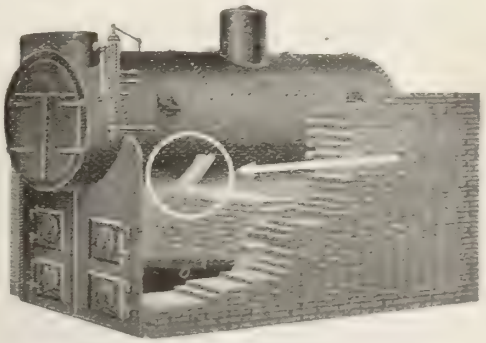
A few satisfied Canadian users of **The National Girth Seam Protector** to whom we invite you to write—

Toronto Paper Mills, Cornwall, Ont.
Dominion Iron & Steel Co., Ltd., Sydney, Nova Scotia.
Dominion Products Co., Ltd., (National Plant, Montreal).
Montreal Locomotives, Ltd., Longue Pointe, Que.
Howard Smith Paper Mills, Beauharnois, Que.
Montreal Cotton Mills, Valleyfield, Que.

Indorsed by Boiler Engineers, Boiler Inspectors and Insurance Companies, you have in this National Protector the only perfected device that will prolong the life of your boiler by keeping the girth seam absolutely dry.

Booklet, explains all details—the cause of fire—cracked boilers, how to prevent and how to lastingly remedy.

Send to-day for your copy.



MADE IN CANADA

The arrow points to the National Boiler Girth Seam Protector as it appears when attached.

National Boiler Seam Protector Company of Canada

Toronto Office: 568 Manning Ave., TORONTO ***Office:*** 910 New Birks Bldg., MONTREAL

If interested, tear out this page and keep with letters to be answered.

NO SMOKE

The JONES
Underfeed Automatic
STOKER

Automatically lowers your coal bill 15 to 25 per cent. It feeds the coal scientifically—neither too much nor too little - precisely enough to keep steam pressure steady regardless of load. Under YOUR boilers the Jones Stoker means

More Steam from Less Coal —and
CHEAPER COAL

The Jones eliminates smoke nuisance and money loss in wasted fuel. It does away with much coal-shoveling labor and a lot of fire worry, too.

We've a booklet illustrating Jones Underfeed Automatic Stokers in Canadian plants. It also explains how the Jones Stoker ordinarily pays for itself. Write:

Jones Underfeed Stoker Co.
LIMITED
37-41 Britain Street, TORONTO

Boiler House Elevators

YOU cannot get our new catalogue on Boiler House Elevators unless you ask for it in writing. This is necessary under the new regulations, but we shall be very pleased to send it to you on request. It is well printed and profusely illustrated. Secure your copy now.

Ed. Bennis & Co., Ltd.

Little Hulton, Bolton;
28 Victoria St. S.W. 1.

Economy Renewable Fuses Save 80%

Anyone Can Renew a Blown Economy Fuse

It takes but a moment to have the blown fuse back in the circuit every whit as good as new with the aid of an Economy "Drop Out" Renewal Link.
Used in the world's greatest plants and institutions—thousands upon thousands annually—because there isn't a better fuse at any price and there isn't another fuse that will actually lessen your fuse bill 80% or more.
Made in Canada. Sanctioned by the Canadian Fire Underwriters' Association.

Write for free samples

ECONOMY FUSE & MFG. CO. OF CANADA, LIMITED
UNITY BUILDING - - MONTREAL
Manufacturers in Canada of "S. & C." High Potential Fuses—to 150,000 Volts

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

WHEN COAL COSTS SO MUCH — WHY WASTE IT?

GALT SPRINKLER STOKERS provide the best and most economical method. They automatically feed the coal to the furnace in a light, continuous stream.

Ask for Catalogues.

The Galt Foundry Co., Galt, Ontario

Toronto Office: W. M. McRobert, 826 Traders Bank Bldg., Phone Main 4362; Junc. 3354.

Murphy AUTOMATIC Furnace

PAPER MILLS

Paper mill power plants are operated 24 hours per day and 365 days per year—less 12 hours per week; high duty conditions!

That MURPHY STOKERS "make good" for requirements is evidenced by 11 *repeat orders* in 1917, for 25 *stokers*—8,700 H.P and *"first orders"* from six mills, for 22 *Murphys*—5,400 H.P.; 47 stokers, 14,100 H.P.

The first Murphy installation in a paper mill was 34 *years* ago; that mill has ALWAYS BEEN USING Murphy Stokers.

For printed matter address,

MURPHY IRON WORKS, BUFFALO, N.Y., or DETROIT, MICH.

LAPIDOLITH

Will make your concrete floors hard as granite and waterproof!
Will cut out dust, etc., going into your machinery. Just flush it on!
Will mean no more patching and repairing needed!
Will you let us send you copy references applying to your line!
5 gallon can will treat 400 square feet.

The oldest and most reliable Concrete Hardener obtainable

Sales Agents

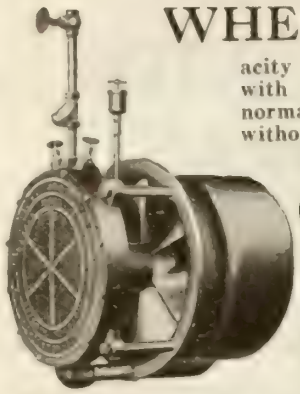
Beveridge Paper Co., Limited., Montreal

TORONTO BRANCH: 58 Lombard Bldg. MARITIME BRANCH: 82-84 Water Street. St. John, N.B.

If interested, tear out this page and keep with letters to be answered.

WHY put in another boiler

WHEN you can increase your present steaming capacity to 200 and in connection with stokers even 300% of the normal rating of the boilers without injury to the boilers by installing a



COPPUS TURBO BLOWER

You will have all the steam you want all the time. Hundreds of satisfied customers will attest to this. No drop in steam pressure when a heavy load comes on, and you can laugh at the weather man, as you can dispense with him for your draft. Besides, the blower will pay for itself in a short time, as it will burn cheaper fuel.

Cut out this Ad., put your name and address on the margin, and mail to us. Without further trouble you will get all the particulars.

500,000 H.P.

In boilers equipped with Coppus Turbo Blowers in four years. The Coppus has replaced a great many other blowers, but no other blower has ever replaced a Coppus.

Coppus Engineering & Equipment Company
167 Union Street, Worcester, Mass.
Agents for Montreal—Mason Regulator & Engineering Co.
Agents for Ontario — The Power Plant Equipment Co., Toronto, Ont.

MASON

Reducing Valves

Pump Regulator
Balanced Valves
Damper Regulators

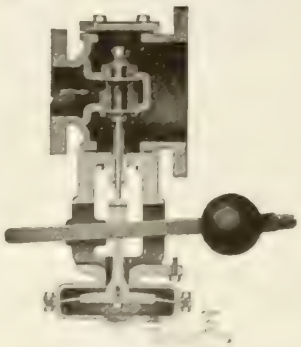
If you order a Mason you will get absolute satisfaction. This we guarantee you. You simply cannot make a mistake.

Dependable regulation under every possible condition.

Our complete catalog tells you WHY. Let us mail you a copy.

Mason Regulator Company
BOSTON, MASS.

TORONTO REPRESENTATIVES:
The Arthur S. Leitch Co.,
506 Kent Bldg., Toronto.



Kieley & Mueller Specialties

Regulating Valves
Back Pressure Valves
Pump Governors
Separators
Traps

FOR EVERY SERVICE

SALES ENGINEERS

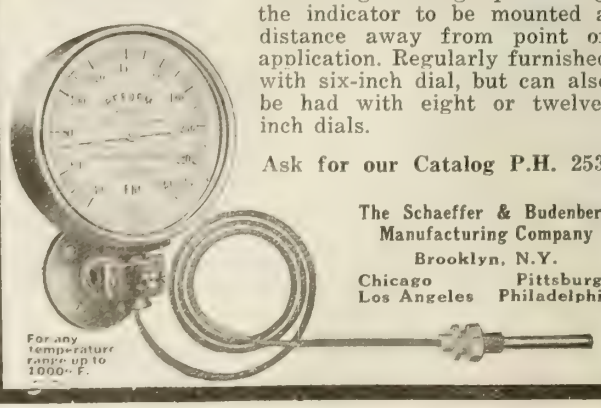
THE ARTHUR S. LEITCH CO.
TORONTO

A combination that spells efficiency with a big E. Adaptable for installation wherever industrial thermometers are used. Mercury actuated, therefore sensitive, accurate and reliable. Ruggedly constructed, insuring maximum durability.

"Reform" Dial Thermometer

can be furnished with rigid stem extending to bottom or back or with flexible connecting tubing permitting the indicator to be mounted a distance away from point of application. Regularly furnished with six-inch dial, but can also be had with eight or twelve-inch dials.

Ask for our Catalog P.H. 253.



The Schaeffer & Budenberg Manufacturing Company
Brooklyn, N.Y.
Chicago Pittsburgh
Los Angeles Philadelphia

If Quality of Manufacture and Reliability in Service

have any meaning in the Engineering World, this list of our leading specialties should appeal to the best judgment of every Engineer and Power Plant Superintendent.

Mason Standard Bronze Reducing Valve

Mason Reducing Valves (Genuine),
Mason Pump Governors,
Mason Pressure Controllers.

Bundy Steam Traps for every service,
Coppus Turbine-driven Blowers,
Sims Hot Water Generators.

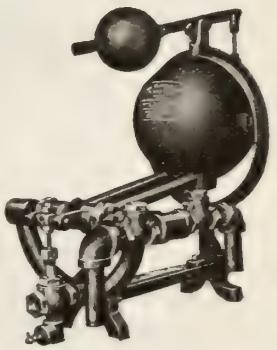
Sims Storage Heaters,
Sims Open Feed Water Heaters.

Bundy Oil Separators,
Ashton Gauges and Safety Valves.

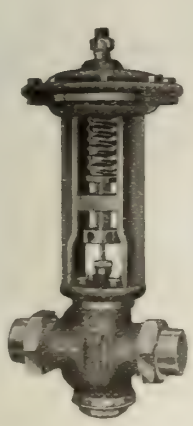
Federal Metallic Packing,
Everlasting Blow-off Valves.

Bawden Pumps (Reciprocating & Centrifugal)
Stratton Steam Separators.

Reilly Multicoil Feed Water Heaters,
Reilly Evaporators and Distillers,
Reilly Multiscreen Feed Water Filters.



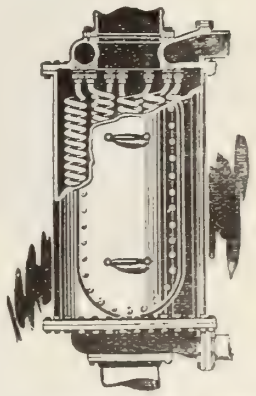
New Bundy Return Trap



Mason No. 55 Pump Pressure Regulator

ABOVE EVERYTHING

our Sales Engineers know the *practical application* of our lines to *actual conditions,* and sell from *knowledge,* not from *catalogs.* We furnish *results,* not merely *machinery.*



Reilly Multicoil Feed Water Heater

THIS MEANS REAL SERVICE

Bulletins and full information gladly furnished.

The Mason Regulator & Engineering Co., Limited

Successors to H. L. PEILER & COMPANY

MONTREAL, 380 St. James Street — FACTORY, 960 St. Paul Street, Montreal

TORONTO REPRESENTATIVES, The Arthur S. Leitch Co., 506 Kent Building, TORONTO

If interested, tear out this page and keep with letters to be answered.

We handle everything required for your Boiler-room

A. H. HETT, Patentee and Sole Owner
40 years experience in this line

Including New and Slightly Used Boilers of every type and size

"Information" pertaining to our now famous **20th Century Shaking and Dumping Grate Bar.**

The following list of installations, **including many repeat orders,** made from January 1st to December 31st, 1917, should be convincing evidence of the value of our Grate Bar.

		Set	Sq. Ft.
[illegible]	Toronto, Ont.	1	22½
American Bank Note Co.	Ottawa, Ont	1	25½
[illegible] J. R.	Ottawa, Ont.	6	442½
British Chemical Co.	Trenton, Ont.	5	165
Bank of Hamilton	Hamilton, Ont.	3	54
Brooks Woollen Co.	Simcoe, Ont.	1	20½
Board of Education	Toronto, Ont.	5	68
Board of Education	Belleville, Ont.	3	40
[illegible]	[illegible], Ont.	1	22
[illegible] & Sons, Henry	Montreal, Que.	1	27½
Board of Education	Hamilton, Ont.	2	39
Canadian Rattan Chair Co.	Victoriaville, Que.	1	18
Colonial Whitewear Co.	Guelph, Ont.	1	16
Chappel Bros.	Sydney, N.S.	1	20½
[illegible]	[illegible], N.S.	2	33
[illegible]	[illegible], Ont.	1	12½
Canadian Trenton Potteries Co.	St. Johns, Que.	1	20¼
[illegible]	[illegible], Ont.	1	24½
[illegible] ity Hotel	London, Ont.	1	12¼
[illegible] Jasper Cap Co.	Toronto, Ont.	1	28
[illegible] County Orange Hall	Toronto, Ont.	1	14½
[illegible]	[illegible], Ont.	2	45
[illegible]	[illegible], Ont.	1	15
[illegible]	[illegible], Ont.	1	27½
[illegible]	[illegible], Ont.	2	45
[illegible]	[illegible], Ont.	1	55
Duncan Co., W. D.	Toronto, Ont.	1	20¼
[illegible]	[illegible], Ont.	1	15
[illegible]	[illegible], Ont.	1	9
[illegible]	[illegible], Ont.	1	20½
Deacon Shirts Co.	Belleville, Ont.	1	10
[illegible] Molasses Co.	Dartmouth, N.S.	1	16
[illegible] Co., E. B.	Hull, Que.	1	41
[illegible]	[illegible], N.S.	1	18
[illegible]	[illegible], N.B.	1	20
Georgetown Floral Co.	Georgetown, Ont.	1	9
Heslop & Sons	Greensville, Ont.	1	18
Hamilton Cotton Co.	Hamilton, Ont.	1	[illegible]
Harding, William	Toronto, Ont.	1	10½
[illegible]	[illegible], Ont.	1	18
[illegible]	[illegible], Ont.	1	18
Hamilton Spectator Bldg	Hamilton, Ont.	1	22½
[illegible]	[illegible], Ont.	1	20
[illegible]	[illegible], Ont.	1	14
Harrison, Joseph	Toronto, Ont.	1	12
Imperial Laundry Co.	Midland, Ont.	1	14
Langston & Co., W. R.	Toronto, Ont.	1	24
King Motor Car Co.	Detroit, Mich.	1	7
[illegible]	[illegible], Ont.	1	30
[illegible]	[illegible], Ont.	1	[illegible]
Ledson Rule Co.	Windsor, Ont.	1	10½

		Set	Sq. Ft.
Lytle Co., T. A.	Toronto, Ont.	1	33
Leonard & Sons, E.	London, Ont.	3	48½
Modern Laundry Co.	Detroit, Mich.	1	25
Moore, J. B.	Toronto, Ont.	1	33
McArthur Co., Collin	Montreal, Que.	2	55
McClary Mfg. Co.	London, Ont.	3	76½
Mason & Risch	Toronto, Ont.	1	27½
Moirs, Ltd.	Halifax, N.S.	1	22½
Maritime Coal Ry. & Power Co.	Chignecto, N.S.	1	36
Marx, C.	Lambton Mills, Ont.	1	14
Milligan, J. J.	Lambton Mills, Ont.	2	20
Northcote Apartments	Toronto, Ont.	1	8
Nova Scotia Government	Dartmouth, N.S.	3	125
Ont. Gov. (various institutions)	[illegible]	17	390
Orr Bros.	Toronto, Ont.	1	12
Prince George Hotel	Toronto, Ont.	2	50
Provident Loan Co.	Hamilton, Ont.	1	14
Perfect Fit Co.	Listowell, Ont.	1	18
Paddy Bros.	Toronto, Ont.	1	18
Poupore Co., W. J.	Port Colborne, Ont.	1	38
Queen's Hotel	Walkerton, Ont.	1	10
Stanley Mills	Hamilton, Ont.	1	14
Strand Theatre	Toronto, Ont.	2	21¾
Simms Co., T. S.	St. Johns, N.B.	2	54
St. Simon's Church	Toronto, Ont.	1	10
Studebaker Corp. of Canada	Walkerville, Ont.	2	50
Stearns Co., Ltd., Frederick	Windsor, Ont.	1	27½
Standard Paint & Varnish	Windsor, Ont.	1	25
Smith, Mackenzie & Hall	Toronto, Ont.	1	11
Smart Woods Co.	Ottawa, Ont.	1	15
Standard Silver Co.	Toronto, Ont.	1	6¾
Simcoe Tanning Co.	Simcoe, Ont.	1	12¼
Toronto Hat Mfg. Co.	Toronto, Ont.	1	25
Toronto Slipper Co.	Toronto, Ont.	1	4
Taxicab Service Co.	Detroit, Mich.	1	25
T., H. & B. Ry. Co.	Hamilton, Ont.	1	16
Turner & Gates Bldg.	Toronto, Ont.	1	12½
Union Stock Yards	Toronto, Ont.	1	14
Victoriaville Furniture Co.	Victoriaville, Que.	1	36
Windsor Hotel	Montreal, Que.	1	47
Weston Sanitarium	Weston, Ont.	1	14
W. W. J.	Hamilton, Ont.	1	11
Wilson Hardware Co.	Gladstone, Man.	1	14
Whittal, A. R.	Montreal, Que.	1	20
Williams Mfg. Co.	Montreal, Que.	3	66
Water Works Pumping Station	Fredericton, N.B.	3	60
Wilson Engine Co.	Brantford, Ont.	1	36
Y. M. C. A.	Ottawa, Ont.	3	60¾
Y. W. C. A.	Toronto, Ont.	1	10½
		171	3911½

We particularly ask that you go over the above list very carefully and you will no doubt be surprised at the large number of well-known firms now using our Grate Bars.

Boiler Repair & Grate Bar Company

84 CHURCH STREET — Detroit Representative C. W. Andrews, 27 Woodward Avenue — TORONTO, ONTARIO

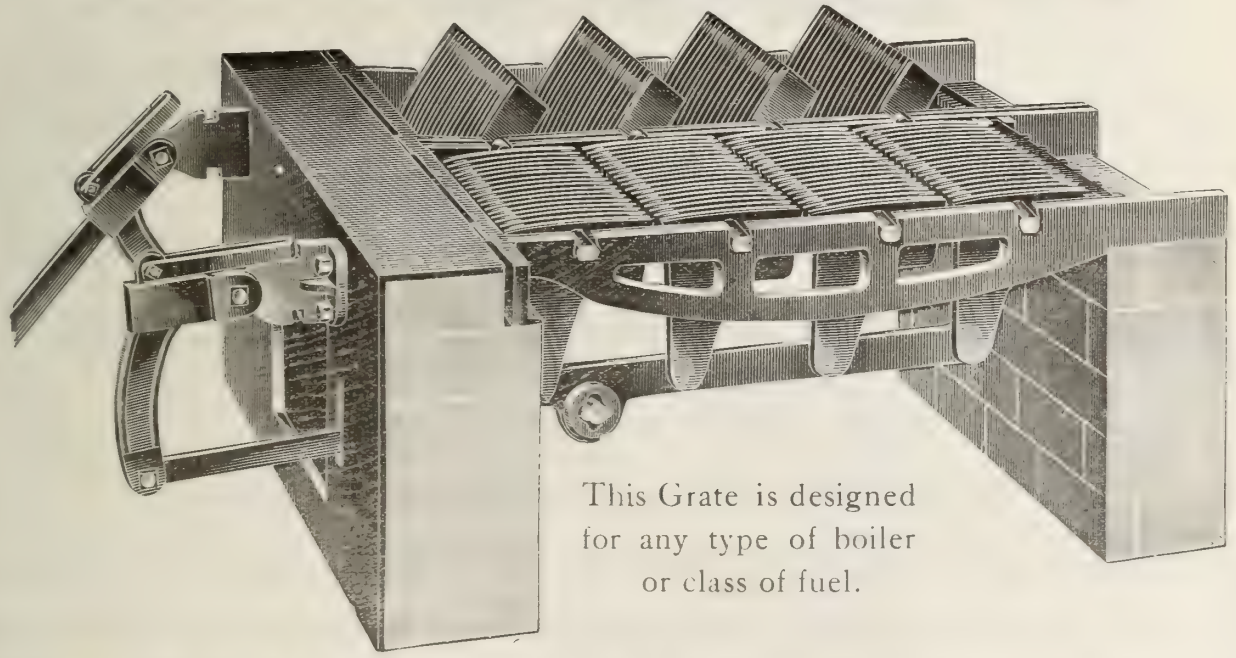
Write us for Our Trial Proposition to all reliable firms

O. C. HETT, General Superintendent

Any information in connection with anticipated changes in your boiler-room will be cheerfully given free of charge.

The now universally popular

20th Century Shaking and Dumping Grate Bar



This Grate is designed for any type of boiler or class of fuel.

The above cut gives a fairly accurate idea of our patented 20th Century Shaking and Dumping Grate Bar, which is designed with both a $\frac{3}{8}$" and $1\frac{1}{2}$" mesh. This grate is to-day giving better general satisfaction than any other bar of this type being offered to the public.

We guarantee a saving of at least 10% in fuel. This should interest you.

Boiler Repair & Grate Bar Company

84 CHURCH STREET — Detroit Representative C. W. Andrews, 27 Woodward Avenue — TORONTO, ONTARIO

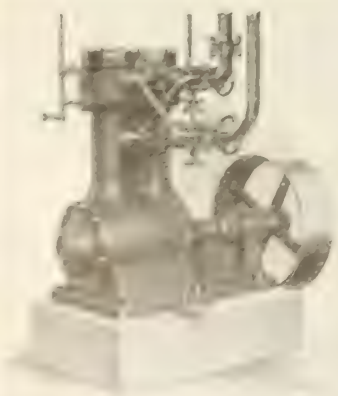
ECONOMY:

THE one consideration that should govern the choice of Refrigerating Machinery is its ability to operate economically continuously. The purchaser who overlooks the wide difference between quality and price, overlooks the inevitable loss due to poor construction, which is invariably in excess of the money originally saved.

THE LINDE CANADIAN REFRIGERATION COMPANY, LIMITED

37 ST. PETER STREET, MONTREAL

Manufacturers of Quality Refrigerating Machinery



Ice-making and Refrigerating Machinery

Built in any capacity that you desire. HORIZONTAL OR VERTICAL

Our SMALL MACHINES have the same "regularity of Operation," "Reliability" and "Efficiency" as our large ones.

AMMONIA FITTINGS, CONDENSERS, BRINE COOLERS, ETC.

Our Machines are in daily operation in Canada

CORLISS and POPPET VALVE ENGINES

The Vilter Manufacturing Company

242 Beecher St. - - - Milwaukee, Wisconsin

Are You Doing Your Bit

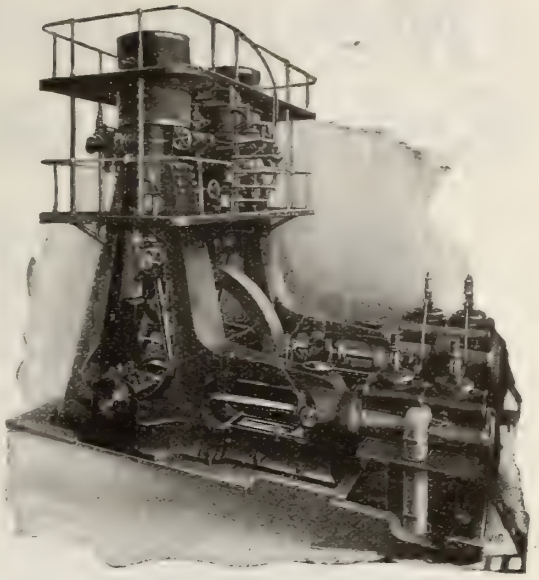
to Help the Food and Fuel Commissions?

Conservation of food and fuel is one of the most important questions confronting the world to-day. Therefore, let us help you do your bit by installing "FRICK EQUIPMENT," the most up-to-date, economical apparatus on the market to-day.

We manufacture all types and sizes of machinery consisting of Vertical and Horizontal, belted; simple, tandem and cross compound Corliss; and poppet valve engines; also live and exhaust steam absorption, and high speed enclosed machines.

Let our corps of experienced engineers assist in planning your new installation or altering your present plant.

Write for our latest catalogues and bulletins.



Frick Company
WAYNESBORO, PA. U.S.A.
ICE MACHINERY SUPERIOR SINCE 1862

Canadian Representatives:
FRICK ICE & REFRIGERATING COMPANY, Montreal, Canada

Lost--134 Tons of Ice Per Year

268 tons of refrigeration—approximately 134 tons of ice per year—that is the loss which results from a 1½-inch uncovered brine line, 200 feet long, with the atmosphere at 75° and the brine at 15°. Think of it—this loss is equivalent to 2½ days' output of a 100-ton refrigerating plant! Figured in terms of ice, the loss is equal to a solid block of ice 10 feet wide, 15 feet long and 30 feet high, or in other words, 1,342 two hundred-pound cakes. Exposing brine or ammonia lines to the atmosphere is just as illogical as storing ice in the sun.

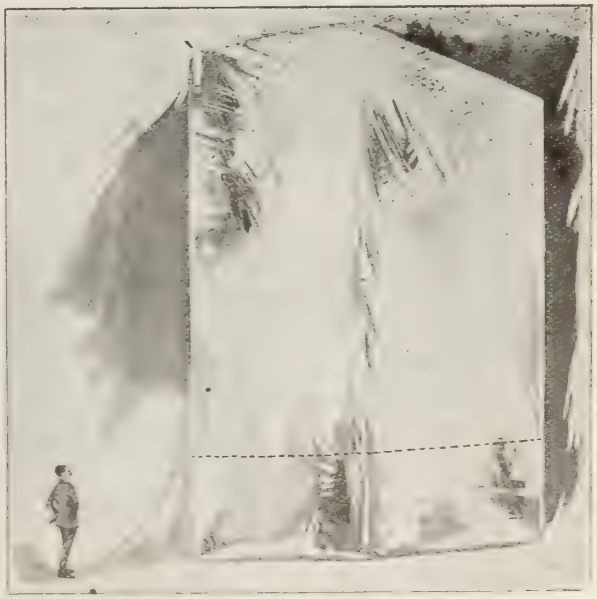
Nearly four-fifths of this loss can be saved by using the correct thickness of

Nonpareil Cork Covering

For Cold Pipes and Tanks

In fact, under ordinary conditions, Nonpareil Cork Covering will save its own cost the first year and continue to yield big dividends for a long time to come. Cork is one of the best known nonconductors of heat and its very nature adapts it to the requirements of insulation for cold pipes better than any other material. Nonpareil Cork Covering is durable in service, easy to apply, neat in appearance and reasonable in cost.

Our 64-page illustrated book, "Nonpareil Cork Covering," will be sent, free of charge, upon request.

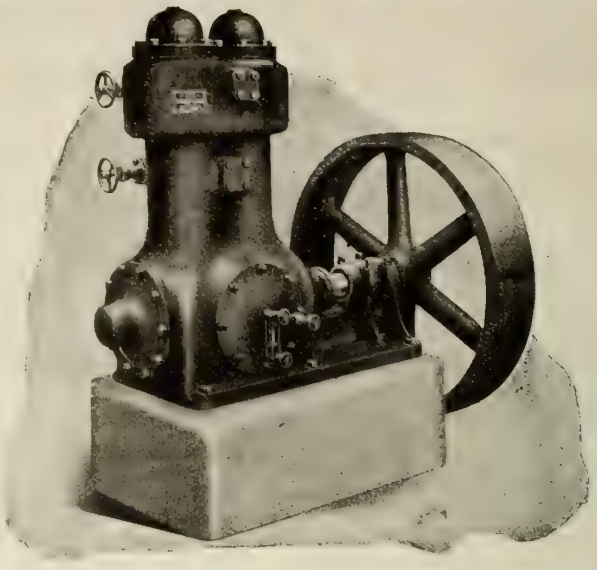


pro luce a cake of ice 10 x 15 x 30 feet high, weighing 134 tons. Nonpareil Cork Covering will save the
or 110 tons.

Armstrong Cork & Insulation Company, Ltd., 504 McGill Building MONTREAL, QUE.

Also manufacturers of Nonpareil Corkboard Insulaton for cold storage rooms; Nonpareil High Pressure Covering for steam lines; Nonpareil Insulating Brick for boiler settings; Nonpareil Cork Machinery Isolation for deadening the noise of machines; Circle A Cork Brick for cold storage rooms floors; and Linotile for floors in offices, residences, etc.

Mechanical Refrigeration



is essential to success in many lines of manufacture, and YORK Products have played an important part in the development and expansion of these lines over the entire field.

We not only design and make a Refrigerating Plant suited to the needs of our customers, but all the details are handled by our own organization, which assures the best service possible.

YORK Refrigerating Machinery is the result of years of careful research, exhaustive tests, and the labor of experienced Engineers and competent Workmen; and for the Manufacturer who depends on the quality of his product for the continued success of his business, it is the logical equipment to buy.

Write us for information and prices.

YORK MANUFACTURING CO. - YORK, PA.

(Ice-Making and Refrigerating Machinery Exclusively)

Represented in the Dominion by

CANADIAN ICE MACHINE COMPANY

MONTREAL, 626 Coristine Building. TORONTO, 82 Chestnut Street. WINNIPEG, 85 Lombard Street

1905

Illustrative of our *progress* in EIGHT years and truly applicable proportionately to the last FOUR years.

"WHY?"

We aim constantly to excel in every phase of COLD STORAGE DOOR PRODUCTION.

Satisfied users assure us of *Repeat orders* and our conscientious efforts to so serve you as to insure higher efficiency and economic success —makes our progress *positive*.

1913

Careful investigation into the *relative merit* of the various makes of *COLD STORAGE DOORS* means decision for JAMISON—or else your LOSS.

JAMISON COLD STORAGE DOOR CO., Inc.

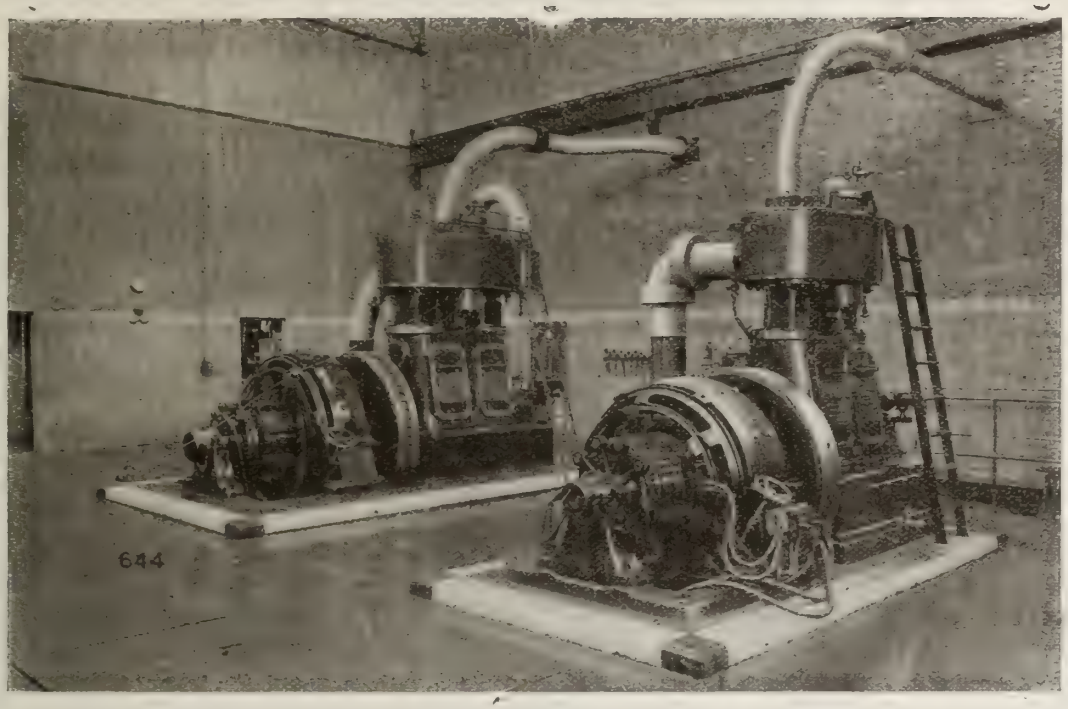
Formerly JONES COLD STORE DOOR CO.

HAGERSTOWN, MD. - U.S.A.

P.O. BOX 93

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

BELLISS & MORCOM, LTD.
Engines and Air Compressors



Belliss & Morcom Engines installed in McGill University Power House
Total Horse Power, 1010 B.H.P.

We have for immediate delivery several Engine Generator Sets. Write for Particulars.

Send Us Your Enquiries For

Steam Engines	Condensing Plants	Hydraulic Pumps
Gas Engines	Centrifugal Pumps	Hydraulic Accumulators
Oil Engines	Boiler Feed Pumps	Pressure Filters
Diesel Engines	Water Wheels	Gravity Filters
Steam Turbines	Water Meters	Water Softening Plants
Air Compressors	Hydraulic Presses	Refuse Destructors

Activated Sludge Sewage Disposal Plants

Complete Power Plants Designed and Erected

LAURIE & LAMS

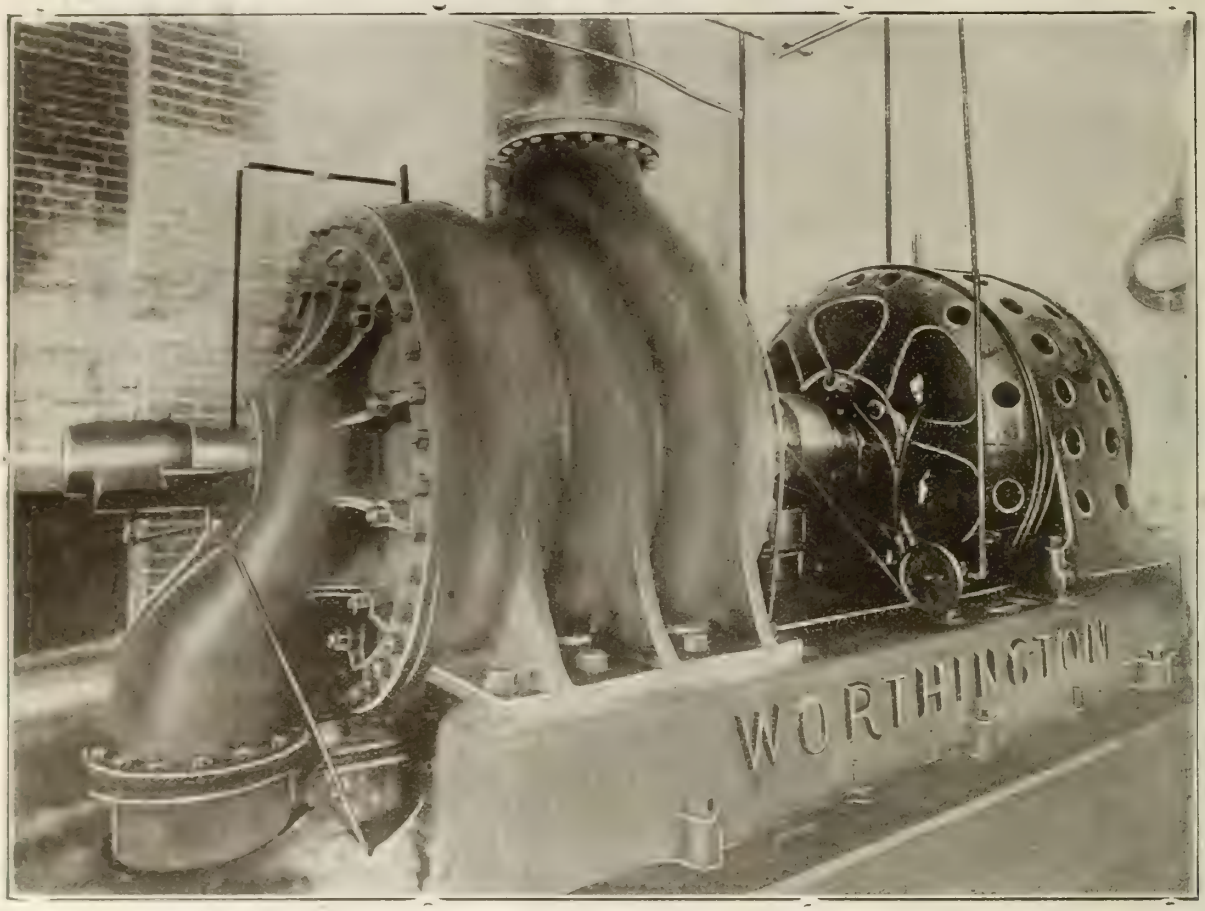
Engineers

211 Board of Trade Bldg. :-: :-: MONTREAL

THE JOHN McDOUGALL CALEDONIAN IRON WORKS CO., Limited

Manufacturers of Boilers, Castings, Condensers, Elevators, Engines, Filters, Forgings, Hydraulic Machinery, Pumps — centrifugal and reciprocating, Steam Turbines, Tanks, Water Wheels, Water Works Plants

Works: Seigneurs and William Streets, MONTREAL



5,000,000 gallons daily—Montreal Water Works—Driven by 400 H.P. Induction Motor.

Our Engineers have spent many years developing Centrifugal Pumps and we are now able to offer you perfected designs in any size pump from inch and a half and up for any service you may desire, and to be driven either with motor, engine or belt.

Write us for Engineering information, or prices, any time.

Sole Canadian Agents for H. R. Worthington Co.

Keeping in Stock at Montreal a large assortment of their Boiler, Feed and General Service Pumps

The Publisher's Page

TORONTO JANUARY 1918

The Economy of Business Paper Advertising

By H. E. CLELAND, NEW YORK

Awarded the Higham prize at the convention of Associated Advertising Clubs, at St. Louis, June, 1917
This prize is given annually to the one delivering the most constructive address in fewest words.

(Continued from last month)

SO, in a quiet, substantial, and most-times unheralded way, the business papers are leaders of progress in their respective industries and in this character they tie to them the progressive men of the industries. Only progressive men are worth while to advertisers. Therefore, the business papers not only aim directly at those industries where the advertisers' products may be sold, but they automatically select the men in each industry whose words carry weight of buying authority. But modern business papers—those which, for instance, are members of the Associated Business Press—go even further and put before the advertiser the exact number of each classification of subscribers. So that, in a technical industry, for instance, the advertisers are shown how many firms, executive officers, purchasing agents, superintendents, engineers, etc., are on the paid subscription list and from these the advertiser may estimate the buying power which each publication holds for his product.

In other words, the business papers are helping to put advertising closer to the status of an exact science.

And that, in turn, spells greater economy in advertising.

"BUYING POWER" THE TEST.

I said that the buying power per subscription in a business paper was greater than the buying power per subscription of any other medium because things are bought for business and not private consumption.

To illustrate this, one industry last year bought approximately $500,000,000 worth of goods and 90 per cent. of this industry is covered by two business papers having a total paid circulation of 22,000, or an average of material bought per subscriber of about $20,500.

Since it is a fact that less than five per cent. of our population has an income of over $4,000 per year, it may readily be seen that private and business consumption are far, far apart.

I quote from an industry with which I am familiar and not one picked because of its exceptional buying capacity. There are probably many which exceed it.

So, the thought is that each dollar invested in business paper advertising buys more potential sales results because each appeals to a greater buying power.

And that, too, is economy in advertising.

THE POTENT THING.

Now, all of you advertising men know that the really potent thing in advertising is cumulative effect. You know that even poor and mediocre advertising, persisted in, pays and pays handsomely.

You know, on the other hand, that sporadic advertising, even of the best kind, has only a temporary effect and that effect is seldom of sufficient force to pay.

The splurger makes his splash, the ripples die out and the surface becomes calm and serene. He loses because his advertising is too costly to be kept up continuously.

THERE IS NO SUBSTITUTE FOR CONTINUITY IN ADVERTISING.

It is possible, because of the low rates in business papers, for practically any manufacturer to advertise week in and week out or month in and month out, to hammer away until by sheer force of persistence he drives his claims home and sells his prospect.

It takes time to sway men the advertiser's way. It takes repeated effort to get the first return from advertising.

The advertising catacombs are filled too full of the bones of half-tried efforts.

There are publishers who permit and agents who induce advertisers to adopt "splurge" advertising, and these I charge with the crime of high treason against the cause of effective advertising.

Advertising which cannot reap the benefits of cumulative effect is not as profitable as it ought to be. Therefore, it is not as economical as it might be.

Business paper advertising is economical because, intensive circulation permits rates low enough to allow practically any manufacturer to advertise continuously.

FOLLOW THE SALESMAN'S METHODS.

That advertising is best which comes closest to the best in salesmanship.

What does the salesman do? Assume that he is selling steam engines, does he make a house-to-house canvass of say, Chicago? Not on your life. Aside from the utter insanity of that procedure, it takes twelve years and eight months for one man to make a house-to-house canvass of Chicago. He picks out steam power plants or plants in course of design or of building and goes to those and no others.

Does he make his sales talk to the office boys and stenographers in those plants? Not in one thousand years. He goes to the man who buys or recommends.

Does he talk to these men about steam calliopes or about steam engines You know the answer.

Does he endeavor to show the economy and efficiency of the steam engine as a prime mover and does his talk resemble that of an engineer or a chauffeur? You know the answers to that, too.

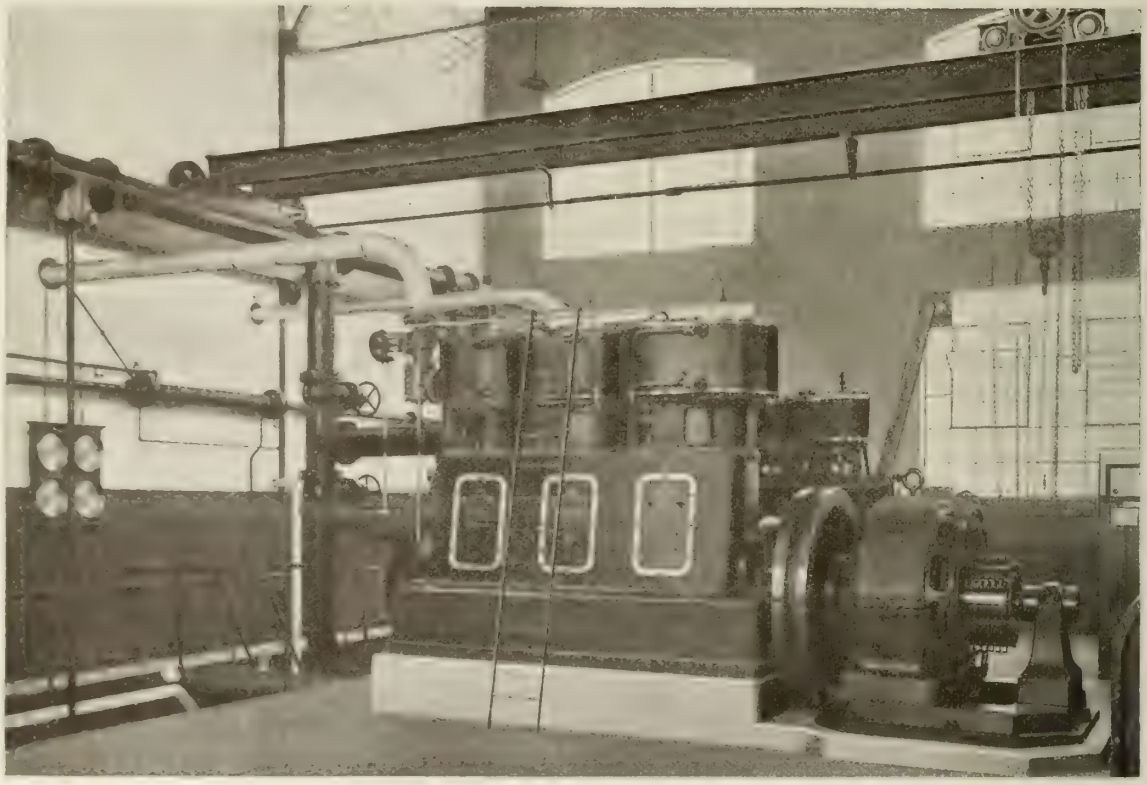
Now, why does the salesman do these things? Because the efficient salesman knows how to follow the straight line—the shortest distance between two points—and because his concern will not pay for the super-expense of roundabout methods.

For precisely the same reason, the wise manufacturer uses the business papers to carry his advertising message.

(Concluded next month)

POWER EQUIPMENT

Built to Meet Your Own Requirements



A corner in the Engine Room of our New Power Plant recently erected at our Main South Works. Equipped with G. & McC. Co. Three-Cylinder Compound and Two-Cylinder Compound Vertical Forced Lubrication Steam Engines.

G. & McC. CO. ENGINES and BOILERS

will provide your plant with

A Continuous and Economical Service

WE BUILD

Horizontal and Vertical Steam Engines; Steam Turbines; Return Tubular and Water Tube Boilers; Heaters, Tanks, Pumps and Condensers; Transmission Machinery; Safes, Vaults and Vault Doors.

The advice of our Engineering Experts, our Catalogues, Specifications, Photographs, etc., will be cheerfully supplied to interested parties.

The GOLDIE & McCULLOCH CO., Limited

Head Office and Works: GALT, Ontario, Canada

TORONTO OFFICE:	WESTERN BRANCH:	QUEBEC AGENTS:	BRITISH COLUMBIA AGENTS:
Suite 1101-2, Traders Bank Bldg	248 McDermott Ave., Winnipeg, Man.	Ross & Greig, 412 St. James St. Montreal, Que.	Robt. Hamilton & Co., Vancouver, B.C.

Steam-Electric Plant
Dominion Power & Transmission Company.
Hamilton, Ontario.

Staff Article

The power house plant, machinery and equipment described in the following article represent a degree of excellence in design and arrangement equalled by few plants elsewhere and possibly excelled by none. In addition to being evidence of the technical skill and ability of the officials concerned with its construction, it further affords convincing evidence of the manner in which reputable power companies realize both their duty to present consumers and the necessity of preparedness for emergencies as well as future developments.

THE tremendous war-created activity in metal working and power using plants throughout Ontario, with its resulting drain upon the electrical resources of the province, has directed so much of the general public's attention to hydro-electric power plants and schemes that comparatively little attention has been given to the scale on which privately-owned systems have been increasing their capacity and strengthening their system generally so as to insure continuity of service under any required circumstances.

Location and Capacity

These circumstances render more than ordinarily interesting the extremely modern and complete steam operated power station which has just been recently completed and put into service by the Dominion Power & Transmission Co., Hamilton, Ont. The plant is situated just outside the eastern limits of the City of Hamilton, and is designed to have an ultimate capacity of 75.000 K.V.A., of which 25,000 has been installed up to the present time. The output is delivered at a voltage of 42,000 to the high tension lines of the company, whose main source of supply is their hydraulic power plant at DeCew Falls, 34 miles distant from Hamilton.

In addition to its generating capacity, the steam plant is designed to act as a stepdown transformer station of 25,000 K.V.A. capacity to transform the high tension current to 13.200 volts for distribution to local factories in the manufacturing district in the near vicinity. Fifty per cent. of this stepdown capacity, i.e., 12,500 K.V.A., has been installed so far.

General Layout

A cross sectional elevation of the entire plant is shown in Fig. 1, and an exterior view of the building from the same viewpoint forms the title illustration. By comparing the location of the principal features a clear idea of the arrangement and disposition of the various equipment, items and departments will be obtained. Fig. 1 is particularly interesting, as the actual arrangement of the plant as shown enables the process of power generation to be followed in strict sequence of operation.

Coal Handling

Commencing at the right, the coal handling plant is shown where the fuel is dumped direct from the cars into the hopper of the coal crusher or placed in auxiliary storage provided in this building, which has 1,250 tons capacity. The coal handling plant, which was supplied by C. O. Bartlett & Snow Co., has a capacity of 60 tons per hour, and includes a feeder, crusher, elevator and weighing larry. The steel-cased double-plunger feeder has a 26 in. by 30 in. opening, the coal being moved by two plungers operated by adjustable eccentrics. It is driven by sprocket and chain drive from crusher countershaft through a clutch, so that it can be cut out at any time and the crusher driven independently.

The feeder discharge is coupled directly to the top of a 2-roll crusher, directly gear-driven by a 25 horse-power Westinghouse motor at 750 revs. per min. Each roll consists of two heavy cast iron spiders supporting six cast steel segments, forming a roll 26 in. dia. by 24 in. long. The roll shafts are 4 7/16 in. dia., one being rigidly supported, while the other is carried on adjustable sliding bearings backed up by heavy coil springs. They are set to deliver coal of 2 in. size and under.

The bucket type elevator is a conspicuous feature in Fig. 1, extending from the crusher below the train tracks up to the bunker between the stacks. It has a length of 138 ft., and is enclosed in a casing 5 ft. high by 9 ft. wide, with ladders on either side. The coal bunker has a capacity of 420 tons, and is pro-

vided with three 18 in. by 18 in. double undercut doors, through which it drops into the weighing larry.

Boiler Room

Interior view of boiler room, Fig. 2, shows the weighing larry in position for supplying fuel to the two nearest boilers. The hopper of the larry has a capacity of 5 tons, and as can be seen in the illustration, is supported on two cross girders like an overhead crane, the rail centres of the overhead track being 21 ft. The hopper scale has a capacity of 10 tons, with reverse reading beam. The gates on the delivery spouts which lead from the hopper to the stokers are controlled from the larry cage, as are also the overhead bunker doors. A 5 horse-power Westinghouse slip-ring polyphase motor is direct geared to the larry trucks for traversing purposes.

FIG. 2. MAIN AISLE OF BOILER ROOM, SHOWING OVERHEAD COAL LARRY WHICH WEIGHS THE FUEL AND DISTRIBUTES THROUGH CHUTES INTO THE STOKER HOPPERS.

Inclined Tube Boilers

Four water tube boilers of the inclined tube type are installed. These are built in single settings, and were supplied by the Edge Moor Iron Co., having an individual capacity of 1,050 horsepower. Each boiler has four drums made of 7/16 in. plate, with an outside diameter of 35⅛ in. and a length of 20 ft. They are constructed of fire box steel, and the longitudinal seams are double butt strapped and triple riveted.

Each boiler has 472 Am. standard soft steel tubes, 4 in. dia. by 20 ft. long, the two lower rows being No. 9 gauge and the balance No. 10. Flanged steel header construction is used, along with oval hand holes and inside covers, which are tightened by boiler pressure, and are independently removable.

Stoker Installation

The mechanical stokers were constructed by the Taylor Stoker Co., and each has 11 retorts, the total width being 19 ft. 6 in. and depth 8 ft. 3½ in. One stoker engine is provided for each pair of stokers, and the same practice is followed with the fan equipment. The fan engines were built by the Harrisburg Foundry & Machine Works, and are of horizontal type. They are located on the ground floor level next the condensers, and are supplied with heated air from the generator cooling system.

The fan wheels are direct connected to the engine crankshafts and are capable of delivering sufficient air to operate all of the stokers at 150 per cent. of their normal rating. The stokers, individually, are capable of firing their respective boilers at a sufficient rate to force them to 235 per cent. normal rating without difficulty. Boiler accessory equipment includes Ashton pop safety valves; Hancock feed water and check valves; Faver blow-off valves; Homestead blow-off cocks; Ashcroft steam gauge and Reliance water column. Automatic soot blowers and the customary instruments to enable the engineers to operate the boilers efficiently are likewise provided. Rolling doors provide convenient access to the tube header and form an attractive front to the boiler.

Foster superheaters are installed on each boiler, under guarantee to raise the temperature of 31,500 lbs. of steam per hour to 538 degs. F. which, at a pressure of 200 lbs. per sq. in. represents a superheat of 150 deg. When operating at 150 per cent. of boiler rating, this degree of superheat would be increased to 160.

Chimney Stacks

Flue gases are distributed to the atmosphere by two chimneys of radial brick construction, erected by Canadian Kellog Co. The stacks are of identical proportions, being 240 ft. high above foundation; 22 ft. 2 in. dia. base; 12 ft. internal top diameter. They are lined to a height of 40 ft. from a point 2 ft. below flue opening. The lightning conductors have 6 copper points, ¾ in. dia. by 8 ft. long with 1½ in. solid platinum tips all connected and grounded in accordance with best modern practice. Accessory equipment includes 4 in. H. and M. draft gauges and connections and 2 in. pyrometer connections.

Water Purification Plant

The make up water for the plant is obtained from Burlington Bay and in order to render it suitable for use is

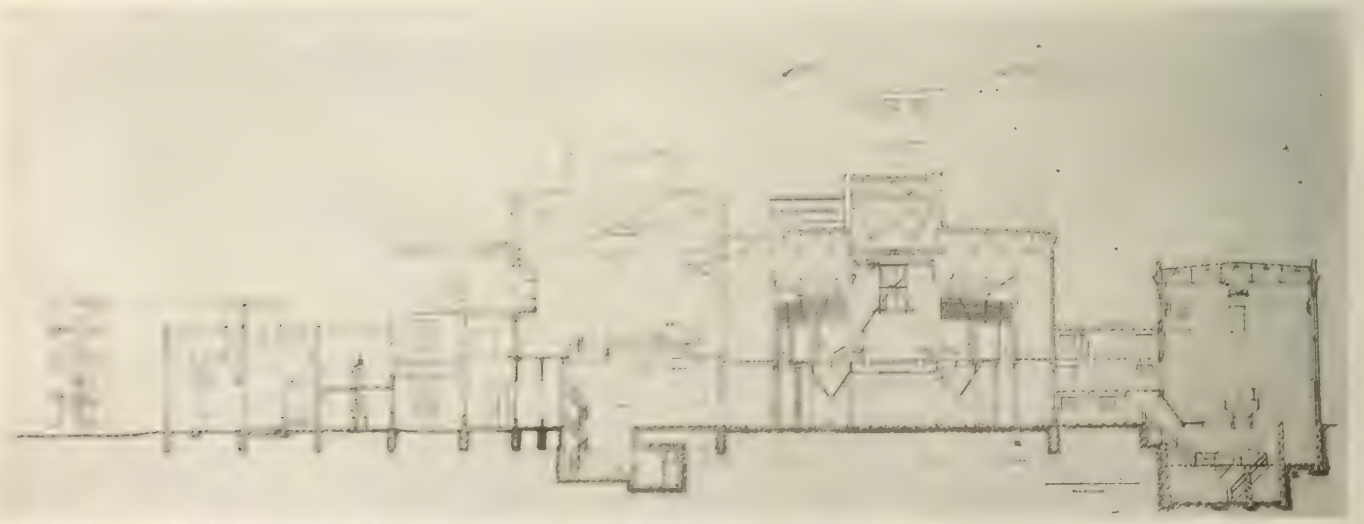


FIG. 1. SECTION OF POWER STATION. NOTE SYSTEMATIC ARRANGEMENT OF OPERATIONS FROM RECEIPT OF FUEL AT RIGHT TO DELIVERY OF CURRENT TO DISTRIBUTING LINE AT LEFT.

treated by the We-Fu-Go system of water purification. This plant is housed in a separate building at the extreme left of the title illustration, and was installed by Wm. B. Scaife & Sons Co. It is of quite extensive proportions, and amongst principal items are two reaction ft. 4 in. high, equipped with mechanical 4 in. high, equipped with mechanical stirring devices and each requiring 4 hours for treatment of its capacity of water.

Two filter tanks 8 ft. dia. by 5 ft. 4 in. high contain the filter beds of crushed quartz (98 per cent. silica) supported by a layer of washed and graded gravel. The flow of water from the settling tank into the filter tank is regulated by brass-fitted balanced valves with seamless copper floats. Constant alarm bells operated by the floats ring in water softener and boiler rooms. The filter beds are provided with air wash pipes for cleansing purposes, having discharge openings equally distributed over the filter beds and connected to a pressure blower.

The two generating units installed are identical in type and size, being Westinghouse turbo-generators of 10,000 equivalent K.W. capacity, delivering 3-phase current at 6,600 volts; 1,100 amps. per terminal; 66 2-3 cycles. The generators are of the 4 pole type and run at 2,000 revs. per min.

The layout of the plant is such that when future extensions are completed, six turbo-alternator units will be accommodated, each of a maximum rated capacity of 12,500 K.V.A. giving a total station capacity of 75,000 K.V.A. or an equivalent of 60,000 K.W. at a power factor of 80 per cent.

The generator department occupies the central portion of the power house, the three principal parts—boiler room, generator department and switch and transformer rooms being parallel with each other, as shown in Fig. 1. There are three floor levels in the generator department; the lowest one is below ground level and forms the pump well for the condensed circulating pumps; the ground level floor on which are carried the condensers and auxiliary equipment, and on which rest the foundations for the turbo-generators; the main or operating floor on which the generating units are erected, and which is level with the boiler room floor (see Fig. 1). Two views of the main floor are shown in engravings Figs. 3 and 4 while a view of the auxiliary equipment for one unit is shown in Fig. 5. The plan layout of the entire generating equipment is shown in diagram Fig. 6.

Steam Turbines

The design of turbine adopted is that known as the "impulse reaction" type. The turbines are of Westinghouse construction and employ multiple expansion parallel flow.

Steam is admitted through primary admission valves of balanced poppet type enclosed in steam chest. Secondary admission valves, automatically operated by mechanical connection with governor, are arranged to admit steam to lower stage when load exceeds capacity of turbine with steam received through primary valve. The secondary valve will also operate in this manner should vacuum or steam pressure fall to a point where the turbine is unable to carry the load normally, returning to its seat when excess capacity is no longer required.

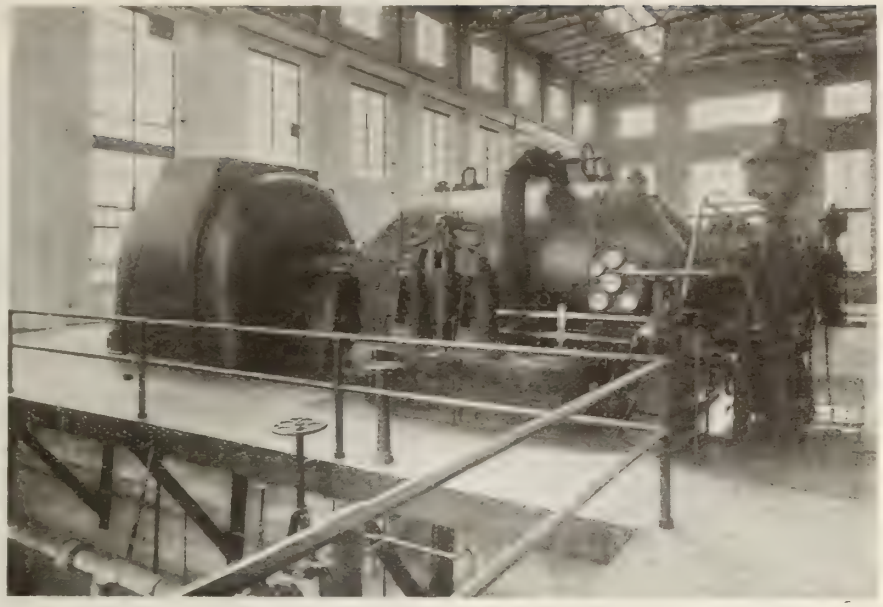


FIG. 4. ONE OF THE 12,500 K.V.A. TURBO-GENERATOR UNITS, SHOWING STEAM ADMISSION VALVES, GOVERNOR GEAR AND THROTTLE VALVE.

An automatic throttle valve, controlled by separate safety governor, is arranged to close before the turbine speed exceeds a safe limit. It can be adjusted for any predetermined speed, and means is provided for tripping by hand from a convenient location.

Blading

The impulse section consists of two rows of moving and one row of stationary blades, the balance of the machine consisting of reaction type blades. The steam passes through the impulse section towards the generator; and then towards the centre of the turbine where it divides and passes toward each end in opposite parallel flows. Nickel iron is the material of which the impulse blades are constructed, and phosphor bronze for the reaction blades.

The main bearings are self-aligning, and lubrication is effected by an oil pump operated from worm gear on turbine shaft, with delivery and return piping between reservoir and bearings, sufficient head being provided to insure ample flooding of bearings.

A speed variation of between 3 and 4 per cent. can be obtained under normal conditions, while a speed changing device is provided with remote control from the operating station.

FIG 3. MAIN FLOOR OF GENERATOR DEPARTMENT. NOTE EXCITER SET IN FOREGROUND, ALSO EXHAUST AND CIRCULATING WATER PIPES.

Condensing Plant

The circulating pumps in the pump well are turbine-driven centrifugals of the closed impeller type. The location of the pump is such that the intake level is 1 ft. below discharge level, the total pumping head, exclusive of friction head through condenser, being 2 ft. The pumps are gear-driven by Westinghouse impulse turbines through reduction gear of the Westinghouse self-aligning type, having right and left hand helical gears to equalize end thrust. The large gears are carried on solid bearings.

The condensers are located on the ground floor immediately below the turbines. They are of the surface type with two passes, the circulating water entering at the bottom and leaving at the top while the steam enters at the top. In the foreground of Fig. 3, can be seen the circulating discharge pipe going down at an angle, also an angle pattern of atmospheric relief valve with discharge pipe passing through wall into boiler room.

The effective cooling surface, measured on the outside of the condenser tubes is 15,000 sq. ft. there being in each condensor 3,040 tubes of 1 in. outside dia. by No. 20 gauge, active length of tubes being 18 ft. 10 in. Both tubes and tube plates are of muntz metal, the plates having a thickness of 1¼ in.

Condenser capacity is such that 13,800 gals. of water per minute will maintain a vacuum of 28 in. (referred to 30 in. barometer) when handling 143,000 lbs. of condensed steam per hour with injection water at a temperature of 68 deg. F.

Hot Well

Individual hot wells are provided for each condenser, the accessory equipment assembled in each group (see Fig. 5) including air pump, condensate pump, feed water heater and boiler feed pump.

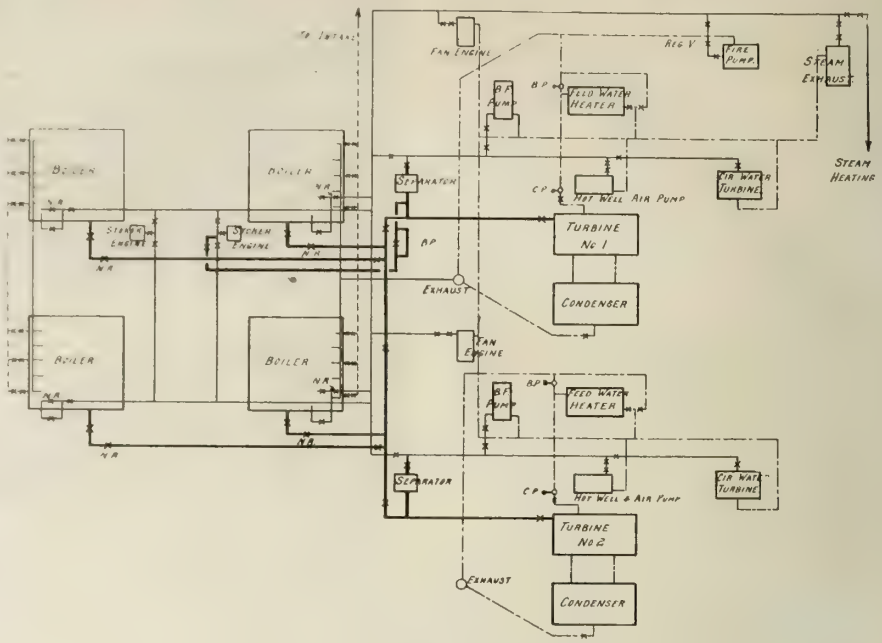


FIG. 6. PLAN LAYOUT OF BOILERS AND AUXILIARY EQUIPMENT.

The air and condensate pumps are mounted on a common shaft and are directly driven by a Westinghouse impulse turbine running at 2,500 revs. per min. The air pump is a Westinghouse-Leblanc rotary with solid bronze runner, and a capacity of 12-2-10 cu. ft. per sec. The condensate pump is centrifugal.

These pumps with the turbine are placed between the Cochrane open type feed water heater and the foundation wall of main turbine, see Fig. 5, the foreground on the illustration being the grating which covers the circulatting pump well. The circulating water pipe from the pump to the condenser can be seen at the left hand bottom corner where it passes through the foundation wall to the condenser.

Behind the feed water heater can be seen the boiler feed pumps and also the fan engine previously referred to.

Boiler Feed Pumps

The boiler feed pumps are of the direct turbine driven centrifugal type. A Westinghouse horizontal impulse turbine running at 2,500 revolutions per minute drives a multistage centrifugal pump of the horizontal volute type with double suction, having 3 stages and a capacity of 525 U. S. gals. per min. The total head operated against, including pipe friction is 520 ft., and water up to 210 deg. F. can be handled. The horse-power of turbine at 200 lbs. per sq. in. is 125.

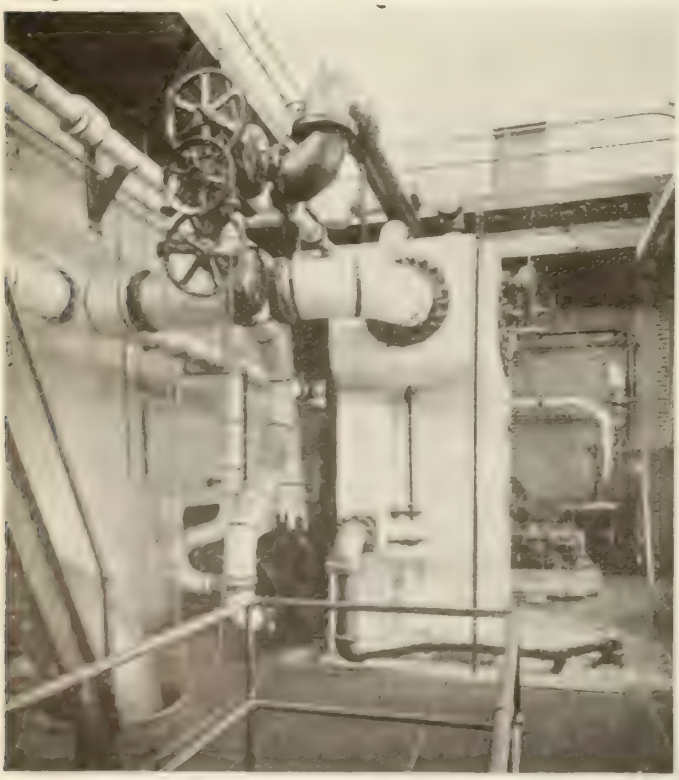


FIG. 5. AUXILIARY EQUIPMENT IN HOT WELL. AIR AND CONDENSATE PUMPS ARE AT LEFT OF FEED WATER HEATER, AND BOILER FEED PUMP BEYOND.

Generator Details

The general appearance of the generators will be gathered from views of main floor Figs. 3 and 4. They are of the revolving field type, with 4 poles, direct connected to the turbine shaft, and having removable end bells to allow access to windings. The field coils are wound with copper strap in slots cut in field core and the insulating material is capable of withstanding a temperature of 150 deg. C. without injury.

The armature core is built of laminated steel in cast iron frame and held firmly in place between two end plates. The armature winding is insulated with material with 90 deg. C. safe limit of temperature rise.

The windings and core are cooled by forced draught generated by two sets of fan blades attached to the rotor shaft which draw air from the air conditioning plant and force it towards the centre from both ends, whence it is expelled outward in a radial direction through air ducts into the passages which give the characteristic external appearance to generators of this type. The warm air is then returned to the conditioning plant where it is cleaned, cooled, and delivered to the intake passages of the generators again.

Air treating plant was installed by the Carrier Air Conditioning Co, and consists of 2 No. 263 F humidifiers with the necessary tanks, sprays, eliminators, pumps, piping and nozzles. Each has a normal capacity of 78,000 cu. ft. per min., with overload of 109,000 cu. ft.

The eliminators consist of vertical galvanized iron plates spaced uniformly in rows, and with parallel surfaces bent to a small angle so that a series of continuous sinuous passages are provided through which the air must pass. The first four corrugations of eliminator plates act as washing surface and are closely spaced so that air passing through is broken up in small thin layers, causing all particles of dust to come in contact with the wet surfaces. The air then enters the spray chamber in which are 560 spray nozzles which maintain a finely atomized spray against the direction of the flow of air. These spray nozzles are placed 3 ft. in front of the final eliminator plates which are provided with an independent set of flooding nozzles which maintain a constant sheet of water flowing down the wet surfaces and allow the spray nozzles to be shut off entirely in very humid weather and the washing procured through flooded eliminators only.

FIG. 7. INTERIOR OF CONTROL GALLERY AND OPERATING ROOM. BEHIND THE INSTRUMENT BOARD AT THE LEFT IS A LARGE BAY WINDOW GIVING UNOBSTRUCTED VIEW OF MAIN FLOOR (SEE FIG. 3.).

The casing for each humidifier which contains the foreging apparatus is 10 ft. long, 13 ft. 8 in. wide, and 13 ft. 1½ in. high. Each unit has a marine light inside, with external switch, and a 15 horse-power motor is provided for operating the centrifugal pump which supplies the water to the nozzles.

Exciters

Westinghouse motor generator exciter set is provided for, each generator being a 75 K.W. 125 volt, shunt interpole generator, driven by a 112 horse-power, 550 volt, 3 phase induction motor. motor.

Power for the exciters is taken from the 6,000 volt station service bus, through a bank of 6600/550 volt step down transformers, each exciter having its individual transformers and switching equipment, with circuit connections as shown in the schematic diagram Fig. 9.

As a precaution to ensure continuity of service, a spare exciter, driven by a steam impulse turbine, is available, which may be quickly connected to any machine in case of necessity. This is effected by tieing in on the 125 volt d.c. field bus, opening the field switch which connects the machine to the exciter and closing the field switch which connects its with the field bus. The two field switches are remote controlled circuit breakers mounted on a panel which also supports the motor operated contactor for inserting or cutting out resistance in the generator field, the rheostat for this purpose being located behind the panel.

The switch for tieing in the spare unit on the field bus is located on a panel in the operating room which panel also carries the switches for the 50 ton capacity service crane in the engine room. The other half of the same panel controls all circuits supplied by the storage battery, including direct current motors, control equipment, auxiliary d.c. lighting circuits, etc., a tie switch enabling the two sections of the panel bus to be tied together as shown in Fig. 9.

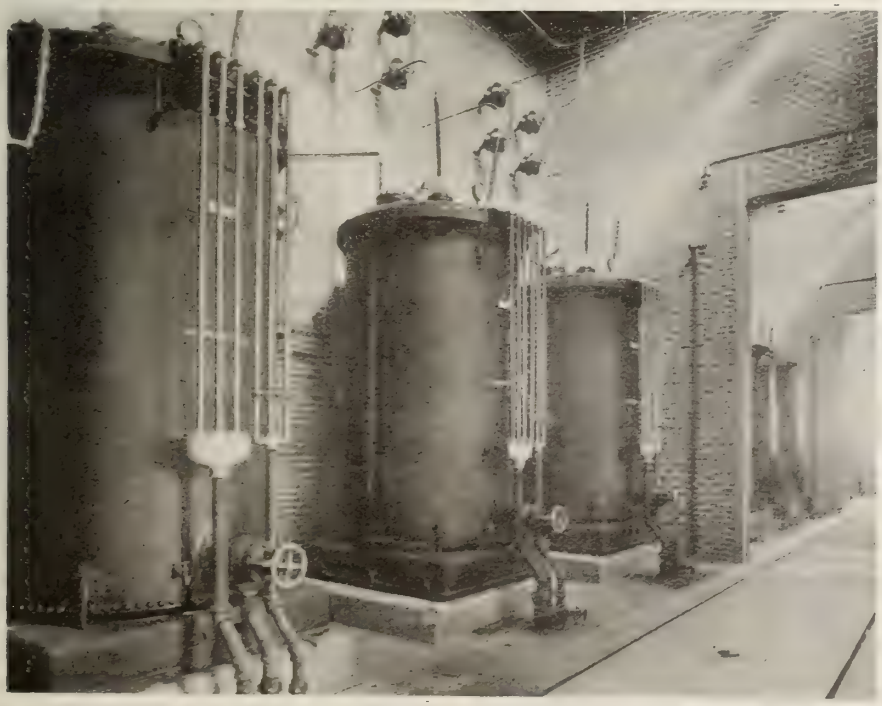


FIG. 8. TRANSFORMER EQUIPMENT. NOTE POCKET ARRANGEMENT OF ROOMS. ALSO WHEEL-MOUNTED BASE PLATES, WHICH FACILITATE REMOVAL OF INDIVIDUAL TRANSFORMERS IN CASE OF MISHAP.

Transformers

Each generator is connected to a bank of three, single phase transformers which step up the voltage from 6600 to 42,000 volts. The machine together with the transformer constitutes a unit and these units are electrically connected only on the 42,000 volt bus, thus introducing two banks of transformers between machines to serve as buffers to the short circuit current, in the event of trouble in one. No special reactance coils are used in the system.

There are at present two banks of step up transformers installed in the power house in a room adjoining the high tension switch room, and separated from it by a brick wall. As shown in Fig. 8, partition walls form pockets to separate each bank of three, single phase, 4,000 k.v.a., 41,000/6,600 volt, oil insulated, water cooled, Westinghouse transformers representing a capacity of 12,500 k.v.a. per bank. They are delta connected on both the high tension and low tension sides.

The conductors from the high tension terminals are of ¾-in. copper tubing and are carried on wall and ceiling insulators through the wall insulator bushings to the 42,000 volt bus bar.

Openings are left in the side walls of the pockets for a passage aisle in front of the row of transformers. A car track runs along this aisle and should it be required to remove a transformer

for inspection or repair all that it is necessary to do is to cut the transformer out of the circuit, disconnect the unions on the oil and water pipes and roll the transformer, whose base is mounted on wheels, on the truck. It may then be removed out under the 10 ton capacity hoist in the inspection room at the end of the row, which is separated from the transformer room by a rolling steel door. The remaining two transformers in the bank would then constitute an open delta connection for carrying the load.

Step Down Feeder Transformers

In addition to its generating capacity, the station is designed to act as a step down transformer station for distributing power to the surriunding manufacturing district. The ultimate capacity of the plant devoted to this service will be, when completed, 25,000 k.v.a., but at the time of writing, equipment for a capacity of 12,500 k.v.a. is installed and one 13,200 volt feeder line leaves the station to supply power to the nearby plant of the National Steel Car Co.

The transformation is effected through a bank of three 42,000 13,200 transformers, identical in design and rating to those in the generator circuits. They occupy the last pocket at the North end of the system and are connected on the high tension side through disconnecting switches and a G. A. type circuit breaker to the 42,000 volt bus. The low tension 13,000 volt bus is at the north end of the 6,600 volt bus structure Fig. 12, as also are the switching apparatus, choke coils, and lightning arresters for the feeders. The feeder lines leave the building at this point through the roof and are carried across the roof to the partment, Fig. 12, and on the floor above are 3 pole, oil circuit breakers shown in Fig .11 for the generators and supply circuits.

The current from the generators is carried to the controlling breakers by 12,500,000 c.m. lead covered cables.

Two station service switches, electrically interlocked, serve to energize the light and power transformers from either side of the system as desired.

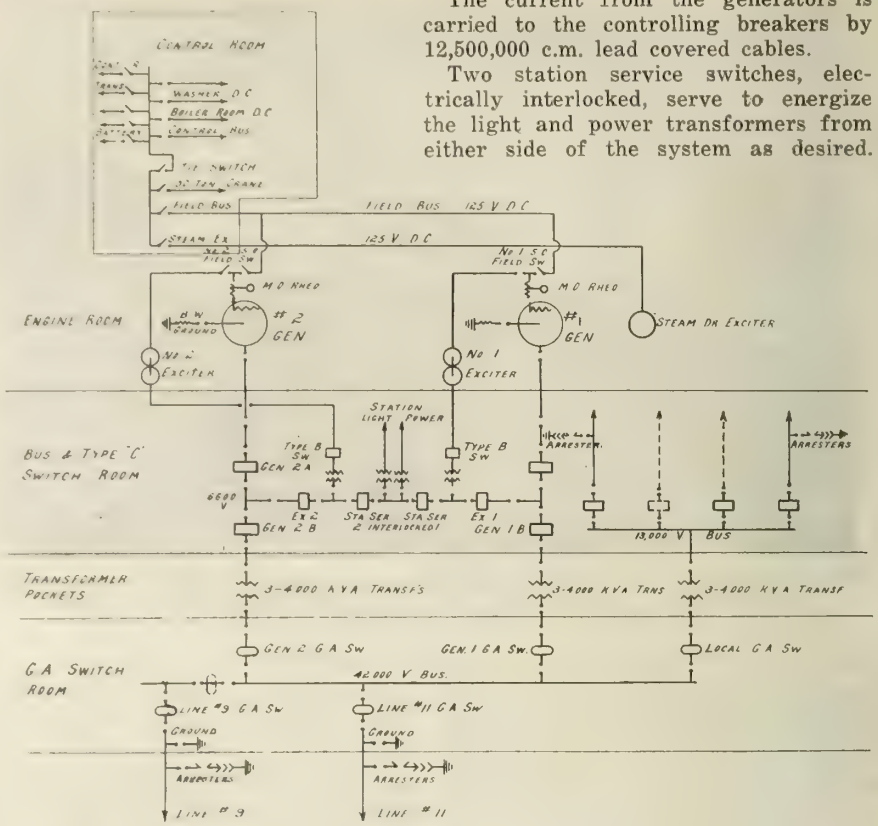


FIG. 9. DIAGRAM OF STATION WIRING SHOWING SWITCHES.

FIG. 10. INTERIOR OF SWITCH ROOM, SHOWING OIL SWITCHES AND BUSES FOR 13,000 VOLT CURRENT.

outgoing pole line. The cells containing the aluminum cell lightning arresters are provided with asbestos doors and the choke coils are helices of aluminum rod.

Low Tension Bus Arrangement

The 6,600 volt bus bar and switching room is divided into upper and lower compartments which contain the necessary switching and auxiliary equipment for supplying alternating current to exciter motors and station light and power service at a lower voltage than 6,600 volts. The low tension distributing, station service, transformers with disconnecting switches, shunt, and current transformers, are installed in a concrete structure in the lower com-

The controller operates the trip coil of one switch and at the same time energizes the closing coil of the other switch but the closing current cannot flow until the first switch is open, thus the closing of the switch does not commence until the other switch is open.

Control

The operating room shown in Fig. 7 is on the second floor, open to unobstructed daylight on the three sides and with a large bay commanding a view of the turbine room from the fourth side. Here the operator electrically controls the 6,600 volt generator circuits, the 42,000 volt oil switches on the transformers and transmission lines and the oil switches on the 13,000 volt feeders from the bench board.

The main switchboard faces the bay window overlooking the turbine room and is of the benchboard type with dummy buses with the indicating instruments mounted on pedestals in front of the benchboard. All oil switches are equipped with a telltale lamp system, indicating the "open" and "closed" position of the switches on the benchboard in the operating room, by small telephone lamps.

Directly behind the operator are mounted the totalizing panels which show by indicating and graphic recording meters, the total amount of power supplied by each unit to the outgoing lines. A feature of these panels is the row of test connections at the

base of the panels which facilitates inserting a test meter in any circuit desired, should the board meter be damaged or as a check on its accuracy.

The proximity of the panel to the stairway which leads to the room, warranted the enclosing of the rear of this panel by a structure, which gives it a more sightly appearance and at the same time allows of easy access for inspection.

The operating room is sufficiently large to accommodate the necessary control apparatus for the completed installation. The entire number of benchboard sections are in place and it only remains to drill and wire the board as further units are added. Another panel, not shown in Fig. 11 contains the tie switches for the direct current auxiliaries previously mentioned and this is mechanically operated.

Safety Measures

Reference to Fig. 9 will afford an idea of the ample safety protective devices employed, both for protecting the apparatus and for ensuring safety for the operating force when engaged in examining or repairing any part of the system. Every piece of apparatus may be segregated by means of disconnecting switches, one on each side of every oil switch, and when these are opened the wiring above and around the oil switch is dead and the oil switch can be inspected, and dismantled without danger. The outgoing lines are protected against lightning and static surges by electrolytic arresters. Another detail involving the safety of the operators and the proper operation of the station is the locking of the 13,000 volt disconnecting switches. Where the ordinary knife switch may open up by reason of the magnetic repulsion when carrying heavy loads, thus often seriously damaging adjacent apparatus by the intense heat of the arc, the lock type switch here employed in the feeder lines ensures a positive connection under heavy currents.

Auxiliary Equipment

In a separate room on the ground floor is located the storage battery reserve for supplying direct current to the control, crane service, and other circuits in case of an interruption of the main circuit. This battery consists of 66 cells, has a normal voltage of 125 volts, and a normal discharge rate of 200 amp for one hour.

The 50 ton power house crane is manufactured by Cleveland Crane and Engineering Co. and is the cage operated type. It is provided with mechanical brakes of the double friction, band type, self lubricating and running in oil. A solenoid operated electric brake is also connected to the armature shaft of the hoist motor and connected so as to apply itself in failure of current. It is equally effective in stopping motor in hoisting or lowering and is capable of sustaining the full load of the hoist. Each hoist is provided with Auto circuit breakers, which break the circuit when the hook is raised above or descends below a predetermined point.

FIG. 11. VIEW IN 6.600-VOLT SWITCH ROOM. SHOWING RANGE OF ENCLOSED SWITCHES.

A 10 ton capacity, hand operated hoist is provided in the inspection room on the transformer floor. In this room are also the oil tanks for the transformer oil, consisting of two tanks, one for clean, and one for dirty oil. Two small oil tanks for the oil switches and lightning arresters are mounted above the transformer oil tanks. Electro-Seal insulating oil is used.

The transformers and high tension oil switches are provided with sewer connections and provision is made so that in case of an explosion in the tank or a fire, the oil can escape to the sewers.

Two pumps form part of the equipment for handling the oil. One delivers oil from the tanks, up to the transformers and a centrifugal pump operates the small filter press output for filtering and drying the oil.

Transmission Lines

The two 42,000 volt transmission lines leaving the station are carried on one set of steel towers and deliver their output to the high tension out-door switching station at Bartonville, there to be linked in parallel with the long distance transmission lines from the hydraulic station at DeCew Falls.

In order to join the two stations together it is necessary to synchronize the two and therefore synchronizing equipment is provided in the control room. The signalling devices are an aid to the operator when bringing an incoming machine up to synchronism, as by means of it he may inform the turbine attendants, on the floor below, what is desired of them. The various

FIG. 12. ONE SIDE OF THE 6.600-VOLT BUS STRUCTURE LOCATED DIRECTLY BELOW SWITCH ROOM SHOWN IN FIG. 11.

orders are illuminated on the signal board, provided for each machine, by pressing an electric button. The attendant then executes the order and presses the corresponding button on his board, signifying to the operator that the order is carried out. When it is desired to call the attention of an attendant to any particular machine, a Klaxon horn is sounded and a lamp lights up over the machine intended.

It is quite interesting to note that the power station at DeCew Falls can feed back on the 42,000 volt bus in the steam station and cause the generators to operate as synchronous motors, when the turbines are throttled and just sufficient steam admitted to circulate through the turbine blades and keep them from becoming excessively hot through friction effect. This is a particularly valuable feature in this case, for until demand on the station necessitates every unit carrying a power load, those machines not generating may be put to economic use as synchronous condensers for regulating the power factor of the load, thus maintaining the required voltage at the receiving end of the hydraulic line from DeCew Falls under a wide range of load.

From the operating standpoint, this system is very advantageous, as it admits of regulation at the Hamilton end of the line, the generator field being overexcited to increase the power factor and decrease the voltage drop in the lines on heavy loads and underexcited to decrease the power factor and increase the voltage drop on light loads. The improvemnt in regulation thus effected will enable the lines from DeCew Falls to carry more power than before and incidentally show an immediate profitable return on the capital which has been expended, to provide for future power demands.

The power house is built entirely of brick and steel with reinforced concrete floors and is as fireproof as far as any station can be. The inside walls of the engine room are faced with white enamel brick up to the crane level, above which, the walls are satin brick and the ceiling a buff gypsum. The floor is laid with English red quarry tiles and conforms with the general interior finish of the power house to give it a neat and bright appearance. The steel throughout, and most of the cement floor surface, is painted gray.

Every convenience is provided for the operating staff, the equipment including adequate office accommodation for the superintendent, locker room and wash room for the employes, well equipped repair shop and intercommunicating and local telephone system. Excellent lighting is provided throughout, all the larger rooms being very effectively illuminated by properly contained nitrogen lamps suspended from the roof trusses. The plant has been in operation since June 1917, and was designed and built by the following members of the Co.'s organization: W. C. Hawkins, chief engineer and managing director: Geo. Service, mechanical engineer; Chas. H. Hutton, electrical engineer, to whom we are indebted for the illustrations and data accompanying the article.

SOUTHERN CANADA POWER CO. DEVELOPMENTS

THE map accompanying the annual report of Southern Canada Power Co. recently issued shows that the company's operations cover an exceptionally wide range of territory, doubtless the largest east of the Niagara power zone. On the south power is carried across the international boundary into Derby, Vermont. On the west the transmission lines approach as near to Montreal as St. Johns, Iberville, St. Hilaire and Beloeil. On the north Drummondville and adjacent municipalities are tapped, while on the east the principal points of consumption are Sherbrooke, Lennoxville, Richmond and Compton. These distances are approximately 70 to 75 miles east and west, north and south.

It is quietly but gradually developing into an important development, and is extending a network of power wires throughout the south-eastern section of the Province of Quebec, and working up the available hydro-electric propositions in that area.

The report states:

"Considerable progress has been made during the year in the consolidation of the subsidiaries acquired, as referred to in the last report. Since then the company has purchased the municipal plants of the City of Granby and the Town of Bromptonville, and is now engaged in the joining up of its various isolated properties.

"The company at present has under construction about eight-five miles of transmission lines from Sherbrooke to Granby and Cowansville, from Sherbrooke to Bromptonville, and from St. Cyrille to St. Germain through Drummondville, with the necessary sub-stations and distribution systems.

"The power development at Richmond, Drummondville, Foster and Granby are being considerably improved and enlarged and put into shape for the most economical operation, through the transmission lines, with the other plants of the company.

in connection with the engineering investigation of the company's water powers, and additional riparian and other rights have been acquired, so that practically all such work usually preliminary to such developments is now completed."

CANADA'S COAL PROBLEM

The "Monetary Times" recently published a four-page article by Arthur V. White on "Canada's Coal Problem." Mr. White is consulting engineer to the Conservation Commission, and has filled many important engineering appointments in Europe and America.

Canada at present imports annually from the United States 4,500,000 tons of anthracite and from ten to fourteen million tons of bituminous coal, the latter largely for power purposes. It is believed that the American anthracite fields—even at the pre-war rate of production—will be exhausted in a hundred years. The friendliness of the United States towards this country has recently been emphasized in this very question of the coal supply, but circumstances are conceivable in which our neighbor to the south might feel compelled, in the interests of her own population, to completely shut off the export of anthracite, and to barter her bituminous output for particularly necessary Canadian products, such as electrical power.

Canada now exports to the United States about 275,000 horse-power of electrical energy, which Mr. White calculates as equal to three million tons of coal, and goes on to estimate the developed electrical horse-power of Canada at 1,813,200, and the possible horse-power at 18,800,000. But by no means all of our water powers, he says, may be economically developed. He calls attention to the importance of conserving all of this horse-power and turning it to public uses.

MAILS BY AIR AROUND WORLD

ADDRESSING a large asembly of members of the Canadian Club at luncheon recently in Toronto, Lord Montague impressed upon his hearers the present and future importance of aviation. In the early days of the war many people had undertestimated the value of aircraft—the airplane and seaplane—in modern warfare. There was no doubt any longer as to the possibilities of the aircraft.

Lord Montagu predicted that the time was not far distant when airplanes would be used to carry the mails around the world. Lord Montague stated that he was a member of a committee in London which has under consideration a scheme for the establishment of an Imperial aircraft service when the roar of guns in the war zone ceases. He believes that all the colonies of the British Empire should be linked up in the scheme.

"Commercially the airplane will play a wonderful part in the developmen of business life of Canada after the war," said Lord Montagu. "Toronto has now become the aviation centre of the North American continent, and after the war the aviation factories and schools of instruction should be continued. They will be necessary. The Germans may be our superior in some respects in the matter of building machines, but they cannot beat us in the quality of the men. Canadian aviators have demonstrated to the Germans that they are constituted in make-up and fighting qualities of the right kind of stuff. Generals who watched them have told me that as fighters at a high altitude they are remarkable for courage, ingenuity and skill."

Eyes of the Army

Referring to the invaluable service rendered by the airplane and seaplane in the present struggle in Europe, Lord Mon-

tagu declared that the Generals are kept in close touch with what is going on behind the lines of the enemy. The Allied aviators had demonstrated their superiority over the Germans in this respect and could rightfully lay claim to the title, "Masters of the air." What the Allied armies lacked in man-power was more than made up in the invaluable branch of the army. Lord Montagu impressed upon upon his hearers the fact that with the exception of the United States there was a lack of man-power in the army of every Allied power fighting in Flanders. Consequently every month as the war goes on brings more vididly to the minds of the people the relative importance of the airplane and seaplane.

An Army of Pilots

In conclusion Lord Montagu made a special plea for co-operation in the matter of striving to keep the aviation service and schools of instruction in Toronto and elsewhere at a very high standard of efficiency. He said there were between 1,500 and 2,000 Canadian pilots at the front, while an additional 500 were in Toronto preparing to go to the front.

INDUSTRIAL ALCOHOL

THE problem of a future supply of gasoline is yearly becoming more acute, in fact the question of finding a substitute for petroleum itself is recognized as being a matter of a few years only. Just when circumstances will justify efforts to establish an alcohol industry cannot be very well decided till the influence of war conditions has been removed. Discussing the prospects of producing industrial alcohol in this country, W. J. Dick, writing in the Canadian Mining Institute Bulletin, states that imports of petroleum and petroleum products into Canada have been rapidly increasing, while the domestic production has been decreasing. The imports of petroleum, crude and refined, during the calendar year 1914 totalled nearly 244½ million gallons valued at over $11,000,000. As our crude petroleum production in 1914 amounted to about 7½ million gallons, valued at about $344,000, it can be seen that Canada is dependent upon foreign sources for her supplies of petroleum and petroleum products. The production of crude petroleum has come almost solely from Ontario and is steadily but surely declining in spite of attempt being made by drilling to enlarge the areas of producing fields, or to find new ones.

In considering the development of a substitute for petroleum for certain purposes such as illumination, cooking and for use in internal combustion engines, industrial alcohol, which is used to a considerable extent in Germany and Great Britain, is suggested.

In 1914, the imports of refined and illuminating oils amounted to over 12,800,000 gallons, valued at $970.000; during the same year 24,400,000 gallons of gasoline, valued at $2,747,000 were imported. If industrial alcohol could be produced economically in Canada so as to replace these products there would be a saving of over 3½ million dollars worth of imports. On account of the rising price of gasoline it has been reported that many tractors have been rendered idle in the Prairie Provinces, thus reducing the acreage to be sown. Some people are of the opinion that the high cost of gasoline is occasioned by the present war, but the Director of the United States Bureau of Mines declares that the prevailing prices may not only continue for some time, but will undoubtedly reach higher levels before there is any permanent relief. He states that the United States Government will, during the next fiscal year, pay 31½ cents for its gasoline. He, therefore, concludes that, if the United States, using such vast quantities, is compelled to pay this high price, the private consumer will have to pay much more. Furthermore, at the present rate of production, the known supply of crude oil in the United States, from which we are getting our present supply of gasoline, will be exhausted in 27 years.

In considering the establishment of an alcohol industry in Canada, it is necessary to distinguish war conditions from those obtaining in normal times. As alcohol is essential in the manufacture of smokeless powder, present prices are abnormally high; whereas, under normal conditions, there is not the great demand for alcohol for this special purpose and it would then have to compete with kerosene and similar products.

The raw materials used elsewhere than in Canada for the manufacture of industrial alcohol are potatoes, sugar beets, molasses, and sawdust.

The present price and yield of potatoes in Canada are not such as would warrant the founding of a potato alcohol industry in Canada. The British Committee on Industrial Alcohol reported that it would not be possible to establish potato-alcohol industry in Great Britain unless potatoes were less than 29 cents per bushel. W. T. Macoun, Dominion Horticulturist, states that, if best methods are followed, 300 bushels of potatoes per acre can be produced. He estimates the cost of production and marketing such a crop of 20½ cents per bushel but says that this will be reduced on large areas where the most modern machinery is used. *The Census and Statistics Monthly* states that the profit per acre, in 1913, for spring wheat grown in Manitoba, Saskatchewan and Alberta was $2.65, $1.72 and $2.09 respectively, so that it is evident that if potatoes were sold at 21½ cents per bushel there would be a greater profit to the farmer than growing wheat in these provinces.

Potatoes used in the manufacture of alcohol need not be sacked and may be shipped frozen with but a trifling loss.

The establishment of an alcohol industry on a suitable scale would be, as outlined previously, a means of carrying on profitable agriculture in areas otherwise unsuited to crop growing; the feeding of the spent mash to cattle would encourage live stock growing and the alcohol produced could be consumed by the farmers as illuminant, for cooking and heating purposes, and as a source of motor fuel.

THIRD LARGEST DAM IN WORLD IN QUEBEC

THE most important water conservation work thus far undertaken in Canada is that undertaken by the Quebec Government and now nearing completion at La Loutre, on the St. Maurice River. It will store up the waters of the St. Maurice for the benefit of its many water powers and will double the low-water flow.

This work had been projected for many years, as the regulation of the river is of the greatest value to the important developed water powers at La Tuque, Grand'mére and Shawinigan Falls, but no construction work was undertaken. After full investigation of the project, both from the engineering and financial viewpoint, the Quebec Streams Commission let the contract for construction in the summer of 1915.

The work has progressed steadily since in spite of the great difficulties in transportation. It is now 80 per cent. completed, and will cost about $1,500,000. When finished, it will create a reservoir of 160,000 million cu. ft., forming the third largest artificial reservoir in the world, being exceeded only by the Assuan reservoir on the Nile and the Gatun lake on the Panama Canal. From the owners of the power sites already developed, the Commission will receive a revenue of upwards of $130,000.

Between the reservoir and the mouth of the St. Maurice there are 17 power sites with heads of from 10 feet to 150 feet. The aggregate descent at these sites totals 800 feet, but the dams erected in developing the various sites will increase this total head to 900 feet. Under present conditions, these sites have a total capacity of approximately 350,000 theoretical h.p., but it is estimated that some 900,000 h.p. will be available when the flow is regulated from the reservoir. At Shawinigan, Grand'mére and La Tuque alone, the three sites at present utilized on the St. Maurice, the potentiality will be raised from an aggregate of some 190,000 theoretical h.p. to over 400,000 h.p.

Will Expedite Coal Shipments to Canada.—C. A. Magrath, Dominion Fuel Controller, who has been in Washington and New York for some days in connection with the fuel situation, has succeeded in arranging for a number of emergency shipments of coal to Canada. This has been done despite the pressure coming from the consumers in the United States to limit the exportation from the country in order to relieve the acute situation across the border. While there is a shortage of coal in some districts, there must be a large supply in the country and the problem is largely one of transportation and distribution. This is accentuated both in connection with distribution in Canada and additional shipments from across the line, by war conditions.

Modern Steam Power Plant and Its Appliances-III

By John H. Hale*

Despite the wonderful developments of hydro-electric power generation, the modern steam power plant occupies a firmly established position in engineering effort from which its removal, if it take place at all, will never be more than temporary. The economies possible in large plants and the duty of all engineers to adapt such methods to their small individual plants wherever possible is emphasized by the writer.

THE efficiency of the steam engine is often based on the amount of fuel burned per indicated horse-power per hour, but is more properly based on steam consumption. The highest class of steam engine, running condensing, will use under test conditions, from twelve to twelve and one half pounds of water, in the form of steam per indicated horse-power per hour, while the ordinary automatic cut-off engine, with single expansion, noncondensing, uses from twenty-eight to thirty-five pounds. The fuel used per horse-power per hour, therefore, depends on the quality of coal, and the efficiency of the boiler and furnace, as well as upon the efficiency of the engines.

A good boiler, properly set and fired, will show a much higher efficiency in per cent. than the engine. When operated with high-grade coal, and under the best of conditions, a boiler may deliver to the engine as much as 75 per cent. of the theoretical heat of the coal, and if the coal contains 14,500 B.T.U. per pound, this is equivalent to 9.78 lbs. of water evaporated from a feed water temperature of 120 deg. to steam at 200 pounds pressure (gauge). If the engine uses 12 pounds of steam per horse-power, this means a coal consumption of 1.23 pounds per indicated horse-power per hour, or if the engine uses 30 pounds of steam a coal consumption of 3.07 pounds. These figures if transposed for efficiency would be as follows: one pound of coal having 14,500 B.T.U. is equivalent to 11,281,000, foot pounds, which on a supposition of 75 per cent. efficiency in the boiler, is equal to 8,460,750 foot pounds, which if all utilized by the engine would produce 429 H.P. per hour, instead of the amounts above stated.

On this basis the higest class engine has an efficiency of scarcely 19 per cent. and the other of a little more than 7½ per cent. and the efficiency and boiler combined is but 14¼ per cent. and 5.7 per cent. respectively.

It is economy, therefore, in most cases to use a high class engine. There are instances, however, where the engine is used for so short a time in each year, that the saving may not be sufficient to pay the interest on the additional cost, and a cheaper engine, even if comparatively wasteful, may be better economy.

Compound Engines

Compound engines, when high pressure can be obtained, have an advantage in economy over single cylinders, and triple and quadruple expansion engines, under some conditions, show a saving over simple compound, but they require a pressure of 150 to 200 pounds, and a comparatively steady load to develop their advantage to a great degree.

A large boiler is generally an advantage, but it is not economy to use a large engine to develop small power. Sufficient steam to fill the cylinder at the terminal pressure of each stroke has to be furnished, whether the engine is doing more or less work, and this frequently amounts to far more than the steam used to do the work.

Thus a 24-in. by 48-in. engine, making 60 revs. per min. with cut-off, uses 30 h.p. of steam in displacing the atmosphere without exerting any available power. For the same reason back pressure greatly increases the cost of power.

When selecting an engine for any particular power-plant, the first thing to decide is the amount of power required. If an engine is already installed, and the new engine is only a replacement, this is an easy matter, as indicator cards may be taken from the engine which is to be replaced. If the power house is an entirely new one, then a list of the machinery to be driven will have to be made out, and the total power determined from the amount taken to drive each one individually.

Great care should be taken when figuring out the power to take into account the length of time, and also the particular time of day during which each machine will run, as this has a great bearing on the determination of the proper size of the engine. When the list of powers and time of running of each machine is fixed, a power curve should be laid out, showing the variation in load on power house during the twenty-four hours, or portion of it which constitutes the daily run.

The power curve will give the minimum average and maximum, or peak loads, and an examination will tell whether it is best to develop the power with one unit, or divide it between two or more units.

Running Conditions

When power to be developed has been decided, it is then necessary to examine the running conditions of the plant. The first thing to find out is the steam pressure available; whether the steam is superheated and if so, the degree of superheat; also whether the engine is to run condensing or non-condensing, and if the latter, the amount of back pressure. If there is an exhaust steam heating system in connection with the plant, the amount of exhaust steam needed, and the number of months in the year it is in operation, will have to be determined. When this information has been collected, it will be seen how much steam economy will affect the selection, for, if the heating system takes as much or more steam than the engine does to develop the power required, the steam economy is not of such importance as it otherwise might be, but in the majority of plants in this country of any size, the elements of steam economy enter largely into the problem by reason of the fact that the steam required for power is largely in excess of that required for heating, and that the heating plant is shut down for about half the year.

This being the case, it is necessary for the engineer to determine the most economical engine for his purpose. His choice will be somewhat influenced by price, but in the long run it pays best to buy a well made engine, built by a reputable firm, and one that is economical in the use of steam.

Any good firm of engine builders will give a guaranteed steam preformance of their engine, but this guarantee should be carefully examined to see that the guarantee performance is under the same conditions, and that the engine is run on saturated steam, as many engines which are built especially to run with superheated steam, and give good results under these conditions, fall down badly when running on ordinary saturated steam, and it is the builders of these engines that are apt to give their guaranteed performance with superheated steam, resulting in disappointed customers who have overlooked the difference in conditions.

Best is Cheapest

For all round economy and reliability the four valve or Corliss type, as now built by the best makers, will always hold first place. The purchase of a cheap machine should be avoided as it is only by careful work in connection with the wearing parts, and such machine work as will ensure tight pistons and valves, that the low steam consumption guaranteed by the best makers is obtained.

The cost of keeping up repairs on this type of engine has often been used as an argument against it, but an examination of the records of the best builders will show an astounding number of engines that have been running for years without a cent's worth of repairs. In citing one particular plant, there are two Goldie & McCulloch Corliss cross compound noncondensing engines, running under 150 lbs. steam pressure, and 150 rev. per min. These engines have been in oper-

*Secretary Canadian Association of Stationary Engineers.

ation for three years, running on an average eighteen hours per day, and I personally consider them as good today as when we received them, and up to this date there has not been a single cent expended on them for repairs.

Turbine Features

The problem of increasing the capacity of an existing power house, which is already crowded for room, has been successfully solved by the advent of the exhaust-steam or low-pressure turbine. The chief reason for the rapid growth in favor of the low-pressure turbine is the fact that the steam turbine is much more economical in the low pressure stages than a reciprocating engine, being capable of producing a horse-power on or about 30 pounds of steam at atmosphere pressure and twenty-eight inches of vacuum.

It will thus be seen that if we have an engine that develops a horse-power on 15 pounds of steam when running condensing, and 20 lbs. when running non-condensing, and put the steam into a low pressure turbine, we would have (allowing 5 pounds per horse-power for condensation in the cylinders) 15 pounds left to put into the turbine, and there develop ½ horse-power, or altogether 1½ horse-power, with our original 20 pounds of steam, or at the rate of 20 ÷ 1.5 =12.5 pounds per horse-power for the combined engine and turbine.

This will give a rough idea of the gain in using an exhaust steam turbine, which not only increases the capacity of the plant 50 per cent. but decreases the steam consumption per horse-power 16¼ per cent. The low pressure turbine, with its condenser and other auxiliaries, would not take up more than about one half the floor space of the original unit.

To every engineer who is operating a steam plant, I would like to say give your engine and boiler room your best and most careful attention, and show administrative ability, and then you will get the best efficiency that may be got out of a steam plant such as yours may be.

CANADA'S TRADE POSITION

COMMENTING on the thrift of Canadians the "Wall Street Journal" says:

Canadian foreign trade for ten months of 1917 approaches $2,000,000,000 — a per capita of $2,500. Of but recent development, the volume of commerce for the whole year will doubtless nearly equal in dollar value our own foreign trade for 1900, when we had 97,000,000 people. With but one-thirteenth our man-power, Canadian exports and imports will exceed one-fifth of our own.

It may be said low cost production and high prices of farm exports and manufactured food and shipments of military supplies have made this possible. But in reckoning these factors the adverse circumstances in which Canada had the opportunity to lay the foundation for future international trade must be given due consideration.

Position in 1914

In the summer of 1914 Canada was tentatively surveying the means of recovery from continent-wide liquidation. In the west and also in the east a prolonged real estate boom had collapsed, coincident and correlative with a severe contraction of commercial credit and radical readjustment of domestic trade in volume and method. It was a moot question whether real business revival would manifest itself in the autumn of 1914 or the following spring.

Credit was in its most sensitive stage of convalescence, when the declaration of war came as a clap of thunder from a cloudless sky, and 100,000 industrial effectives went voluntarily to the colors. The supply of labor was never adequate to pioneer construction; nevertheless, over 400,000 men went into service voluntarily from all classes and from the most productive occupations.

War Bonds

At least $500,000,000 of war bonds have been purchased by the Canadians. The Ministers of the Crown were justified in the implicit confidence which they placed in the Canadian instinct of thrift. There are racial and political differences in Canada, but thrift in common, homely household terms, is a Dominion-wide virtue, characteristic of the passive and the unaggressive, as well as of the industrious and ambitious.

INDUSTRIAL DEVELOPMENT IN JAPAN

THE following observations regarding the formation of industrial companies in Japan since the outbreak of the war have been furnished by E. F. Crowe, Acting Canadian Trade Commissioner, Yokohama:

Metals

Although the iron industry of Japan is still in its infancy, it gives promise of assuming considerable importance in the future. Before the war the annual production of Japan was about 260,000 tons of iron, this being around one-half of its consumption. Since the war several new companies have been formed for the production of iron. Six companies with a combined capital of 40,000,000 yen have established new works.

With regard to steel, three new companies have commenced operations and four new works have been established. Their total combined capital is estimated at 5,000,000 yen. One company is producing steamer shafts, railway wheels, and tires as well as supplying the home trade. They have received orders from China and India. It is stated that the intention of this company is to devote all its energy to the export trade rather than to the domestic field.

It is generally conceded that the future of the zinc industry of Japan is good and that a large export trade is to be expected after the war. One company is already manufacturing zinc for exportation. Japanese zinc ore contains many other metals. such as gold, silver, and copper and the refining of these metals is carried on along with the treatment of the ore. Five new zinc companies are operating six works for the treatment of Japanese zinc ore and have a total combined capital of 7,600,000 yen.

In March, 1916, a company was formed with a capital of 1,000,000 yen for the manufacture of aluminum. It is stated that the process to be used is different from that in vogue in Europe and the United States. The alumina is obtained from a clay which is a product especially of Japan and is treated by an electrolytic process.

A company was formed in January, 1917, with a capital of 100,000 yen for the purpose of producing sheet lead for the use of chemical industries. Sheets are being turned out measuring ten feet by four feet and it is claimed that they are superior to any which have hitherto been manufactured in Japan.

Metal Goods

A company which was first established in 1913 for the manufacture of galvanized iron sheets and galvanized iron wire has increased its capital from 300,000 yen to 700,000 yen. Up to the present its output has been confined to the home market but it intends to export its products later.

Two companies with a combined capital of 1,500,000 yen have been formed for the purpose of manufacturing wire netting.

Machinery

For the manufacture of machinery, three new companies with a combined capital of 2,300,000 yen have been established. In addition to the manufacture of munitions, rotary printing machines, etc., and gun metal are also being manufactured.

Electrical Supplies and Accessories

There have been formed during the period under review six companies for the manufacture of electrical supplies and accessories, such as electric motors, dynamos, switches, lamp bulbs, carbon electrodes, carbon brushes, etc. Their total combined capital is 4,530,000 yen and they operate eleven factories. An improved process for the manufacture of micanite has enabled a Japanese com-

Mining

There have been organized three coal mining companies with a combined capital of 1,550,000 yen. One company is also producing coke in large quantities. In December, 1916, a company was formed with a capital of 120,000 yen to exploit a sulphur mine. A special process is used in refining the raw material.

Note.—A yen equals approximately 50 cents at the normal rate of exchange.

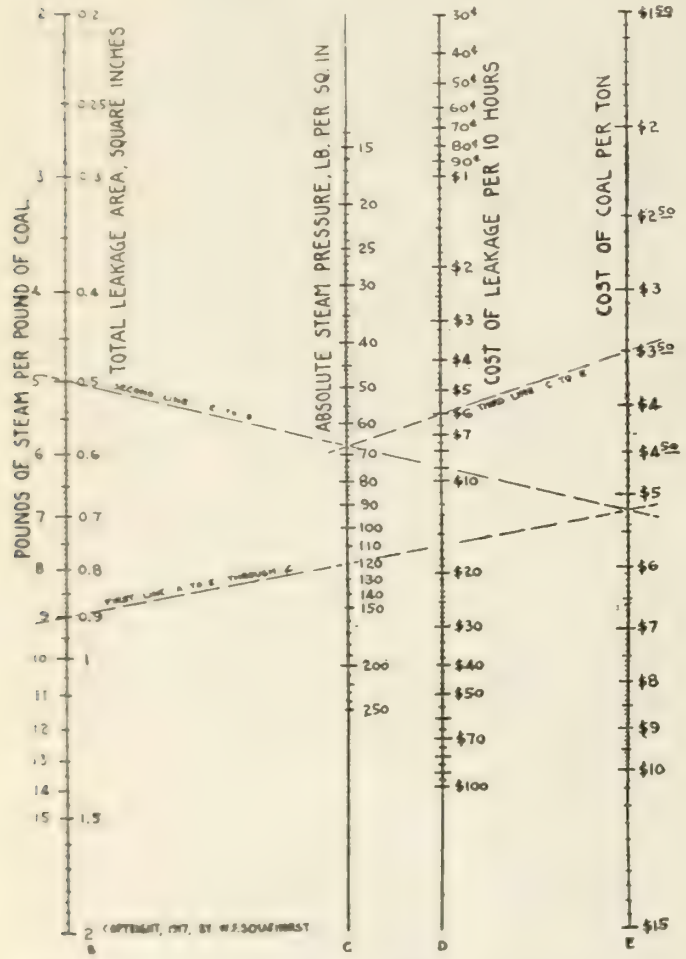
EACH MAN TO HIS MATERIAL

By D. A. Hampson

THE most famous saying of the late Bob Fitzsimmons was to "strike from where your hand is." The machinist doing work around in various factories cannot help notice that the employees of the various places follow this advice unknowingly. For instance in a large creamery, the writer saw the engineer cutting

threads on some pipe and for a lubricant he had a squirt can filled with butter: he was cutting nice threads too—his pipe vise was near the engine and he kept the can resting on the cylinder head where the butter was heated to a liquid.

In a leather tanning plant, they burned leather scraps under a 40 h.p. boiler and while it wasn't coal by any means, it did very well with the aid of a blower. Elsewhere in the plant leather scrap was used—in babbitting, a piece of leather took the place of putty, ends of leather were slitted up into belt laces, etc. Down at the paper mill they worked over vast quantities of old rope into pulp but it was only natural that for repairs and in an emergency rope was used for supports and slings and ties where an outsider would have insisted that iron rods and wood blocks were the only materials that would fill the bill.



THE COST OF LEAKING STEAM

By N. G. Near.

TO determine the cost of leaking steam with any degree of accuracy we must know at least four factors: (1) The number of pounds of steam evaporated by 1 lb. of coal; the greater this is the less is the cost of leaky pipes, other conditions being the same; (2) the total area of leakage; (3) the absolute steam pressure, which is equal to the gauge pressure, plus the atmospheric pressure; at sea level this is usually reckoned as gauge pressure, in pounds per square inch, plus 14.7; and (4) the cost of coal per ton of 2,000 lbs.

For example, how much money is lost every 10 hours under the following conditions: Nine lbs. of steam are generated by each pound of coal. The total area of leakage is ¼ sq. in. The gauge pressure is 105 lbs. per square inch (making the absolute pressure very close to 105 + 14.7 = 120 lbs. per square inch). The cost of coal is $3.50 per ton.

Referring now to the chart, lay a straightedge across the chart three times as indicated by the dotted lines and the problem is solved. Run the first line from the 9 (column A) through the 120 (column C) and locate the intersection in column E. Run the second line from that point of intersection to the 0.5 (column B) and locate the intersection in column C. From that point of intersection run the third line to the $3.50 (column E) and the answer is found at the intersection with column D. The answer is $6 loss per 10 hours.

In case it is found that the total leakage area is less than shown in column B, the chart may be used by shifting decimal points. For example, if, in the above problem, the leakage area had been 0.05 instead of 0.5 sq. in. the answer would be 60 cents instead of $6 per 10-hour day.

When using the chart, the steps must follow in the order shown and above described. First line, A to E through C. Second line, E to B. Third line, C to E.

The range of the chart is great enough to easily handle any ordinary problem.

The United States super - dreadnought Tennessee will be driven by four alternating-current motors, one to each propeller shaft, supplied by current at 3,400 volts from two 13,500 horse-power turbo-generators. The motors will be wound for both 36 poles and 24 poles, operating on the former as squirrel-cage machines and on the latter as wound rotor machines.

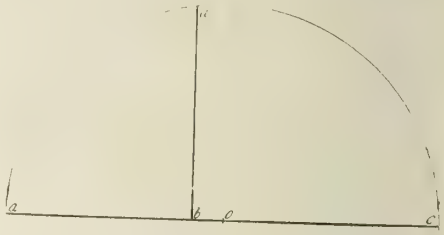
STORING COAL IN BULK

WHEN coal is stored in bulk the piles should not be higher than 10 ft. according to the British Fire Prevention Committee. Iron pipes 3-in. or 4-in. in diameter, or, failing these, eathenware pipes or ducts formed of incombustible material, should be inserted vertically in the piles as they are built up, their lower ends being at different heights above the ground throughout the piles, with about one pipe or duct to every 300 sq. ft. of surface; a thermometer should be occasionally lowered down these pipes or ducts to ascertain the temperature from the centre of the pile; and if wet, very small, soft, or impure coal is received it should be dumped round the edges of the pile, or in some position where the air can get to it freely and where other coal will not be packed on top of it.

MEAN PROPORTION

By J. H. R.

IT is sometimes required to find the mean proportion between the lengths of two lines. This can be done either by calculation or by the graphic method. Taking X as the mean dimension between A and B, the proportion would be A : X : : X : B, or $X^2 = A\ B$. Suppose it is desired to find the mean proportion between two lines 3 and 4 inches long. Using the above proportion we have 3 : X : : X : 4, or $X^2 = 4 = 12$. Hence, $X = \sqrt{12} = 3.464$ inches. Proof:—the product of the two extremes of any direct proportion must equal the product of the two means; thus, 3 : 3.464 : : 3.464 : 4, and $3 \times 4 = 1^2$, while $3.464 \times 3.464 = 11.9993$. The slight difference in the two values is due to the number of decimal places.



MEAN PROPORTION DIAGRAM.

To find the mean proportion by the graphical method, proceed as follows: On a straight horizontal line lay off the lengths of the two known lines A-B and B-C. Bisect the total length A-C at the point O; from this point, with a radius O-A or O-C, describe the semi-circle shown. The perpendicular line B-D drawn from the juncture of the other two lines will be the mean proportional length.

Canada Gets Largest Increase in U. S. Coal.—Steady increase in coal exports from the United States during the last two years, despite an equally steady curtailment in fuel supplies to South American countries in an effort to handicap Germany's trade carried by neutral steamers, is shown in figures issued by the Bureau of Foreign and Domestic Commerce, Washington. Canada now is receiving the largest increase in fuel supplies, with smaller increases going to Panama and Cuba. Italy has received only 500,000 tons in ten months this year, compared with 1,665,000 last year.

NEW PROJECT FOR ABSTRACTING NITROGEN FROM AIR

IT is interesting to note that the fixation of atmospheric nitrogen is being undertaken on a commercial scale in England. The process to be employed bears the name of a well known inventor, Mr. Kilburn Scott, and depends on the action of intense electric arcs to liberate the nitrogen from the air and accomplish its fixation for commercial purposes in the form of nitric acid gas.

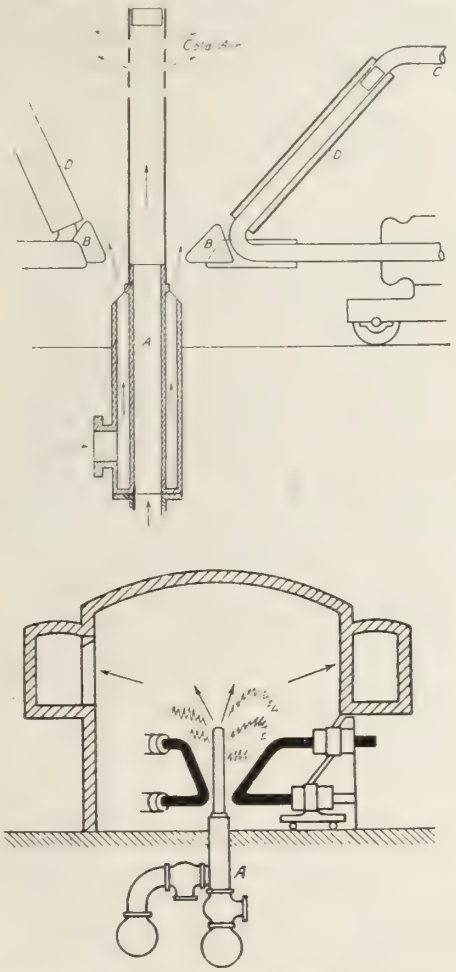
The operation is carried on in a special fire brick lined furnace in which are mounted the three horn-shaped electrodes spaced at 120 degrees to one another and surrounding a central air supply pipe. Each horn electrode approaches close to, but does not touch, the central pipe at its lowest tip and diverges sharply upwards. The general arrangement is shown in the accompanying illustration reproduced from the patent specification.

An alternating 3-phase current is utilized, each electrode being connected with one of the supply wires. The air pipe A is grounded and forms the neutral point of a star-connected 3-phase system of which the three alternating but practically continuous arc flames represent the load on the system. The arcs are driven upwards by three blasts of air which issue from the outer tube of the central pipe. The inner tube projects upwards to a point about level with the top of the electrodes and at this point there are three more nozzles supplying air under pressure. These blasts provide the cold zone which is necessary for the fixation of nitric acid gas. The air which drives the arcs upwards is preferably at a high temperature, but the air which emerges from the top of the pipe must be as cool as possible.

Due to the intense heat to which the pipe and electrode parts are subjected, provision is made for renewing parts that are liable to be burned away. The cold air pipe is surrounded by a tube which is easily renewable, and the electrodes C which are made of steel tubing through which cooling water is circulated, have renewable clips D to protect them.

The mixture of nitric acid gas and cool air is drawn off through large sized openings and passes to flues which connect with the various furnaces.

The initial installation is of 1.000 electrical horsepower capacity which will be increased if the results come up to anticipation. It is claimed on behalf of the process, that it enables nitric acid to be produced with considerable profit, the output per kilowatt



ARRANGEMENT OF ELECTRODES IN APPARATUS FOR FIXATION OF NITROGEN FROM THE ATMOSPHERE.

year being 1½ tons, which at the prevailing prices for electric power and manufactured product leaves a good margin of profit.

ELECTRIC POWER IN BULK

By L. E.

EVERY year more and more attention is given to the supplying of power in bulk to manufacturers in rural districts, and a good deal of friction frequently arises between the large power companies and those municipalities who seek to develop their outlying districts. It may be said that up to the present this rural business has not been sought after in the British Isles as diligently as might have been the case. It is perhaps due to the fact that the possibilities of its development have not been estimated at full value, or possibly the parties interested have devoted more attention to the business which is nearer home and which is more immediately remunerative.

The cost of transmission is always a serious item when the sale of power in bulk is being considered. One company has increased the distances between supports gradually until they now have solid copper conductors operating with perfect satisfaction in spans of 250 feet. How much further they can extend is now a matter for experiment, but above 250 feet it would seem that local atmospheric conditions would have an important bearing on the subject.

Composite Conductors

Possibly copper-clad steel or other combination of metals may render it possible to increase that distance and so enable distribution to be carried out at a less cost per mile. Steel or reinforced concrete posts which are now being used in some localities may eventually do much to solve the support problem, for the simple reason that the maintenance of poles is a considerable item where the poles form a large proportion of the invested capital. Insulated copper is, of course, out of the question for rural work, as its increased weight shortens the spans, thereby raising the cost of supports, and the insulation neither adds any factor of safety nor decreases the cost of the supporting insulators.

There is some divergence of opinion as to the voltage which is best adapted for rural district supply and also as to the scheme of transformer connections which it is best to adopt as a standard. In the majority of cases 110 volts can be used for single, and 220 volts for polyphase work, as this perhaps offers the most flexibility of any scheme of secondary voltages. On the primary side may be used delta connected three wire 6,600 volts, and 2,200 volt systems.

A Desirable Circuit

There is of course much to be said in favor of 4,000 volt or 11,000 volt, star connected, earthed neutral primary circuit for rural work, as according to A. S. Hall, who has had a great deal of experience, it has the advantage of fewer earths being necessary, thereby lowering earthing cost, and a further advantage of enabling the circuit to be cut out entirely by an automatic switch in case any of the three wires should be earthed, whereas the delta connected three

wire primary will sometimes operate with one wire down. An increase of voltage is possible, with a resultant lower copper cost, and a single wire can be run to handle singe phase distribution transformers using earth return. Further, if any earth fault should develop it will be on the high-voltage side, which is the voltage being earthed against, and by earthing the secondary also the consumer is rendered doubly safe.

A plan which is sometimes followed, and which has saved considerable first cost, has been the banking of transformers in multiple, on both primary and secondary sides. This is not good practice in town work, but the objections are not so apparent in rural distribution and there is a decided saving in both transformer and copper on account of being able to use larger transformer units, and so take full advantage of the diversity factor of grouped consumers.

ELECTRIC LOCOMOTIVES MAY SUPERSEDE STEAM

Actual want of any commodity provides the most direct appeal possible for its conservation. The use of electricity, instead of steam, on those portions of Canada's railways adjacent to waterpowers would materially reduce our dependence on the United States for coal. In 1916, the railways of Canada used 8,995,000 tons of coal, or about 61 per cent. of our total production. A writer in "Conservation" remarks that the increased price of coal may soon compel us to use hydro-electric energy extensively as a railway motive power.

Certain American railway companies have carried out extensive experiments in electrification within the past two years and many of the results are of more than ordinary interest. On its Rocky Mountain division, the Chicago, Milwaukee & St. Paul replaced its steam locomotives by electric. Electricity is decidely superior to steam in operating efficiency, especially in cold weather. Electric power made it possible to operate more trains over the same tracks and that, without the need for "helper" locomotives. Again, there was a great saving in terminal and round-house facilities, and the rolling stock was not subjected to as much wear and tear as when steam was used. This latter fact was largely due to the superior braking qualities of electric-drawn trains. Air brakes were not used on grades, except in cases of emergency. In fact, it was found that as much as 11.3 per cent. of the power consumed during the period of the test was generated by the trains themselves on the down grades. The experiment was so satisfactory that the company has decided to instal electric equipment on its Cascade division as well.

In a region so lacking in coal and so rich in water-power as is Central Canada, we may expect that, in time, the increase in the cost of coal will, in favorable situations, induce the electrification of part of our steam railway mileage. If the coal now consumed by railway locomotives could be turned to other productive uses, an important step would be taken in making Canada more independent of the American coal market. Concurrently with that advantage, the country's trade balance would be considerably improved.

THE LEAD ACCUMULATOR AS A FACTOR IN TRANSPORTATION

By C. T.

IT is a rather surprising fact that the lead accumulator, as a source of motive power for electric pleasure vehicles, trucks, factory trucks, etc., has not become more general, considering the number of good sound business reasons in favor of its use in such applications. A little study of the accumulator itself will enlighten the reader on the main conditions retarding its adoption.

Early Forms

The "box of power," which Lord Kelvin, then Sir William Thompson, was so enthusiastic about, when he received it from Paris, had a great many serious defects. It was the first of the lead accumulators, in which the oxides were pasted on the lead plates, instead of being formed on them by the electric current, in the expensive way that N. Plante had adopted. It was followed a very large number of other forms of pasted plates, all of which were subject to the same faults; the paste was liable to chip off, and the plates themselves tended to bend towards each other, thus short circuiting the cell and running it down. Then numerous forms of grids were adopted, all designed with pockets to contain the oxides, so as to prevent them chipping off. The trouble with these was the fact that the oxides change in volume, or tried to do so, very considerably, in the process of charge and discharge, because of small pieces of the oxides being forced out of the grids and hence short circuit followed sooner or later. The pure lead grids also were subject to the same trouble as the lead plates as they tended to buckle and bend towards each other, thus giving better chances for small chips of the oxide to lodge between them. The oxides which were pushed out of the grids also tended to build up a bridge at the bottom of the containing jars, thus short circuiting the plates, when the bridge was complete.

Improved Types

Steady continuous work of 30 years has gradually eliminated the major of these troubles; the oxides do not as readily come out of their grids, and when they do they are prevented from short circuiting the cells by perforated separators, and by providing the plates with feet, causing them to stand well above the bottoms of the jars.

But after all trouble is only overcome by continual care, periodical testing, and continual charging. In the process of both charging and discharging the lead accumulator, sulphate of lead is formed. During charge, if the operation is properly carried out, the sulphate is all converted into oxides; but if not, some sulphate remains, interfering with the working of the cell as explained below. In the process of discharging, the formation of sulphate goes on more or less continuously. Sulphate of lead is, to all intents and purposes, an insulator in the position it occupies in the lead accumulator. It also tends to break the circuit, to break the connection between the electrolyte and the lead grid. If some lead sulphate is allowed to remain when charging is complete, it practically screens the portion of the lead plate upon which it is formed, from the action of the current, the resistance of the cell being higher in consequence, and its output less. If the discharge of the cell is allowed to continue indefinitely, a screen of sulphate is gradually built up all over the lead grid, which completely puts the cell out of action.

Care of Cell

It is standard practice now to not discharge a cell below a pressure of 1.8 volts, and 1.85 volts is better; 2 volts being the initial pressure directly after charging is completed. The lower the pressure to which a cell is allowed to fall, the greater is the difficulty in restoring it to its normal working condition. As long as the discharge has not gone too far, and the pressure has not fallen too low, the cell can be restored by prolonged re-charging, sometimes with an occasional discharge. But the restoration is affected at the cost of the lead grids themselves.

The improvements in the lead accumulator have been very much quickened by the advent of a rival in the form of the alkali accumulator. Salts of nickel, and iron are employed, and the whole thing is constructed in a very much superior manner from mechanical point of view. The plates in the alkali accumulator are of steel plated with nickel; and the active materials are carried in perforated boxes made of the same material, the boxes being held in the steel plates in such a manner that there will be hardly any of the troubles that arose with the early forms of lead accumulator. The alkali accumulator furnishes a much lower pressure than the lead accumulator, 1.2 volts per cell, as against the two volts of the lead accumulator, but it is claimed that a smaller weight of cells is required to perform a given work.

MEANS OF PRODUCING HEAT FROM ELECTRICITY

THERE are two ways of producing heat from electric energy—by means of resistance and by means of an arc—and heat can be produced for use by either of these methods from direct or alternating currents, single or polyphase and at any commercial voltage. Hence, practically all heating devices in the market can be

operated from any available source of current. Of these two methods, that of producing heat by means of resistance (aptly termed the "Joulean Effect" since it is based on Joule's Law) is almost universally employed; about the only exception is that of the use of the arc in arc welding and arc furnaces.

Alternating Current

Moreover, due to prevalence of alternating-current supply throughout the country as well as its greater flexibility and efficiency when used over the wide range of voltages required by the various processes of application, alternating current is used in the great majority of cases. The use of the transformer with its many available taps makes possible the attainment of varying temperatures with an ease and efficiency that cannot be approached by the use of direct current, and as the heating unit load is practically noninductive and can be used in polyphase as well as single-phase circuits, the use of alternating curent for this work gives a unity power factor in almost every case and possesses many advantages over direct current. For instance, in order to obtain the low voltage used in spot welding from a direct-current supply, it would be necessary to employ a rheostat in connection with a specially wound low-voltage generator with the attendant large losses, while by the use of alternating current these voltages are readily obtained from practically any commercial supply circuit by means of the transformer.

One of the many advantages of electric heat is that it is susceptible of graduated and automatic control as to localization, time and temperature, to an extent and nicety impossible with any method of combustion. This is true whether the control be by hand or automatic, although automatic control permits of greater refinement than does hand control.

Control Methods

Varying heats, high, low and intermediate, are obtained with hand control by switching devices which connect the heating units or groups of units in series, in parellel or in series-parallel, much in the same manner as a four-motor street-railway equipment is handled, while if an alternating current is used, this same effect is also obtained by use of the delta-Y connection with constant voltage on the supply.

These different heats occur in certain well-defined and distinct steps according to the wattage produced by the various connections and grouping of the heating units, although in cases of small current demand, gradations between these steps can be obtained by means of a rheostat in the case of direct-current supply, and by varying the voltage on the secondary side of the transformer when alternating current is used.

In carrying on the various processes of industrial heating there is always a certain definite temperature that will produce the best results in the shortest time; which is best suited to any particular phase of the process, and it is the ability of electrically controlled units to not only meet and maintain this specific temperature to a nicety, but also to vary within a fraction of a degree with the temperature requirements of the various phases of the process, that makes the electric control stand out as superior to that employed by any method of combustion heating.—Society for Electric Development Bulletin.

ELECTRICAL NOTES

Watt Meter Reading.—In measuring the power on a three-phase power circuit withone single phase watt-hour meter, how should the readings be added up to get the total amount of power consumed by a motor?

Answer.—The arrangements can be made to vary, dependent upon whether it is required to make the reading once or for permanent use. To consider the first condition, number the three line wires as 1, 2, and 3. Connect the current coil of the meter in any one of the wires, say, No. 1. One end of the potential coil is already attached within the meter. Connect the other end to one of the other two wires, say, to No. 2. When the motor is running, take the readings by counting the number of revolutions of the disc in a given time and interpret this in watts according to the regular rules for reading meters. Now stop the motor and connect the current coil of the meter in main No. 3, leaving the potential coil unchanged. Take the readings under these conditions. If the motor is running "free" the chances are that in one of the two connections the meter disc will turn slowly backwards, and in the other positions it will turn faster forwards. In case these two directions are realized, the backward turns are to be subtracted from the forward. It will always be the case when the power factor is less than 50 per cent. When the power factor is just 50 per cent. the meter that turned backwards will completely stop. In this case the entire true power is recorded by the other meter. When the power factor is greater than 50 per cent. both meters will turn in the forward direction, but at different rates, and the sum of the two readings is to be taken. For the second condition—for permanent connections—you will need to set up an artificial "Y," say, for an approximate determination, by connecting incandescent lamps in series. Just the size and number to use would depend upon your particular voltage. The three ends represented by the Y are to be attached to the main line wires. The middle point of the Y serves for connection to the required terminal of the potential coil of the meter, the current coil being connected into any one of the mains. The meter will now record one-third of the total power, so the readings are to be multiplied by 3. An error in this method of determination is due to the fact that the potential coil has now but about three-fourths of the voltage impressed upon it as that for which the instrument was calibrated and it may run too slowly.—R. B.

* * *

Starting Box Connections.—A text book which I have on electricity shows the connections for a starting box on a direct current shunt motor, with the release magnet in series with the shunt field, but while making a repair on a starter for a 20 h.p. shunt motor in the plant where I work I noticed that the electro magnet was independently connected across the line and not in the field circuit. Would not the method given in the book be the correct way to protect the motor from dangerous speed if the field circuit was broken?

Answer.—A large number of present-day motors are designed for adjustable speed by shunt field control. The range of the shunt field current is so great that it is practically impossible to design a no-voltage release coil to go in series with the shunt field and work over this range. A coil in series with the field must be designed for a specified magnetizing current for the particular motor on which it is to be used, and this varies in differently designed motors of the same h.p. rating. In order to avoid these difficulties the coil is put across the line. It does not afford any protection against open circuit in the shunt field, this contingency being taken care of by the overload circuit-breakers or fuses in the line.—J. M. S.

* * *

Meaning of K.V.A.—Kindly explain what is meant by the following on a name-plate: 200 k.v.a, 5,000 alternations, single phase, 550-volt alternator? I wish to know the meaning of a kilovolt ampere; how it is obtained in this case, and its use in stating the rating of electrical apparatus.

Answer.—With direct-current the product of the number of volts by amperes gives the watts, and 1,000 watts, of course, is a kilowatt. The same is true of alternators when the circuit is simply straight resistance with no inductance. Such instances would be typified by incandescent lamp loads, furnaces, and the like. When motors, transformers, etc., are used, the current lags behind the volts in phase, and the instantaneous true power is not the simple product, but a number less than that; therefore, the kilowatts are less than the kilovolt amperes. As it is usually desired to keep track of the current capacity of the machine, the latter expression is the more useful. The term "alternations" is usually employed to give the number of single reversals per minute, a cycle being two complete alternations, and cycles per second, which is the more usual designation, being the number of double reversals per second. Thus, 5,000 alternations would then be regarded as $\frac{5,000}{120} =$ 42 cycles per second. The 200 k.v.a., 500-volt machine would then have a current capacity of 363 amperes, but the character of the load would determine whether 200 k.w. or less was in the circuit.—W. N. R.

WILL INVESTIGATE GAS PROBLEM

THE serious condition existing throughout South-Western Ontario as a result of the shortage of natural gas is to be investigated at once by the Ontario Railway and Municipal Board. The board will be asked to enquire into a number of things that are causing a great deal of ill-feeling and controversy in the district. On one hand it is charged that the producing companies are not producing up to capacity in order to further plans for getting new contracts at higher rates. Another complaint is that while some municipalities are getting an adequate supply of gas others, in which contract prices are lower, are going without.

PUMPS WANTED IN FRANCE

THE "Official Bulletin" of the United States Government announces that the following cablegram has just been received from the Paris headquarters of the American Red Cross:—

"'Send us pumps,' is an appeal to-day from a Red Cross delegate in the devastated area. The retreating Germans left little untouched there last spring. Spokes were cut from wheels of farm carts, orchards were felled, farmhouses wrecked. In many cases pumps were destroyed, wells filled with rubbish and polluted.

"Of the few men and women who have managed to filter back to live in the one good corner of their wrecked buildings, to clear the fields of barbed wire and try to till them, none dares drink from the old wells which they had depended on all their lives unless they bear a sign reading 'Good water,' to show that they have been purified.

"To these safe wells people come from far and near with their jugs and pails. To make their already difficult life a little easier and to make it possible for more of them to come back to their devastated fields—all they have—as soon as pumps can be brought, ten will be sent to fill the need for them in this district. It is a real though slight contribution to the giant task of reconstruction."

PULPWOOD REFORESTRY

THAT the greater portion of the cut-over pulpwood lands of Canada will take from 30 to 100 years to reforest themselves instead of about 20 years, as lumbermen have supposed, is the statement made by Dr. C. D. Howe, of the Faculty of Forestry, University of Toronto, to the Commission of Conservation.

Of special significance, in view of a possibility of the diminishing coal resources of the United States soon forcing Canadian railways to use hydro-electric energy for traction purposes, was the address of S. T. Dodd, traction expert of the General Electric Co., Schenectady, N.Y. He fully described the electrified western section of the Chicago, Milwaukee and St. Paul Railway, which covers a distance of 440 miles, and has found electric traction to be considerably cheaper than steam.

EFFICIENCY INSTRUMENTS FOR SMALL BOILER PLANTS

IT is the rule, rather than the excepiton, for designers and managers of modern, large size steam power plants, to spare neither pains nor expense in providing first class, labor saving, economy producing devices throughout the installation, knowing well, from past experience, that the saving effected by their use will more than repay that first cost involved.

How, then, is one to account for the pronounced lack of interes, which is characteristic of owners and managers of small isolated-boiler plants, in securing more efficient operation from their power units by instaling a few of the common, money-saving appliances? If this atttitude is due to a belief that the cost of such devices renders their use prohibitive except for the large stations, it is wrong. If it is the result of indifference, it is criminal. When it is considered that while the actual waste in fuel in any individual station may not be inordinately large, the sum of these preventable wastes taken from the thousands of small capacity plants, must represent in the aggregrate many thousand tons of coal per year. This is equivalent to squandering the rapidly dwindling coal resources of the country. Now, more then ever before, when the scarcity of fuel has become so acute as to constitute a grave national crisis, it behooves every steam producer to get the most out of every pound of coal, and this can only be accomplished by tackling the problem in a scientific way.

It is suggested by C. T. Baker, in a recent issue of "Industrial Management," that the small plant should be managed and operated along scientific lines as well as the big ones, but in carrying out the policy too much should not be attempted at once. Progress should be made a step at a time adding some new piece of apparatus such as a CO^2 recorder, flue gas thermometer, draft gauge, etc., as soon as circumstances permit, and making it a point to see that the operating force is thoroughly instructed in the use of such apparatus as fast as it is installed.

If the management and engineer of the small and medium sized plant will look over their apparatus carefully, and analyze their boiler plant operation fully, they will find many ways to effect a substantial saving at a relatively small outlay of money. In some instances, boiler efficiency can be so materially increased as to permit the shutting down of one or more boilers for a part of the day or night and may result in some cases in saving a considerable outlay of money for additional boilers, where it has been supposed that the boilers were overloaded.

ALCOHOL AS AN ENGINE FUEL

THE suitability of alcohol for generating power in the internal combustion engine has been sufficiently established by exact tests and by practical experience of alcohol motors for general purposes. The conclusion thus drawn is that, although the calorific value of alcohol is little more than half that of gasoline, the efficiency per brake horse-power is from 28 to 31 per cent. compared with that of 16 to 20 per cent. for gasoline. The higher efficiency of alcohol is due to severals factors, namely:—The volume of air required for complete combustion is about one-third of that required by gasoline, thus reducing the waste heat in the exhaust. This smaller dilution with air ensures more perfect admixture before the explosion and consequently favors complete combustion. The mixture can be subjected to a pressure of 200 lb. per square inch in the cylinder without spontaneous ignition; the saftey limit for gasoline is 80 lb. Mixtures of alcohol vapour and air containing from 4 to 13.6 per cent. alcohol are all explosive, whereas the explosive range of gasoline is from 2 to 5 per cent; thus requiring more exact adjustment of gasoline and air in the cylinder. The exhaust from the alcohol engine is smokeless and odorless and the products of combustion do not clog the cylinder valves.

CARBON BRIQUETTES WOULD SAVE MONEY

TO save from 45 cents to $2.50 per ton is a possibility for the anthracite coal users of the Prairie Provinces. In 1916, Canada imported 4,570,000 tons of anthracite coal, nearly all of which was used for domestic purposes. Of this, about 400,000 tons were shipped to destinations in Manitoba and west thereof for domestic use. As the eastern portion of Saskatchewan forms the competitive area between supplies of United States coal on the one hand and the high grade bituminous coal of the Rocky Mountains on the other, the cost of coal in that portion of the province is high.

An investigation undertaken by the Commission of Conservation in co-operation with the Advisory Council for Scientific Research shows the economic possibility of manufacturing a high-grade fuel from the lignites of Saskatchewan. The results are published in the pamphlet "Carbonizing and Briquetting of Lignites." Carbonized lignite briquettes are stated to be practically equal in heating value to anthracite coal. They will, therefore, stand comparison very closely on the basis of cost. An examination of the accompanying table will show that the difference in favour of briquettes as compared with anthracite coal varies from 45 cents per ton at Portage la Prairie to $2.50 per ton at Moose Jaw. This allows a profit of $1.00 per ton to the producing plant having a capacity of 30,000 tons per annum. With a capital cost of $400,000, this would return 7½ per cent. on the investment. The lower price of carbonized briquettes would mean a large saving to consumers in western Manitoba and Saskatchewan and a plant such as that referred to would save some $225,000 to the country annually which is now being paid ti American coal producers.

Steam and Its Generation

EFFECT OF BRICK ARCH ON SMOKE ABATEMENT*

By J. T. Anthony**

THE hard service and almost continuous variation in load under which locomotive boilers are operated renders the results submitted by the author of more than passing interest, and much of the data given will be found capable of immediate and profitable application to many stationary boilers.

The Master Mechanics' Proceedings of 1913 contains the report of the smoke committee appointed by the General Managers' Association of Chicago, which states that "while running, the brick arch is capable of making a 50-per cent. reduction in smoke, irrespective of steam jets."

The tests upon which this statement was based were run with Penn gas coal of the following composition: Fixed carbon, 57.74 per cent.; volatile matter, 34.07 per cent.; moisture, 1.05 per cent.; ash, 7.14 per cent.; B.t.u. per lb. of dry coal, 14,520. The smoke reduction of 50 per cent. was accompanied by an increase in evaporation of 8.6 per cent. due to the arch.

Results With Brick Arch

The Chicago Smoke Commission (of which Dean Goss was chief engineer) made extensive tests, with and without the arch. They found the brick arch to achieve the following: Decreases the average density of visible smoke emissions, 33 per cent.; decreases the total average quantity of cinders and fuel dust emitted in smoke, 25 per cent.; decreases the amount of carbon contained in cinders and fuel dust per ton of coal consumed, 24 per cent.; decreases the amount of ash contained in same, 28 per cent.; decreases the volume of air intermingled with gases of combustion discharged through stack, 15 per cent.; increases the volume of CO_2 discharged through stack, 6 per cent.; decreases the volume of CO discharged through stack, 10 per cent.; increases evaporation per pound of coal, 7 per cent.

These Chicago tests were run with coal from McCoupin County, Illinois, of the following composition: Fixed carbon, 37.47 per cent.; volatile matter, 38.41 per cent.; moisture, 9.89 per cent.; ash, 12.23 per cent.; B.t.u. per lb. of dry coal, 12,884. Both tests were run with a locomotive having a narrow firebox, 40 in. wide by 106 in. long, with 29 sq. ft. of grate area. The air inlet through ashpan was 5.7 sq. ft., or 20 per cent. of the grate area. The arch was 66 in. long and was supported on two arch tubes.

The final conclusions of the foregoing test report also state that "the presence of the brick arch in the locomotive firebox increases efficiency and decreases fuel consumption, decreases the loss of heat units in smoke and ash discharged and reduces the visible smoke. The use of incorrect methods of firing, as indicated by the results of tests in which inexperienced firemen were employed, reduces efficiency, increases fuel consumption and fuel losses and increases smoke discharges."

Smoke Reduction

Tests recently conducted on a Mikado-type locomotive shows smoke reductions varying from 50 per cent. at low and medium rates of firing to 31 per cent. at high rates. The locomotive was hand-fired, using high-volatile Pennsylvania gas coal screened over a 1¼-in. mesh screen; the coal having the following composition: Fixed carbon, 54 per cent.; volatile matter, 31 per cent.; moisture, 0.92 per cent.; ash, 14.08 per cent.; B.t.u. per lb. of dry coal, 13,088. This locomotive had 70 sq. ft. of grate area; a barrel combustion chamber 42 in. long; a 76-in. arch supported on four 3-in. arch tubes; an air opening through ashpan of 7.80 sq. ft. (or 11 per cent. of the grate area) and air openings in grate of 20.21 sq. ft. (or 28.8 per cent. of the grate area.)

In these tests the increase in evaporation, due to the arch, varied from 8½ to 15½ per cent. These three tests are probably the most thorough and reliable that have ever been conducted for the specific purpose of determining the effect of a brick arch on locomotive smoke abatement; and the test results—a reduction in smoke of from 30 to 50 per cent.—are corroborated by the practical experience of railroad men throughout the country. The principal measures taken by railways to-day to meet smoke ordinances consist of issuing firing instructions and equipping locomotives with brick arches.

The formation of smoke is due primarily to the decomposition of the volatile hydrocarbons contained in all bituminous, semibituminous and lignitic coals; though the presence of coal dust that is fed into the firebox, caught up by the draft and whirled out through the flues unburned, adds to the smoke emissions.

As the name indicates, the volatile hydrocarbons are compounds of carbon and hydrogen and are of a very complex character. The heavier compounds are driven off in the form of tar, in a semi-liquid or solid state; while the lighter hydrocarbons are driven off in a gaseous state. The distillation begins at a temperture around 40 deg. F. and is completed at a temperature of 1,600 deg. F. The decomposition of the volatile matter by the action of heat takes place readily at temperatures above 1,400 deg. F.

The exact composition of the hydrocarbons when first distilled from the coal at the different temperatures is not known, as they break down so readily under the influence of heat and are so unstable that it is impossible to collect samples for analysis. The indications are, however, that the heavy hydrocarbons, when first driven off, contain (by weight) about 85 per cent. carbon, 10 per cent, hydrogen and 5 per cent. oxygen. Under the influence of heat, these hydrocarbons break down into carbon, hydrogen, oxygen, lighter hydrocarbons of the methane (CH^4) series and lighter unsaturated hydrocarbons.

The hydrogen, a colorless gas, is highly inflammable and burns readily if there is an oxygen supply above the fuel bed. The lighter hydrocarbons also burn readily if the oxygen supply is sufficient. If it is insufficient, the hydrocarbon is broken down by the heat into carbon and hydrogen, the hydrogen either combining with the oxygen that may be present, to form water, or escaping into the flues unburned.

Soot Formation

Carbon does not exist in a gaseous state at temperatures with which we are familiar in furnace practice; so that when the vrious hydrocarbons are decomposed, the carbon is precipitated as a solid particle in the form of soot; and these incandescent particles floating in the flame give it the luminous color.

The particle of soot (resulting from the breaking down of the hydrocarbons) is well on its way to the flues at the instant of its formation. As was previously noted, it is not brought into violent mechanical contact with a supply of oxygen, but floats along in an atmosphere that has been robbed of much of its oxygen in passing through the fuel bed. The temperatures prevailing in the upper part of the firebox are sufficiently high, generally, to insure ignition and combustion; but under ordinary conditions the

*Abstract of paper read at convention of Smoke Prevention Association, Columbus, Ohio, September, 1917.

**American Arch Co., New York City.

time available for combustion varies from 1 5 to 1 10 of a second, and this is insufficient.

The small quantity of oxygen above the fuel bed; the difficulty of bringing the oxygen in contact with the soot, due to ineffective mixing of the interference of the large volumes of inert and noncombustile gases; and the short time available for combustion, make the burning of soot and the elimination of smoke in locomotive operation a rather difficult matter.

With the conditions that prevail in the locomotive firebox, it is easier to prevent the formation of soot (or smoke) than to burn it when once formed. The precipitation of soot can be prevented by having an excess of heated air (or oxygen) above the fuel bed and bringing this heated oxygen in intimate contact with the volatile hydrocarbons at the instant they are distilled off.

Research work done by the United States Bureau of Mines indicates that the hydrocarbons are decomposed when they have traveled but a few inches from the top of the fuel bed; and if the precipitation of carbon is to be prevented, the air (or oxygen) must be introduced at the top of the fuel bed and intimately mixed with the issuing hydrocarbons.

Arch Mixes Gases

The chief function of the brick arch in abating smoke is that of a gas mixer. By baffling and compelling all the gases to pass through a relatively restricted area above the arch, an intimate mixture of the volatile combustible with the oxygen is insured. While the mixing of the gases at the end of the arch does not take place soon enough to eliminate smoke entirely it has the effect of reducing the smoke emissions, as shown by the tests quoted.

With a firebox without an arch with a characteristic fire—that is, with a bank of green coal under the fire-door, the fire gradually thinning down toward the front end of the grate, where the draft has possibly pulled a hole in it—the bank of green coal under the door is expelling large volumes of rich hydrocarbons, which, passing up along the top zone of the firebox, are decomposed by the heat, causing the formation of soot, which either escapes at the front end as smoke, or is deposited on the heating surfaces to retard the flow of heat. At the same time a large excess of air is rushing through the thin portion of the fire on the front of the grate and is passing directly into the lower flues, without in any way aiding the combustion of the hydrocarbons being distilled in the back of the box, and very often causing flue leaks or failures.

Such conditions are not at all uncommon in locomotive fireboxes unequipped with the arch. Front-end gas analyses often show a large excess of oxygen, due to the blast of air through lower flues, in combination with high carbon-monoxide, hydrogen and hydrocarbon contents, due to incomplete combustion of the volatile hydrocarbons arising from [illegible] under the door.

Where the arch is provided, any excess air coming through the thin portion of the fire on the front of the grates is heated up, deflected and forced back over the end of the arch, where it is mixed with the gaseous combustibles rising from the green coal under the door. With the ordinary type of firebox, the combustion chamber space and the flameway are insufficient to give all the particles of soot and combustible gas time to burn before reaching the flue sheet; but such a mixing as the arch affords results in a material reduction of the smoke, and under moderate rates of firing will result in almost complete combustion of the combustible gases.

Green Fire Conditions

The arch, however, is not sufficient to eliminate smoke when the method of firing here described is followed. A heavy bank of green coal restricts the flow of air at the point where it is most needed and at the time when it is most needed, with the result that most of the hydrocarbons are broken down and the carbon precipitated before being brought into contact with the oxygen entering through the front grates.

A similar condition prevails where the banks cause a restricted flow of air through the fuel bed at the points where the maximum distillation of hydrocarbons is taking place.

A light, level fire should be carried if smoke is to be reduced to the minimum. With the fuel bed in this condition and a "scatter" type of firing being followed, a uniform air supply is obtained throughout the fuel bed, as well as a uniform distillation of the hydrocarbons. This facilitates the mixture of the oxygen and the hydrocarbons from the time they leave the top of the fuel bed, the arch merchanically accelerating this mixture.

Some authorities state that the decomposition of the hydrocarbons is caused by heating them up with an insufficient air supply and then bringing them in contact with the cooler heating surfaces or a draft of cold air. While later evidence tends to prove that this decomposition is caused entirely by heat, shafts of cold air through the firebox are objectionable, both from the viewpoint of combustion and that of boiler maintenance.

Where the arch is used, shafts of cold air entering through the fire-door and holes in the fire are made to mix and mingle with the products of combustion and combustible gases, thereby aiding combustion; and being brought to the temperature of the other gases are prevented from causing uneven temperatures or violent fluctuations at the flue sheet.

Intelligent Firing also Needed

It is evident from the foregoing that the arch is not in itself sufficient to prevent smoke. Intelligent firing is also necessary. Smokeless firing and intelligent firing are almost synonymous, although there are conditions under which smokeless firing is impossible, regardless of the care and intelligence exercised by the firemen.

In some quarters, however, there has been prevalent an idea that smoke was mainly a nuisance and that the emission of dark clouds of smoke did not signify any appreciable heat loss. As a matter of fact, the emission of smoke not only indicates bad furnace conditions, but in many cases the soot and tar escaping as smoke may contain from 10 to 15 per cent. of the heat value of the coal; and this will account from a considerable portion of our "unaccounted-for" heat losses. Tests conducted by the United States Bureau of Mines (set forth in Technical Paper 137) showed that when burning Penn gas coal as much as 32 per cent. of the combustible rising from the fuel bed is accounted for in the soot and tar which is the source of smoke.

In his original paper the author goes ion to show the effects of the arch in different types of locomotive fireboxes and to suggest improvements in design. Several illustrations are also shown. Written discussion of Mr. Anthony's paper was presented by F. S. Deveny, of the Baltimore & Ohio R.R., Chicago, in which he corroborated Mr. Anthony and gave data on the maintenance of arches.

GAS FIRING AND REGENERATIVE SETTINGS

By T. J.

IN the earlier days of gas firing, as applied to retort settings, there were some rather vague ideas current as to the economy just effected. The saving of fuel consumption and the higher working temperatures attained in the retorts were often too hurriedly attributed to the recovery of waste heat. Waste heat is, of course, recovered, and returned to the setting in the preheated secondary air, but all the advantage does not lie merely with this recovery.

The advantages of gas firing as ordinarily practised are chiefly in three directions:—(1) The application of heat. High temperatures are generated in close proximity to the retort, and not as with direct firing at a considerable distance away, where much of the heat applied is in the form of much cooler and rapidly cooling convection currents of gaseous products. The study of flames may be applied with advantage to the question of gas firing of retorts, which is really a question of the application of flames. (2). The regulation of air. This can be accomplished to a very fine point so as to avoid the drop of available temperature due to the admixture of a large excess of air. (3). Regeneration or recuperation. Much heat is in waste products, i.e., gaseous products of combustion (mixed with air), which have passed the retorts and are on their way to the chimney. Any of the contained heat that can be transferred to the incoming air (usually the secondary air) is so much pure gain.

In Europe regeneration and recuperation of heat are used pretty much as interchangeable terms. In America recuperation is applied to the process by which (as in retort settings) the heat of the waste gases is transmitted through the walls of a flue and is given up to the air in an adjoining flue, while regenera-

tion is there chiefly confined to the recovery of heat from heated chequer work over which the hot waste gases are first passed, and then by a change-over valve the incoming cold air is led over the same chequer work. Regeneration in this sense was tried on gas works, but its use was not long continued, though the same arrangement is successfully used on some coke-ovens, notably the Simon-Carves type.

Recovering Waste Heat

It is often too rashly assumed that all the heat taken to the combustion chamber by the secondary air of an ordinary retort is this recovered waste heat. It is usefully applied heat, but not necessarily all waste heat. Some of it may be initial heat. In cases where the secondary air travels are placed between the waste gas flues and the furnace, some of the heat in that air will undoubtedly be derived from the furnace. As the air is ceaselessly passing through these flues, and thus tending to cool them, this constitutes a drain upon the heat resources around the flues, and thus will certainly withdraw some of the furnace heat. Whether this procedure may be right or wrong may be open to discussion.

It is all to the good to get the secondary air as hot as possible; but no mistake should be made by considering the heat it withdraws from the neighboring furnace as recovered waste heat. It is abstracted initial heat, and its loss tends either to increase the fuel consumption or to lower the temperature of the producer gas. It may seem unnecessary to labor or even to mention the point, but the heat that can be produced from a given weight of a given coke is fixed and unalterable, whether the coke is burning direct to the carbon dioxide, as in direct firing, or first to the monoxide and then to the dioxide, as in gas firing. Still the idea lurks around in some minds that gas firing actually produces more heat from the fuel.

What gas firing really does is to transfer much of the heat production from the generator to the actual setting some 70 per cent. of it. In the same way the use of water on the fire bars, which when vaporized and passed through the furnace generates some water gas, does not furnish any new source of heat. Whatever heat is given out by its combustion exactly balances the heat abstracted in its formation. All that is gained in a thermal sense is the transference of heat from the lower part of the fire, where a high temperature favors the formation of clinker, to a high zone where it is more useful and less likely to entail harmful secondary effects, such as fusing the ash into clinkers.

STEAM TURBINES v. DIESEL ENGINES

IT is sometimes remarked as a curious fact that the Diesel engine, whose fuel is oil, finds little favor in the oil regions of the United States. The explanation is, of course, that where fuel is cheap, the most economical type of power plant is one which entails the lowest first cost and the lowest maintenance charges rather than one which can show the highest thermal efficiency. This is one particular instance of the way in which the various factors which determine the choice of a prime mover vary according to the locality and to the conditions of each separate case. Another consideration, which may in extreme cases become decisive, is the load factor of the plant. Obviously, if a power plant is to work only intermittently, the extra capital charges on a highly efficient plant may easily outweigh the saving on the fuel due to the greater efficiency.

The cost of water is another factor in the equation. As between the Diesel engine and the steam turbine scarcity of water will sometimes turn the scale in favor of the Diesel, even when other weighty factors are against it, since about twelve times as much water is required for condensing purposes with steel turbines under general conditions as is needed for jacket cooling with a two-stroke Diesel engine, while four-stroke engines need only one-twentieth the water. In a paper read before the American Institute of Mining Engineers, Herbert Haas sums up concisely the economic considerations governing the choice between steam turbines and the Diesel engine in Western America. Where fuel is dear and the load factor is high, the Diesel engine has the pull; where contrary conditions exist the steam turbines come out the best except where the instant readiness of the Diesel engine gives it preference, and installation cost is of secondary importance. Here it is necessary to balance the cost of keeping boilers under steam continuously against the difference of interest charges of steam turbine and Diesel engine plants. For power plants erected at the source of the fuel either on the oilfields or at the coal mines prime movers will be selected costing least to instal, i.e., steam turbines, since fuel expenditure will weigh less than interest and redemption charges.

In many cases combination plants using Diesel engines for supplying power continuously against the constant main load, and steam turbines for furnishing periodically occurring peaks by the same use of high duty boilers with large water and steam spaces, capable of being forced when necessary, will prove most profitable. Up to capacities of 1,000 horse-power steam turbines can compete with Diesel engines only in special cases, such as supplying exhaust steam for heating purposes. For such small units, particularly for greatly varying loads, reciprocating steam engines are preferable. For larger plants than from 1,000 to 10,000 kw. capacity careful analysis must be made of the relative advantages of Diesel engines and turbines, a knowledge of the load factor, fuel prices, and water conditions being necessary. For power plants larger than 10,000 kw. using units from 6,000 kw. upward steam turbines have the preference, unless a combination of high load factor, high fuel cost and poor water conditions favor a Diesel plant.

WRECKING OF 50-TON AMMONIA COMPRESSOR

THE following particulars of an accident that wrecked a 50-ton amonnia compressor at St. Louis recently are of particular interest in view of the age of the machine, 25 years, which had presumably been free from previous mishap. The compressor was a single-acting machine of the double, vertical, Corliss-engine-driven type installed about 25 years ago. According to the facts as published in "Power," the accident appears to have resulted either from sticking of the discharge valve of the left-hand cylinder or from an accumulaltion of weak liquid ammonia in the suction piping.

The fact that the machine had been standing idle for several weeks, thus giving the slight percentage of water vapor in the ammonia gas ample time to gather in considerable bulk by precipitation in the pocket formed in the piping just outside the suction stop valve, supports the latter assumption. With the second or third discharge stroke of the left-hand piston a tremendous thump was heard, and the vertical frame upon which the cylinder rests, and which is forked front and rear to form four supporting columns at the base, snapped in three places, thus allowing the cylinder to be forced upward. The resulting strain on the 4-in. discharge piping caused a fracture of the sweep tee, which joined the branches from the two cylinders with the main discharge line.

Two oilers, who were standing on the upper gallery at the moment, leaped to the floor below, and besides the injuries thus sustained, were severely burned and partly blinded by the escaping ammonia. The machine is fitted with the customary by-passes for pumping out the cylinders and contiguous suction and discharge piping by means of one of the compressors in operation. The by-pass valves had been opened before the engine was started, and what was deemed ample time was allowed for cleaning the system of any liquid accumulations.

On account of the staying of the wrist-plate stud by means of hog-chains passing fore-and-aft along the face of the wrist-plate and thence diagonally to fastenings at the ends of the cylinder, the starting bar could not be used for the usual preliminary working of the engine valves by hand.

Hydro-Electric Development. — The development of hydro-electric power in Canada, and especially in the Provinces of Ontario and Quebec, during the last ten years, has been almost incredible. At the beginning of the work of the Ontario Hydro-Electric Commission, the late Premier, Sir James Whitney, stated the Commission would not require so much as 10,000 h.p. There is now, in round figures, an immediate demand for 300,000 h.p., and the demand cannot be satisfied.

COMBUSTION EXPERTS CO-OPERATE WITH MANUFACTURERS' ASSOCIATION

UNDER date of January 10 the Canadian Manufacturers' Association have issued circular letter No. 151 to Quebec, Ontario and Manitoba members, advising manufacturers that the following gentlemen, all well versed in the economics of combustion, may be freely consulted, without charge, by those who feel the need for expert advice in the solution of their fuel problems:

Alfred Balmfrith, chief engineer, McGill University, Montreal, Que.

Olaf E. Granberg, vice-president, Boiler Inspection and Insurance Company, 227 Board of Trade Building, Montreal, Que.

W. F. Grazes, chief engineer, Montreal Tramways Company, Montreal, Que.

James A. Milne, electrical and mechanical engineer, Works Department, City Hall, Toronto, Ont.

H. N. Roberts, president, Boiler Inspection and Insurance Company, Continental Life Building, Toronto, Ont.

J. O. B. Latour, chief engineer, General Accident Assurance Company of Canada, Continental Life Building, Toronto, Ont.

A. L. G. Taylor, resident inspector, Boiler Inspection and Insurance Company, Electric Railway Chambers, Winnipeg, Man.

The following series of "Dont's" has been drafted by Mr. Latour and the association executives request that recipients pass it on at once to their engine room staff in order that they may get full benefit from the timely advice to firemen and engineers:

All of these gentlemen have volunteered for the service from a sense of national duty. They cannot, of course, neglect their regular work, but as far as their time permits all of them will be glad to give their best help to manufacturers calling upon them.

USES OF COAL-TAR PRODUCTS

By O.C.

WOOD, when exposed to moisture or set in water, may decay through the action of different organisms or fungi, or it may be destroyed by insects. To prevent this the timber is soaked in some chemical which will act as a poison to such enemies. Mercuric chloride, copper sulphate, and zinc chloride are examples of suitable poisons, and of these the last named is widely used. They are, however, all soluble in water, and may be rather quickly washed out by rain, etc. Creasote oil, on the other hand, is an efficient preservative which is insoluble in water, and consequently is more permanent in its action. It gradually evaporates, but if a heavy oil be chosen, the rate of evaporation is very slow. Creosote oil is the most suitable material for timber preservation, and is most used in Canada. Coal tar, also insoluble in water, is often used, but its penetrating power is very small.

The wood to be preserved by creosote is put in iron tanks, which are then closed and evacuated; the heated oil is now run in and the wood allowed to remain immersed under pressure for some time to ensure the complete filling of the pores. The preservative, to be effective, should contain high-boiling oils; for general purposes not more than 50 per cent. of it should distil below more than 315c. But for wood paving blocks not more than 55 per cent. should distil below that temperature. Economy of creosote oil can be obtained by the use of an inferior oil, which would be mixed hot, in the proportion of 80 parts oil to 20 parts of coke-oven tar, the latter containing not more than 5 per cent. to 6 per cent. of free carbon. The penetration of such a mixture is not less than that of the creosote oil, if the time for which the timber is kept under pressure be slightly increased.

On the American continent the demand for creosote oil is much greater than the supply. In 1913 the United States consumed, for timber preservation, over 90 million gallons (Imperial) of the oil, and of this 62 per cent. was imported from Europe. Between 60 per cent. and 70 per cent. of the total quantity of oil consumed was used for the treatment of railway ties, some 25 million being thus treated. In Canada, 19 million cross ties are used annually, and only about 10 per cent. of these are creosoted; but even for this comparatively small number Canada does not produce sufficient creosote oil. If all the tar produced in gas and coke-oven works in Great Britain were distilled, the home supply of creosote oil would still be quite unequal to the demand, and tar distillers would therefore be certain of a sale for one of their most important products.

Raw tar is sometimes used in the making of roads, but it is better to employ the prepared or dehydrated tar. This is generally poured or sprayed on existing roads. In dry weather it serves to keep the surface free from dust, and in wet weather it protects the road material from the distinegrating effects of water. In the actual construction of roads, coal-tar pitch and asphalt are much used instead of tar. Coal-tar asphalt is made by mixing pitch with suitable quantities of creosote and anthracene oils; and although it cannot entirely replace the natural asphalt in street paving, it is a very good substitute. For making sidewalk, a mixture of coal-tar pitch and natural asphalt is often employed, sandy material being ground up with the mixture, which is then melted and mixed with gravel. The use of pitch, etc., in the making of roads is increasing rapidly, and even at the present time there is a good demand for this residual material from the distillation of coal-tar.

Other Products

Carbolic acid, another coal-tar product, in its pure crystallised state, is used for medicinal purposes as an antiseptic, etc., but it has a much wider application in the crude state for disinfectant purposes generally. The impure carbolic acid has a strong unpleasant smell. It becomes partially liquid on standing, and in this state is much used for disinfecting sewers, stables, etc. Various preparations of carbolic acid or other phenols are made to render the application of the disinfectant more convenient. The most important preparations are those in which the phenols are combined with soap; but carbolic-acid powders, which are mixtures of carbolic acid and lime, etc., are extensively used. Naphthalene sometimes replaces carbolic acid, as a disinfectant, being used in sick rooms, etc., and is often preferable to carbolic acid for the dressing of wounds.

FUEL SAVING "DON'TS"

By J. O. B. Latour, Chief Engineer, General Accident Assurance Co., of Canada Toronto, Can.

1. DON'T fill the furnace with the intention that there will be no necessity for any additional fuel for the next two to four hours. This is quite a common practice with heating boilers, and with bituminous fuel results in very great waste.
2. DON'T regulate the draft by closing the ash pit door, but regulate it with a damper in the smoke flue or pipe between the boiler and the chimney. This also applies to any kind of furnace.
3. DON'T allow any cracks in the brick setting of the boilers, because cold air will enter through these cracks and absorb the heat that should have been transferred to the boiler.
4. DON'T permit the use of grates of any kind which are in bad condition. This will permit the unconsumed fuel to fall through to the ash pit and be shovelled out as ashes or waste.
5. DON'T use a grate that is larger than will permit the burning of at least 12 lbs. of coal per sq. ft. of grate per hour.
6. DON'T permit any pipes or boiler surfaces to remain uncovered, unless it is necessary to transmit the heat through the surface of that pipe to the room in which it is located.
7. DON'T permit any joint in the boiler or any pipe connected thereto to leak.
8. DON'T permit any valve to leak which is located on a pipe supplied by the boiler. This is a very common source of loss. All valves should be positively tight when closed.
9. DON'T attempt to control the quantity of condensation to be collected from any pipe or other apparatus by hand control. There are a large quantity of good serviceable traps to collect these returns of condensation and they should be returned from these traps to the boiler.
10. DON'T permit any surface on the boiler exposed to the furnace heat to become covered with soot or ashes. The tubes should be cleaned at the very least daily.
11. DON'T use live steam for heating rooms, liquids, or other substance when there is exhaust steam from engines or pumps available. If the exhaust steam is not of sufficient temperature to heat the room, the liquids, or other substance to the required temperature, arrange your heating to be done in two stages; for instance, water could be heated to nearly 212 degrees by exhaust steam, then passed through to another vessel to be heated to the desired temperature with live steam.
12. DON'T feed a boiler with cold water when there is exhaust steam available to heat it. Every eleven degrees in temperature that feed water is raised by heating by exhaust steam there is a saving of 1 per cent. in fuel, and in winter time especially feed water is very seldom any warmer than 42 degrees. If this water is heated 212 degrees it will then effect a saving of 15 to 18 per cent.
13. DON'T allow the main steam valves on any engine or pump to leak. This is a very common fault, due to the fact that the leak is not seen.
14. DON'T allow the piston of any engine or pump to leak. This is also a very common defect permitted to go on day after day simply because the leak is not seen.
15. DON'T take it for granted that pipes that lead to sewers, blow-off tanks, or other places of discharge, are tight. If the pipe is warm between the stop valve and the source of discharge it will generally pay to investigate a little closer, because it generally is a sure sign of waste with great profit.

Distributed with the Compliments of the
CANADIAN MANUFACTURERS' ASSOCIATION

Association and Personal

PERSONAL

Robert Law Benson, assistant city engineer of St. Boniface, Man., died at his home on Jan. 2, at the age of 53 years. Mr. Benson was a native of Hamilton, Ont., and had been in the Winnipeg vicinity nine years.

John M. Park, member of the boiler-making firm of Park Brothers, and one of Chatham's most prominent business men, died at his home on Queen Street, Chatham, Ont., on December 24. He was 57 years of age.

W. H. Milner, who was elected to the directorate of the Southern Canada Power Co. recently, at the annual meeting in Montreal, is president of the Miner Shoe Co., Maisonneuve, and vice-president of the Miner Rubber Co., Granby, Que.

William Earle, C. E., died last Saturday at the residence of his father-in-law, Senator Domville of Rothesay, near St. John, N.B. He had done engineering work with the C.P.R., was former manager of the St. John Street Railway, and latterly was District Engineer of Dominion Public Works in Manitoba.

Frederick Triebel died at Montreal on Jan. 1. Mr. Triebel, who was born at Cohoes, N.Y., 67 years ago, came to Montreal and entered the service of the Ogilvie Flour Mills, where he was head mill wright for twelve years. He was also for thirteen years mechanical engineer for the Canadian Rubber Co.

William Clark Hawkins, managing director of the Dominion Power and Transmission Co., of Hamilton, Ont., has been elected president of the Southern Canada Power Co., of which he was already a director. Mr. Hawkins was born at Orange, N.J., in 1866. He became associated with the D. P. & T. Co. in 1901, and was appointed managing director in 1912.

Lieut. George H. Forster, who, before going overseas was manager of the Linde Canadian Refrigeration Co., Montreal, has been badly gased in the recent fighting while serving with the British army. Although his condition is serious, there is hope of his recovery. Lieut. Forster joined the 148th McGill Battalion, under the command of Lieut.-Col. Magee, and left in 1916 for England, but later was transferred to the Imperial Forces.

C.A.S.E. Exhibitors' Association.—The 29th Annual Convention of the Canadian Association of Stationary Engineers will be held at London, Ont., June 25, 26 and 27. As unanimously decided at the last annual meeting, the usual exhibition of power plant supplies will be held. The feeling of the meeting was that the convention and exhibition teach economical and efficient methods in the power plant and thus assist in the national effort to induce industrial production. London is a good centre for the convention, being a large growing city in the centre of Western Ontario, with distributing lines leading to all the important towns and cities in the western part of the province. Full particulars regarding hall and other arrangements will be available at a later date. The secretary is Gordon C. Keith, 32 Colborne Street, Toronto.

HAMILTON BRANCH C.A.S.E. DISCUSSES FUEL AND FLUE GASES

A PRACTICAL and instructive paper, illustrated with diagrams on a black-board, entitled "Fuel and Flue Gases," was read by J. S. Cooke, Belleville, recently in the Orange Hall, North James street, to members of the local branch of the Canadian Association of Stationary Engineers. The meeting was presided over by John Hale, local president. The affair being open, many local engineers interested in the subject were in attendance. Mr. Cooke touched on troubles met with in the operation of boilers which the modern stationary engineer has to combat. The speaker emphasized the fact that through faulty construction of furnace chambers considerable fuel loss was caused by incomplete generation of available heat units, these escaping without serving their full purpose.

Mr. Cooke also touched on black smoke, which, he said, could be seen emanating from innumerable chimneys throughout Canada. If Canada's manufacturers and those in charge of government and municipal and other institutions would only seriously grapple with this very important question many thousands of tons of coal would be saved annually. The speaker also said that the elimination of the black smoke nuisance would be a boon to residents who were often heard to complain about dirty houses and soiled curtains, caused by the escape of the filthy black smoke.

"You can always be sure that when clouds of black smoke are being emitted from a chimney the combustion is not in the right spot," said Mr. Cooke, "and those in charge of such boilers should take steps to counteract the escape."

Mr. Cooke urged manufacturers to take more interest regarding the installation of their boilers and furnaces. Far too much was left to the stationary engineer. The lecturer was accorded a vote of thanks at the close of his paper.

For Tuesday, January 15, President Hale announced a social time and dance, also a musical evening. Supper will be provided. An invitation is extended to the wives and lady friends of members, also unaffiliated stationary engineers. The affair will be held in the Orange hall, North James street.

OPERATOR ORGANIZATIONS

British Columbia Association of Stationary Engineers, Vancouver.—Subordinate Lodges at Vancouver, Victoria, New Westminster, Cumberland, Merritt, and Fernie.

North-West Association of Stationary Engineers, Edmonton, Alta.

Manitoba Association of Stationary Engineers, Winnipeg.

Canadian Association of Stationary Engineers, Hamilton, Ont.—Subordinate Lodges at Montreal, Toronto, Hamilton, Ottawa, Brantford, Guelph, Kitchener, Chatham, Ont.; St. John, N.B.; Owen Sound, London, Stratford, Belleville, Kingston, Sudbury, St. Thomas, North Bay, Port Arthur, Sarnia, and Windsor, Ont. The executive officers of the C.A.S.E. Grand Lodge are as follows:—

Past President—W. G. Forbes, Montreal, Que.
President—R. F. Gofton, Kitchener, Ont.
Vice-President—Wm. Cooke, Belleville, Ont.
Treasurer.—A. W. Heath, Hamilton, Ont.
Conductor—S. Balmfirth, Toronto, Ont.
Doorkeeper—George Moll, London, Ont.
Secretary.—John H. Hale, Hamilton, Ont.

Power Canal Making Progress.—Excellent progress is now being made on the Chippawa Hydro-Electric Power Canal and the preliminary work has got well under way. The construction railway, which will carry away the material excavated, has been completed from the Whirlpool to the power house, and the rest of the line is being pushed forward. The Hydro engineers were handicapped by shortage of labor, but now about 350 men are employed. At the present time operations are being centred on the erection of a concrete bridge for the Niagara, St. Catharines and Toronto Railway tracks at Stamford, Ont. This is only one of about thirty bridges which will have to be built. The engineers are filling in a great many ravines around the Niagara River with the earth taken out in excavating the canal.

The MacLean Publishing Company
LIMITED
(ESTABLISHED 1888)

JOHN BAYNE MACLEAN - - - - - - - President
H. T. HUNTER - - - - - - - - - Vice-President
H. V. TYRRELL - - - - - - - - - General Manager

PUBLISHERS OF

POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air, and Water Power, and to the design and operation of Refrigerating Machinery.

J. M. WILSON, Editor. Manager: B. G. NEWTON.

Associate Editors:
A. G. Webster J. H. Rodgers

OFFICES

CANADA—
Montreal—Southam Building, 128 Bleury St., Telephone Main 1004.
Toronto—143-153 University Ave., Telephone Main 7324.
Winnipeg—1207 Union Trust Building, Telephone Main 3449.
Eastern Representative—E. M. Pattison.
Ontario Representative—S. S. Moore.
Toronto and Hamilton Representative—M. H. Woods.

UNITED STATES—
New York—R. B. Huestis, 111 Broadway, New York, Telephone 8971 Rector.
Chicago—A. H. Byrne, 900 Lytton Bldg., 14 E. Jackson Street. Phone Harrison 1147.
Boston—C. L. Morton, Room 733, Old South Bldg., Telephone Main 1024.

GREAT BRITAIN—
London The MacLean Company of Great Britain, Limited, 88 Fleet Street, E.C., E. J. Dodd, Director, Telephone Central 11960. Address: Atabek, London, England.

SUBSCRIPTION RATE

Canada, $1.00; United States, $1.50; Great Britain, Australia and other colonies, 4s. d., per year; other countries, $1.50. Advertising rates on request.

Subscribers, who are not receiving their paper regularly, will confer a favor by telling us. We should be notified at once of any change in address giving both old and new.

Vol. XI. JANUARY, 1918 No. 1

PRINCIPAL CONTENTS

Steam-Electric Plant, Dominion Power and Transmission Co.... 1-8

General 8-9

Southern Canada Power Co. Developments .... Canada's Coal Problem....Mails by Air Around World....Industrial Alcohol....Third Largest Dam in World in Quebec.

Modern Steam Power Plant and its Appliances—III..... 10-11

General 11-12

Canada's Trade Position....Industrial Development in Japan ....Each Man to His Material....The Cost of Leaking Steam....Storing Coal in Bulk....Mean Proportion.

Electricity and Hydraulics 13-15

New Project for Abstracting Nitrogen from Air....Electric Power in Bulk....Electric Locomotives May Supersede Steam....The Lead Accumulator as a Factor in Transportation....Means of Producing Heat from Electricity....Elec- [illegible]

General 16

Will Investigate Gas Problem....Pumps Wanted in France ....Pulpwood Reforestry .... Efficiency Instruments for Small Boiler Plants....Alcohol as an Engine Fuel.... Carbon Briquettes.

Steam and its Generation 17-19

Effect of Brick Arch on Smoke Abatement....Gas Firing and Regenerative Settings....Steam Turbines vs. Diesel Engines....Wrecking of 50-ton Ammonia Compressor.

General 20

Combustion Experts Co-operate with Manufacturers' Asso- [illegible] Use of Coal-Tar Products.

Association and Personal 21

Editorial 22

Conservation of Fuel.

The Operators' Point of View 23-25

Does a Piston Stop at Reversal?....Fuel Measuring Tank Safety Collars for Exposed Shaft Ends....Helpful Hints ...Handy Coal Conversion Scales....Clamping Block for Emery Cloth....A Water Level Alarm....Resistance of an Oil to Emulsification.

Operators' Instruction Course 26

[illegible] Pages IV

Progress in New Equipment 27

Selected Market Quotations 28

Trade Gossip, Catalogues (Advtg. Section) 46

CONSERVATION OF FUEL

PROMINENT among the many problems with which manufacturers have to contend at the present time, under the stress of economic production, is that of the conservation of fuel owing to the failing of the immediate supply available for industrial and domestic purposes. Existing conditions make it almost imperative that every possible means be adopted to avoid unnecessary consumption or waste of fuel. Measures may be taken, however, to minimize the use of coal to the detriment of other vital and equally important factors of shop or factory operation. Under present circumstances, with a very evident scarcity of fuel, manufacturers may be tempted to forego the heating of their plants during the idle period over the week-end and a corresponding reduction each night. It may seem ridiculous to maintain a fairly warm temperature in a shop from which the workmen are absent for a period of from 24 to 36 hours. While the fuel saving from such a practice would undoubtedly be of considerable importance, it might be well to give more than passing attention to the possible consequences incidental to the unavoidable fluctuation of working temperature.

In many factories or workshops the heating is accomplished by the circulation of the exhaust steam from the engine; in others, the system may be supplied from the live steam from the boilers, or by means of forced hot water or hot air circulation. In any case it is often found that the closing hour is not only a signal to the workmen to knock off, but may also indicate the closing—in whole or in part—of the valves that control the passage of the heating medium from the source to the different "unoccupied" portions of the plant. It is, however, considered advisable, particularly in very cold weather, to always permit sufficient steam or hot water to pass through the pipes to prevent the possibility of freezing. This invariably eliminates piping troubles but creates other contingencies having vital bearing, although seemingly unimportant relation, on the output of the shop.

Early on Monday morning—sometimes after the men have started work—steam is forced through the heating system to warm up the shop, and after a period ranging from ten minutes to perhaps a couple of hours the atmosphere is quite comfortable; but what of the equipment? Metal machinery, especially of a bulky character scattered about a spacious shop, will seldom attain a very high temperature, even in summer weather, unless subjected to the heat of an adjoining furnace or other radiating unit. When the workmen leave a factory and the heat is partly or entirely shut off the proportionately large volume of metal rapidly absorbs the heat from the atmosphere, and then continues to fall until the return of the men in the morning, when the machines are like so many blocks of ice. This order of things is not conducive to an early start, as the men seldom show any great desire to freely handle the cold equipment.

Apart from the evident inconvenience to the operators, the fact that unavoidable delay may be necessary in getting a machine into action, a cold shop is a thing to be avoided. Where accuracy is a feature of the work, and rigid inspection is adopted, it is essential that extreme variations in shop temperature be avoided as far as possible. Under these conditions normal temperature is a very important and necessary factor. Even confining the question to the actual saving of fuel, the result may be open to discussion, owing to the additional initial firing that is necessary to disseminate sufficient heat to meet the shop requirements.

The Operators' Point of View

DOES A PISTON STOP AT REVERSAL?

By N. G. Near

THE writer has read R. Hamilton's arguments in December POWER HOUSE under the above heading with much interest and notes the very clever way in which he endeavors to prove that a piston does not stop at reversal.

A line has no thickness, true enough. It therefore requires no time at all for a crank pin to pass through a line. Therefore, Mr. Hamilton argues the cross head does not stop. That being the case, then, it can be proved that a piston has no "maximum velocity" either. Draw your cross head velocity curve and it will be found that at one "point" the ordinate is longest. The height of that ordinate represents the maximum velocity as taught in most of our text books and the writer has always accepted it as being true and must continue to do so. According to Mr. Hamilton's way of looking at it, though, this solitary maximum being represented by a "point" and a point having no magnitude it takes no time at all for the crank pin to pass through that point and therefore the maximum velocity does not exist (theoretically).

I am attempting, you see, to answer Mr. Hamilton's arguments with his own "thunder" and could probably go all the way around the whole path of the crank pin and prove that our understanding of kinematics is all wrong because of the smallness of a point.

To the question, "How long does a piston stop?" there can probably be only one answer—zero seconds. It doesn't stop a hundredth of a second, a thousandth, a millionth, a billionth, or even a decillionth for such stops are all of longer duration than zero. A stop, as is generally understood, means zero velocity and we surely have a "point" in our velocity diagram where the velocity is zero in the same way that we have a "point" where the velocity may be 10 feet per second regardless of whether the cross head is accelerating or decelerating.

Mathematically, let us assume a case where the length of the connecting rod is infinite and the velocity of the crank pin is C feet per second. The velocity of the piston may then be given as v=C sinA where A is the angle between the crank arm and the line through the shaft and piston. Now, where A is equal to zero the v becomes zero and for that infinitesimally short time the piston STOPS because its velocity is zero. Where the connecting rod is of finite length a similar solution will give the velocity at this "point" as being zero.

True, this may seem like some "pretty fine figuring" and Mr. Hamilton has a strong line of arguments built up on the fact that "zero is nothing" and that if a piston stops zero seconds it doesn't stop at all, which sounds logical because of the play on the words. But everything points to a dead stop via the velocity diagrams and mathematical formulae.

Anything possessing weight must stop before it can be made to reverse in its tracks" as the expression goes. Even a baseball comes to a dead stop when struck by a bat before it can move in an exactly opposite direction. The bat when swinging toward the ball, moves at a fairly constant velocity and is little disturbed when it meets the ball because of its greater mass. The whole bat does not stop because its direction is not reversed although some of the fibres in the bat may stop. But the ball DOES stop. The elasticity of the ball permits it to withstand the shock.

Perhaps all "points" in the ball do not stop at once but nevertheless every atom has its own deceleration and acceleration to perform and if the atoms do not function thusly our philosophy is all wrong.

DOES A PISTON STOP AT REVERSAL?

A PISTON does stop at reversal and I believe it is possible to slow an engine down so slow that every one will admit that it does. Of course, external power would need to be used to run it at such a speed. Now if it actually stops while the fly wheel is turning very slowly, it must also do so at faster speeds. The fly wheel and shaft upon which it revolves have different motions. The outside edge of the wheel travels the faster, but in a constantly changing direction. The speed decreases from the edge to the centre of the shaft where there is no speed but a constantly changing of position, so no matter how slow the wheel moves no part of it or the shaft to which it is firmly fixed can be said to have stopped.

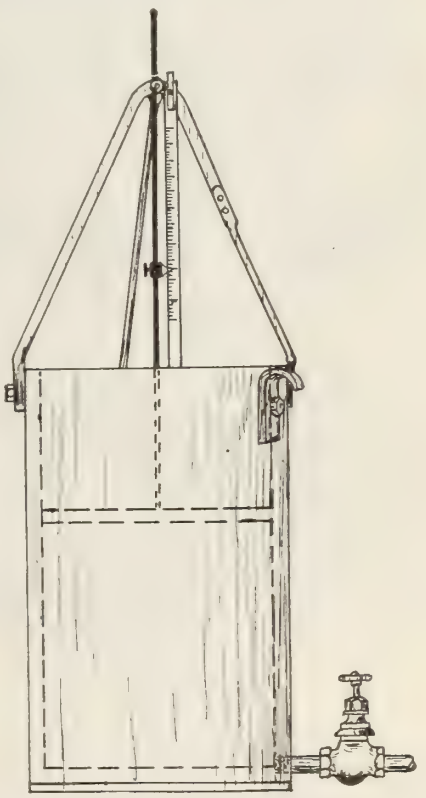
Move a wagonwheel over a knife-edge, and although there is no motion where the wheel is in contact with the knife-edge, there is a constant changing of position the same as in the centre of the shaft, so that no part of the wagon wheel can be said to have stopped.

If a solid body does not change its shape, it is impossible to move one part without moving the whole. One end of a spring can be held at rest while the other part moves. So also with an auto tire, when a given point on the face of the tire comes in contact with the ground the spring of the tire allows that point to stop while other parts are in motion. Some part of an auto tire therefore is at rest all the time while no part of a steel wagon tire rests as long as the wagon moves.

FUEL MEASURING TANK

By D. O. Barrett.

IN taking fuel consumption tests of internal combustion engines, the writer has found the tank shown in the cut to be the most satisfactory method of measuring the amount of fuel used. The tank is a cast iron cylinder accurately bored and the measurement taken. A float is provided in the tank, three arms being attached to the float, so that it will remain central and prevent the rod attached to the float being bent when the tank is moved. To this rod is attached an indicator moving along a 24-in. steel scale graduated in hundredths, this scale being supported by the brackets shown. The tank being rather heavy, hooks were provided so that it could be easily lifted by the crane. The size of the tank to be used, of course, depends upon the size of engines to be tested, but should be large



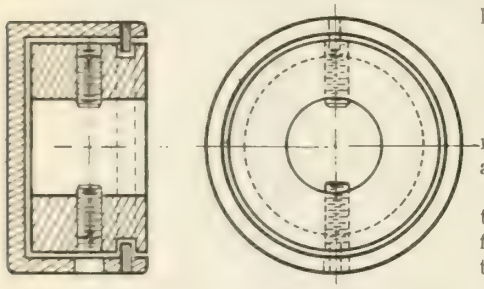
FUEL MEASURING TANK.

enough so that any ordinary run may be made without the necessity of refilling. The one shown was bored to 15.995 in., so that each inch in height represented 0.867 U. S. gallons. Readings being made on the scale graduated to hundredths could thus be made very accurately and easily. These readings could be transferred to pounds after determining the gravity of the oil. This method is much more accurate and quicker than when the fuel is weighed, as the average scales are not accurate and then a balance must be taken each time.

SAFETY-COLLAR FOR EXPOSED SHAFT ENDS

By J. Wright.

A VERY suitable protective means for preventing workmen from getting caught on the exposed ends of overhead shafting is the end safety-collar, shown in sketch. It consists of an inner collar having two headless screws for fastening this to the shaft. A loose fitting outer collar is placed over this. The inner collar has a square groove near the edge, cut reasonably deep, and wide enough so that the two pins fastened in the outer collar will hold it in position, while allowing the



SAFETY COLLAR FOR EXPOSED SHAFT ENDS

shaft and inner collar to revolve freely.

The shaft hole in the inner collar can be made large enough so it can be used on shafts of different diameters, it being only necessary to adjust the screws, and for this purpose a hole is made in the outer collar to insert a screw-driver.

It is readily seen that pressure on the outer collar from a workman's arm or sleeve will cause it to stop instantly, preventing damage such as would be done by the bare end of a revolving shaft.

HELPFUL HINTS

By John Kingston.

LOOKING through my scrap book of items cut from technical papers, I note several items which might be of help to readers. I believe these are not printed in books so far as my own knowledge ...

If brass work requires polishing or tarnishes quickly mix one quart of pure benzoin and eight tablespoonfuls of tripoli powder, shake well while using. A cheaper polish is ¼ ounce of oxalic acid dissolved in one pint of soft water.

To prevent polished steel tools from rusting, warm the tools and dip them into a solution of washing soda.

Two ounces of flower of emery and one ounce of soft soap mixed together into a paste make an excellent article to polish steel. A small quantity of this same paste spread over a piece of smooth wood makes an excellent sharpener for knives, giving them a very sharp edge.

If you wish to lag up a pulley with leather, a tablespoonful of glycerine and one gill of the best glue mixed with a little warm water will cause the leather to adhere nicely to an iron pulley.

For dirty boiler fronts, a good covering which will stand heat without blistering is a mixture of quick drying varnish and powdered soapstone.

A paint often used is a mixture of silica, graphite, and boiled linseed oil mixed to the consistency of ordinary paint; this makes an excellent boiler front covering.

A short rule for calculating the horse-power that a given shaft at a given speed will transmit is as follows:

$0.013 \times D^3 \times N =$ horse-power. This is for light shafts, which carry, say, only pulleys.

For shafts carrying gears use: $0.01 \times D^3 \times N =$ horse-power.

For shafts which are heavy, such as main line shafting, use: $0.008 \times D^3 \times N =$ horse-power.

In the foregoing,

D = diameter of shaft.

N = number of revolutions per minute.

The statement is made that these short rules can be relied upon as being fairly accurate.

Some simple rules for ascertaining the transmitting power of belting, without first computing the speed per minute that it travels, are as follow:

D = diameter of pulley in inches.

R = number of revolutions per minute.

W = width of belt in inches.

For double belting:

$$\frac{D\ R\ W}{2{,}100} = \text{horse-power.}$$

For single belting:

$$\frac{D\ R\ W}{330} = \text{horse-power.}$$

Another rule which can be used approximately for single belts is as follows:

S = speed of belt in feet per minute.

W = width of belt in inches.

$$\frac{W\ S}{900} = \text{horse-power;} \quad W = \frac{900 \times \text{h.p.}}{S}$$

$$S = \frac{900 \times \text{horse-power.}}{W}$$

For double belts:

$$\frac{W\ S}{630} = \text{horse-power;} \quad W = \frac{630 \times \text{h.p.}}{S}$$

$$S = \frac{630 \times \text{horse-power.}}{W}$$

The statement is made that these formulas are based on an average breaking strength through the lace holes for single leather belts of 200 lbs. per inch of width. Taking 3 as factor of safety for belts:

$\frac{200}{3} = 66\ 2/3$ pounds safe working stress per inch width.

Effective pull on belts $= \frac{\text{horse-power} \times 33{,}000}{\text{Velocity in ft. per minute.}} = \text{E.}$

The example given is as follows:

A 36 in. driving pulley at 150 rev. per min. required the width of belt to transmit 6 horse-power. W = width.

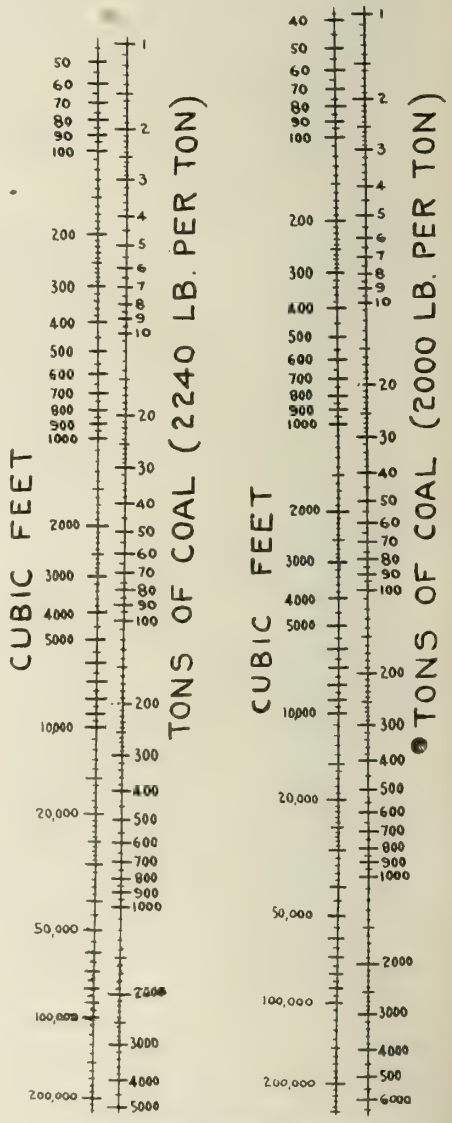
$\frac{36 \times 3.1416 \times 150}{12} = 1413.72$ ft. per minute.

$\frac{6 \times 33{,}000}{1413.72} = 140$ lbs. $= \frac{140}{66.67} = 3$ in. wide.

HANDY COAL CONVERSION SCALES

By N. G. Near.

THESE scales will be found useful for determining the number of tons of coal



COAL CONVERSION SCALES.

in any given number of cubic feet up to 200,000. One scale is constructed on the basis of 2,000 pounds per ton and the other on the basis of 2,240 pounds per ton. The scales are so simple that ex-

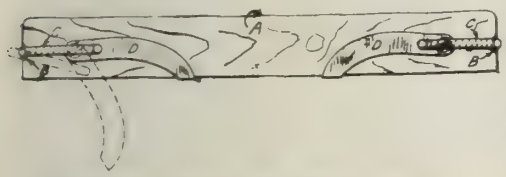
planation is hardly necessary. One thousand cubic feet, for example, would contain either 24 tons or 27 tons. Just glance across from scale to scale and either may be instantly converted into the other. Thus, if it is desired to find how large a bin must be made to hold a given number of tons, these scales will tell in a second the exact number of cubic feet volume necessary.

The scales are usable for either anthracite or bituminous coal. There is very little difference in the weights of these two coals. Many coal men seem to think that anthracite is considerably heavier, but that is not so. Anthracite is a trifle heavier, but not enough to affect results much. The scales may, therefore, run a little low for anthracite and high for bituminous coals, but for all practical purposes they will do very well, for, as is well known, no two coals, even from the same mine, are exactly alike in every particular.

CLAMPING BLOCK FOR EMERY CLOTH

By R. Hamilton

WHEN it is required to fasten emery cloth or sand paper to a block of wood the general practice is to fasten the cloth on the wooden strip by means of small tacks; the sketch here shown illustrates a very handy and serviceable device for this purpose and one that can be easily made from a small piece of



CLAMPING BLOCK FOR EMERY CLOTH.

wire and sheet steel stock. The wooden block can be made of any desirable size and by cutting a groove in each end as shown at B will provide an efficient means for clamping the cloth by means of the toggle arrangement of the U-shaped wire and clamping lever D. The dotted line shows the clamp open to allow of inserting the cloth which is placed over the top A and between the end of the block and the wire C. When the cloth is in position the piece D is pressed back against the block so that the center line of the wire C is forced over the center of D, thus locking the toggle and also the cloth in position.

A WATER LEVEL ALARM

By J. O. McDonnell.

THE illustration shows an electric low water alarm which rings and sets automatically. It is arranged on a tank used for holding condensation from a large hot water heater and other steam-heated articles, and is then used for feed to steam boilers. Very often tanks used for this purpose are placed in an adjoining room or some other remote place where it is difficult for the man in charge to know when the tank is empty, allowing the pump to over-speed and likely become damaged.

Take a piece of board about four inches wide and long enough to reach across the tank. A square hole is cut about the centre for the rod of the float A to pass through as shown at B, Fig. 1. The rod is a piece of light wood made square to fit loose in the hole, so it will work up and down easily with the raising and lowering of the water in the tank. A support is fastened under the board, extending down about 4 in., which

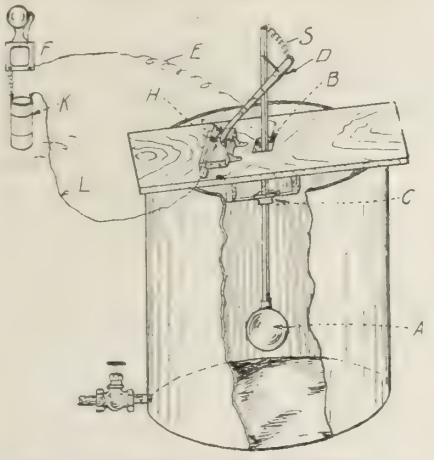


FIG. 1. GENERAL ARRANGEMENT OF WATER LEVEL ALARM.

the rod also passes through to prevent it from swaying, as shown at C. A piece of heavy sheet copper, 8 in. long, ¾ in. wide, cut to the shape shown at D, is fixed to the float rod to swing loose with a small bolt or screw nail, and to it is attached the wire E from the fell F. A small wooden block, 3 in. long, 1½ in. wide, ¾ in. thick, is fixed to the board with a small hinge, as shown at H. A piece of sheet copper is fastened across the block close to edge, with one end extending about ½ in., to which the wire L from battery K is attached. The copper arm D is fixed to the float rod with a small screw nail, so the hook end will come about the centre of the block and will slide out as the float lowers until it passes over the copper plate, which is about ⅛ in. wide, and drops over the side of the block (see A, Fig. 2). The bell tached to keep the arm D pressing

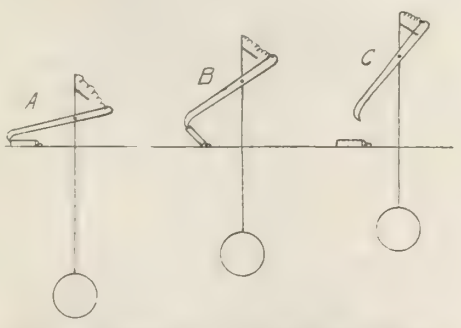


FIG. 2. DIAGRAM ILLUSTRATING OPERATION OF WATER LEVEL ALARM.

rises the hook will turn the block back on its hinges, as shown at B, Fig. 2, when it will slip off and allow the block to drop back on the board. This arrangement prevents the arm making contact with the plate when the float rises.

The bell or battery may be fastened to any window or door frame where it can be distinctly heard. This article is very easily made, and will be found very useful in other places working under similar conditions.

Take a piece of board about four in

RESISTANCE OF AN OIL TO EMULSIFICATION

WHEN oil is used over and over again, as is the usual practice in large power plants, it may emulsify in a few days, if it is not of good quality, and have to be thrown away, as it will not pass through the filters. In order to arrive at a definite knowledge of the emulsifiability of oils, the United States Bureau of Standards has carried out investigations, the results being embodied in Technologic Paper No. 86, entitled "Resistance of an Oil to Emulsification."

To avoid the waste of time and the inconvenience of actually trying the oil in a turbine or other machine, a laboratory test has been devised by means of which it may be predicted whether or not the oil would give satisfaction in service.

The test consists of violently stirring a small sample of the oil with water under standard conditions. Then the oil that will separate out from the water the most rapidly is the best oil for turbine lubrication, other things being equal. It is found that most of the oils on the market are either very bad or very good, and that there is no difficulty in finding turbine oils that will settle out from the water in a minute or less after stirring as described.

For some other purposes it is desirable that oils should emulsify readily; and the test shows that oils of this class, when subjected to the same treatment as the turbine oils, will not separate at all in one hour, nor completely separate in one year. When turbine oils are used for months or years without renewal, they gradually deteriorate until they emulsify readily, even though they are very good oils to start with. The conditions of use in different plants are so different that it would be impossible to predict just how long a given oil would last, but it is believed that any power-house engineer, by the use of this test, could keep track of the deterioration of his oil and thus discover when it is time to clean out his lubricating system.

Niagara Power Released for Buffalo. —Between 80,000 and 100,000 electrical horse-power has been released in Niagara Falls under an order received by the Hydraulic Power Co. and the Niagara Falls Power Co. from the United States Government. Electro-chemical companies working on important war orders will receive power diverted from plants engaged in the manufacture of non-essentials. There will be a general scaling down of the power received by the latter and in some instances large concerns will be cut off entirely. The two power companies are now producing a total of 278,000 horse-power, about 40,000 of which has been coming to Buffalo.

Operators' Instruction Course

EDUCATION PAPER—IV.

AT what rate must water be evaporated per horse-power?

The boiler horse-power corresponds to the evaporation into steam of 34.5 lbs. of water per hour from a temperature of 212 deg. and at atmospheric pressure, or, as it is commonly expressed, from and at 212°.

* * *

What does a dynamo consist of?

The dynamo is a machine for converting mechanical energy into electrical energy. It consists of two elements—a stationary field, which produces the flux or lines of magnetic force, and the revolving element, the armature, which carries the coils of wire, in which are generated electromotive forces, due to the cutting of the lines of force of the field. The simplest form of dynamos must have two poles—a north pole and a south pole, and any increased number of poles would be a multiple of two. Thus a dynamo may be of 2-pole or bipolar, 4-pole, 6-pole and so on. The poles are simply bobbins of wire wound in iron cores and these cores are attached to the inner circumference of a ring of magnetic iron called the yoke.

An armature is a cylinder of iron, usually built up of thin laminations to keep down eddy currents, assembled on a shaft and bolted tightly together. The outer surface of the armature is slotted to receive the sides of the coils which form the winding. These coils have their sides embedded in the slots and are so arranged, grouped, and connected that their electromotive forces will add up and give the total voltage of the machine.

The armature is mounted between the field magnets and the ends of its shaft are supported either by pillar bearings from the base if the machine is a large one, or by the end housings which are bolted to the magnet ring or yoke and provide the bearings for the shaft.

The ends of the field poles next the armature are called the pole faces, and these faces are shaped to the curvature of the armature and are so dimensioned as to best distribute the flux through the windings on the armature.

Between the stationary pole faces and the revolving armature there must be left a clearance, and this is called the air gap. It is desirable to keep this gap as small as possible, because the flux has to cross this gap before it can thread through the armature coils, and as air is a poor conductor of flux compared to iron, some of the flux shows a reluctance to crossing the gap twice, as it would have to do to complete the magnetic circuit between the north and south poles. Rather than take the path of high reluctance through the armature it will jump across from one pole tip to the other pole tip, and consequently becomes lost as effective flux for producing electric current. Hence to avoid this flux leakage the air gap must be kept as low as possible.

If the dynamo is to deliver direct current it will have a commutator mounted on the armature shaft, to which the ends of the armature coils are connected.

Two sets of brushes are provided—the positive and negative. The brushes make contact with the commutator at the neutral point so as to short circuit and reverse the current in the coils at the moment when they would be tending to generate an e.m.f. in the reversed direction. The brushes collect the rectified current from the commutator.

If the dynamo is of the alternating current type it will not need to rectify the current, and hence no commutator will be used. Instead the single phase or polyphase alternating current will be collected through brushes bearing on slip rings.

* * *

What does an electric motor consist of?

The electric motor is a machine for converting electrical energy into mechanical energy. Generally it is the same as a dynamo, only its operating conditions are reversed. It consists of magnetic field poles attached to the yoke with the armature.

* * *

How is an electric current generated?

Electric current is generated whenever a coil of wire, which forms a completed circuit, is rotated in an electric field, so that the number of lines of force which it encloses is constantly changing. The principle on which the generation of electricity depends is that of electro magnetic induction, by which an electromotive force is induced in a coil of wire in which the number of enclosed lines of force is varying. This induced e.m.f. causes a current to flow around the circuit and is proportional to the number of lines of force cut per second.

* * *

What is a commutator?

The commutator of a dynamo or motor consists of a group of copper bars or segments arranged side by side, so as to form the outside of a cylinder. Sheets of mica insulate each bar from its neighbor and from the iron shell and clamping rings that hold the bars in place. The commutator is mounted on the shaft near the armature and rotates with it, and the armature conductors are so connected to the commutator bars that the alternating current generated in the windings is changed to direct or uniflow current at the terminals of the machine by means of the brushes which make contact with the commutator surface. These brushes make contact with the bars to which the coils undergoing commutation or reversal in direction of current are attached, and must be so placed that the contact between proper bars and brushes is effected at the instant when the coil, undergoing commutation, is cutting no lines of flux. This point or setting of the brushes is called the neutral point, and is the proper place for the brushes to secure sparkless commutation.

* * *

What is a refrigeration ton and its relation to ice-making capacity?

The heat required to melt one ton of ice (2,000 pounds) at 32° F. would be $2{,}000 \times 142.2 = 284{,}400$ B.t.u., and so the refrigeration ton corresponds to the absorption of 284,400 heat units. For a refrigeration machine this same amount of refrigeration would be produced by expanding 510 pounds of ammonia from a liquid to a vapor.

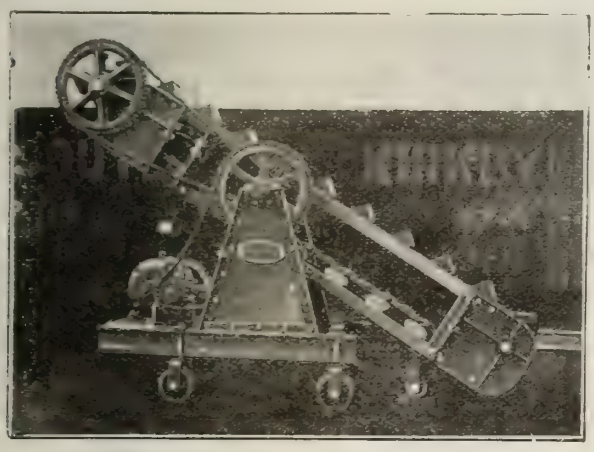
On what principle does the ammonia absorption system work?

The operation of an absorption refrigeration system is as follows: Aqua ammonia, obtained in metal drums from the ammonia manufacturers, is admitted to the generator, and steam, either live or exhaust, according to the type of the machine installed, is admitted to the steam coils of the generator. This causes the liquid to boil and the contained ammonia gas to rise, taking with it from 8 to 10 per cent. of water vapor. This water vapor is removed by condensation in the rectifier, and the ammonia vapor then flows into the condenser, where it is condensed to a liquid state by the action of the cooling water flowing over or through the condenser. From the condenser the liquefied ammonia flows to the liquid receiver, then through an expansion valve into the evaporator, where the liquid expands into a gas and absorbs heat. The gas is then drawn back to the absorber to be absorbed and enrich the weak liquor from the bottom of the generator. The rich liquor is then pumped back to the generator to go through the same process over again.

Progress in New Equipment

A PORTABLE ELEVATOR

MANY industrial processes involving the handling or transport of materials could be performed with greater speed and efficiency and with a large saving in labor,. but in many of these cases the installation of a fixed or elaborate conveying system would not be practicable or justifiable, owing to the changing venue of operation or the irregular, possibly infrequent, and not always calculable periods when its use would be required. Such conditions are admirably met by the use of portable elevators or conveyors. They can be brought into use as and when required; they can be moved from place to place with the greatest ease, and they can be arranged so that the work of loading and unloading can be carried out by merely reversing the running.



PORTABLE COAL ELEVATOR.

The accompanying engraving shows a small portable coal elevator of this type which is manufactured by the firm of E. Bennis & Co., Bolton, Lancs. It is 10 ft. long between centres of the drums and has buckets 8 in. wide.

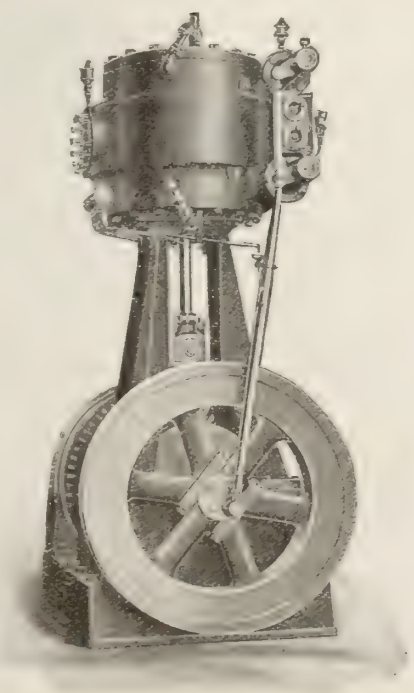
The elevator is mounted on a portable truck in such a manner that the angle of the elevator can be altered if desired. The truck is built out of mild steel sections and is carried on four rollers.. All the rollers are attached to pivoted axles. The top of the axle is made with a square so that it can be turned round with a spanner, and provision is made for locking the wheels in four positions. The elevator is driven by two chain drives. Two sprocket wheels are placed on the pivot shaft. One of these sprockets is driven direct from the motor, and the other sprocket drives the elevator shaft, so that the relative centres of the shafts are maintained irrespective of the angle of the elevator. When in operation, the elevator is pushed up to the coal heap, and the coal trimmed forward to the buckets.

MOTOR DRIVEN DRY VACUUM PUMP

THE makers of the dry vacuum pump illustrated in the accompanying engraving are the Wheeler, Condenser and Engineering Co. of Carteret, N.J., who have endeavored, in its design and construction, to provide an air pump for use on condensers, which will satisfactorily fulfill the requirements of such an apparatus in both marine and stationary applications.

It is especially adapted for use in that type of installation where it is desirable to maintain a high vacuum in the condenser, in which case the use of separate condensate and air pumps is approved practice.

As the cut shows the pump is of the vertical type and is driven by an electric motor direct connected to the crank shaft. The inlet valves of the pump are of the semi-rotative type, which are so manipulated by the valve gear as to draw air from the condenser during its full stroke. Clearance difficulties are eliminated in this design of valve gear by providing ports which register with an equalizing air passage. The discharge valves are of the poppet type and are easily accessible, as are all the wearing parts, and their method of arrangement ensures adequate drainage of condensed vapor.

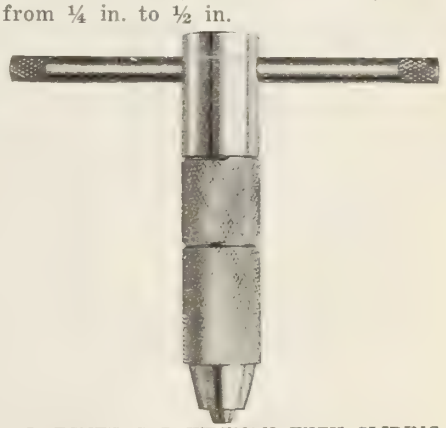


MOTOR-DRIVEN DRY VACUUM PUMP.

Advantages claimed for the electric driven rotative dry vacuum pump over the reciprocating steam drive are: ease of installation; less attention required; no steam pipe radiation losses; and improvement of plant load factor.

RATCHET TAP WRENCH

THE accompanying engraving illustrates a ratchet tap wrench which has recently been placed on the market by the Moss-Ochs Co., Cleveland, O. It is made in two sizes: No. 1, from 0 to ¼ in.; No. 2, from ¼ in. to ½ in.



RATCHET TAP WRENCH WITH SLIDING T-HANDLE.

The device is of strong and substantial construction and consists of a chuck mounted on a shank provided with a double acting ratchet. The T-handle fitted to the upper part of the shank is held centrally by means of a dog which automatically fits in a flat milled on the handle. When required for use in corners and other difficult or awkward situations, the handle slides to either end, which action, combined with the ratchet movement, removes considerable worry from the operator, avoids to a great extent the breakage of small taps, and enables more accurate work to be produced.

The ratchet is immediately adjustable for right or left action by simply turning the milled sleeve shown above the chuck.

SELECTED MARKET QUOTATIONS

A Record of Prices Current on Raw, Semi-finished, and Finished Materials Entering Into the Manufacture and Operation of Power Plant Equipment

BOILER TUBES

Size	Seamless	Lap-welded
1 in.	$36 00	$.....
in.	40 00	.....
in.	43 00	36 00
1¾ in.	43 00	36 00
2 in.	50 00	36 00
2¼ in.	53 00	38 00
2½ in.	55 00	42 00
3 in.	64 00	50 00
3¼ in.	.....	58 00
3½ in.	77 00	60 00
4 in.	90 00	75 00

Prices per 100 feet, Montreal and Toronto.

PLATES

	Montreal	Toronto
Plates, ¼ to ½	$13 00	$12 00
Heads	13 30	12 30
Tank plates, 3-16 in.	13 65	12 10

WROUGHT PIPE

Effective Jan. 7, 1918.
Standard Buttweld.

Size.	Black Per 100 feet	Galvanized Per 100 feet
in.	$ 6 00	$ 8 00
¼ in.	5 10	7 23
in.	5 10	7 23
in.	6 46	8 03
¾ in.	8 17	10 29
1 in.	12 07	15 22
in.	16 33	20 59
1¼ in.	19 53	24 61
2 in.	26 27	33 12
2½ in.	42 12	52 94
3 in.	55 08	69 23
3½ in.	69 92	86 94
4 in.	82 84	103 00
Standard Lapweld.		
2 in.	29 43	35 71
2½ in.	43 88	54 11
3 in.	57 38	70 76
3½ in.	71 76	89 70
4 in.	85 02	106 28
4½ in.	96 52	121 29
5 in.	112 50	141 34
6 in.	145 90	183 36
7 in.	190 40	238 00
8 L in.	200 00	250 00
8 in.	230 40	288 00
9 in.	276 00	345 00
10 L in.	256 00	320 00
10 in.	329 60	412 00

Prices—Ontario, Quebec and Maritime Provinces

WROUGHT NIPPLES

4" and under, 45%.
[illegible] and larger, 40%.
4" and under, running thread, 2[illegible]
Standard couplings, 4" and under [illegible]
4½" and larger, 15%.

IRON PIPE FITTINGS

Malleable fittings, class A, 20% on list; class B and C, net list. Cast iron fittings, 25% off list. Malleable bushings, 25 and 7½%; cast bushings, 25%; unions, 45%; plugs, 20% off list. Net prices malleable fittings: Class B black, 24½c lb.; Class C black, 15¾c lb.; galvanized, Class B, 34c lb.; Class C, 24½c lb. F.O.B. Toronto.

COLD ROLLED SHAFTING.

At mill ..... list plus 40%
At warehouse ..... list plus 50%
Discounts off new list. Warehouse price at Montreal and Toronto.

FINISHED IRON AND STEEL

Per 100 lbs. Delivered	Cents
Iron bars, base, Toronto	$5 25
Steel bars, base, Toronto	5 50
Steel bars, 2" to 4" base	6 00
Iron bars, base, Montreal	5 25
Steel bars, base, Montreal	5 50
Reinforcing bars, base	5 50
Small shapes	5 75

SHEETS

	Montreal	Toronto
Sheets, Black, No. 28.	$ 8 50	$ 8 50
Sheets, Black, No. 10.	12 00	12 00
Canada plates, dull, 52 sheets	9 00	9 00
Canada plates, all bright	10 50	10 50
Apollo brand, 10¾ oz. galvanized	....	....
Queen's Head, 28 B.W.G.	....	....
Fleur-de-Lis, 28 B.W.G.		
Gorbal"s Best, No. 28.		
Colborne Crown, No. 28	....	....
Premier, No. 28 U.S.	9 45	9 45
Premier, 10¾ oz. ...	9 75	9 75

PROOF COIL CHAIN B

¼ in.	$12 00
5-16 in.	11 50
⅜ in.	11 15
7-16 in.	10 90
½ in.	10 70
9-16 in.	10 70
⅝ in.	10 50
¾ in.	10 40
⅞ in.	10 25
1 in.	10 10
Extra for B.B. Chain	1 20
Extra for B.B.B. Chain	1 80

ELECTRIC WELD COIL CHAIN B.B.

⅛ in.	$15 50
3-16 in.	11 70
¼ in.	8 40
5-16 in.	7 40
⅜ in.	6 35
7-16 in.	6 35
½ in.	6 35
⅝ in.	6 35
¾ in.	6 35

Prices per 100 lbs.

FILES AND RASPS

	Per Cent.
Great Western, American	50
Kearney & Foot, Arcade	50
J. Barton Smith, Eagle	50
McClelland, Globe	50
Whitman & Barnes	50
Black Diamond	37½
Delta Files	37½
Nicholson	37½
Globe	50
Vulcan	50
Disston	50
P.H. and Imperial	50

OILS AND COMPOUNDS

Castor oil, per lb.	52
Royalite, per gal., bulk	17
Palacine	20
Machine oil, per gal.	26½
Black oil, per gal.	13
Cylinder oil, Capital	45½
Cylinder oil, Acme	36½
Standard cutting compound, per lb.	06
Lard oil, per gal.	2 50
Union thread cutting oil antiseptic	88
Acme cutting oil, antiseptic	37½
Imperial quenching oil	39½
Petroleum fuel oil	13½

BELTING—No. 1 OAK TANNED.

Extra heavy, single and double	30-5%
Standard	40%
Cut leather lacing, No. 1	$1 95
Leather in sides	1 75

COAL AND COKE.

Solvay Foundry Coke	....
Connelsville Foundry Coke	....
Steam Lump Coal	....
Best Slack	....

Net ton f.o.b. Toronto.

BOLTS, NUTS AND SCREWS

	Per Cent.
Coach and lag screws	25
Stove bolts	55
Plate washers....list plus	20
Machine bolts, 7-16 and over	net
Machine bolts, ⅜ and less	10
Blank bolts	net
Bolt ends	net
Machine screws, fl. and rd. hd., steel	27½
Machine screws, o. and fil. hd., steel	10
Machine screws, fl. and rd. hd., brass ....add	20
Machine screws, o. and fil. hd., brass ....add	25
Nuts, square blank ....add	$1 50
Nuts, square, tapped....add	1 75
Nuts, hex. blank ....add	1 75
Nuts, hex. tapped ....add	2 00
Copper rivets and burrs, list plus	30
Burrs only list plus	50
Iron rivets and burrs	15
Boiler rivets, base ¾" and larger $8	50
Structural rivets, as above	8 40
Wood screws, flat, bright	72½
Wood screws, O. & R., bright	67½
Wood screws, flat, brass	37½
Wood screws, O. & R., brass	32½
Wood screws, flat, bronze	27½
Wood screws, O. & R., bronze	25

MISCELLANEOUS.

Solder, strictly	0 39
Solder, guaranteed	0 43
Babbitt metals	18 to 70
Soldering coppers, 3 to 6 lbs.	0 64
Putty, 100-lb. drums	4 55
White lead, pure, cwt.	15 20
Red dry lead, 100-lb kegs, per cwt.	15 50
Glue, English	0 35
Gasoline, per gal., bulk	0 31½
Benzine, per gal., bulk	0 30½
Pure turpentine, single bbls., gal.	0 74
Linseed oil, raw, single bbls.	1 86
Linseed oil, boiled, single bbls.	1 39
Lead wool, per lb.	0 15
Plumbers' oakum, per cwt.	9 00
Sandpaper, B. & A....list plus	20
Emery Cloth....list plus	20
Sal Soda	0 03½
Sulphur, rolls	0 05
Sulphur, commercial	0 04½
Rosin "D," per lb.	0 03
Rosin "G," per lb.	0 03½
Borax crystal and granula	0 13
Wood alcohol, per gallon	1 80
Whiting, plain, per 100 lbs.	2 20

COPPER PRODUCTS

	Montreal	Toronto
Bars, ½ to 2 in.	$55 00	$48 00
Plain sheets, base 16 oz. and heavier	56 00	48 00
Copper sheet, tinned, 14x60 in., 14 oz.	60 00	60 00
Copper sheet, planished, base 16 oz. and heavier	64 00	49 00
Braziers' in. sheets, 6x4 base	55 00	48 00
Tubing T.P.S., base ¾ in. up to 3 in.	60 00	60 00

Above prices are full sheets and bars. Cut sheets and bars are 5c per lb. higher.

BRASS PRODUCTS.

Brass rods, base ½" to 1" rd.	$0 43
Sheets 24 oz. and heavier base	0 48
Brass tubing, seamless	0 55
Tubin, I.P.S., 1" base	0 55

POLISHED DRILL ROD.

Discount off list, Montreal and Toronto	Net

RUBBER BELTING

Standard	10%
Best grades	15%

WASTE

White.	Cents per lb.
XXX Extra	21
Peerless	21
Grand	19¾
Superior	19¾
X L C R	18½
Atlas	18½
X Empire	17¼
Ideal	17¼
X press	16
Colored.	
Lion	15
Standard	13½
No. 1	13½
Popular	12
Keen	10½
Wool Packing	
Arrow	25
Axle	20
Anvil	15
Anchor	11
Washed Wipers	
Select White	11
Mixed colored	10
Dark colored	09

This list subject to trade discount for quantity

MILLED PRODUCTS

	Per Cent.
Set screws	25
Sq. & Hex., Head Cap Screws	20
Rd. & Fil Head Cap Screws	Net
Flat & But. Hd. Cap Screws plus	Net
Fin. & Semi-fin. nuts up to 1 in.	25
Fin. and semi-fin. nuts, over 1 in., up to 1½ in.	20
Fin. and semi-fin. nuts, over 1½ in., up to 2 in., list plus	10
Studs	20
Taper pins	40
Coupling bolts, pins	10
Planer head bolts, without fillets ....list plus	10
Planer head bolts, with fillet list plus 10 and	10
Planer head bolt nuts, same as finished nuts.	
Planer bolt washers	net
Hollow set screws..list plus	20
Collar screws...list plus 30,	10
Thumb screws	20
Thumb nuts	65
Patch bolts .....add 40,	10
Cold pressed nuts to 1½ in. ..... add	$4 50
Cold pressed nuts over 1½ in. .....add	$7 00

METALS

	Montreal	Toronto
Lake copper	$31 00	$32 00
Electro copper	31 00	32 00
Castings, copper	30 00	31 00
Tin	77 00	80 00
Spelter	10 50	10 50
Lead	9 75	9 00
Antimony	18 00	18 00
Aluminum	65 00	62 00

Prices per 100 lbs...

ROPES AND PACKING

Packing, square braided	0 34
Packing, No. 1 Italian	0 40
Packing, No. 2 Italian	0 32
Pure Manila rope	0 39
Transmission rope, Manila	0 45
Drilling cables, Manila	0 41

LEAD SHEETS

	Montreal	Toronto
Sheets, 3 lbs. sq. ft. lb.	$12 00	$13 25
Sheets, 3½ lbs.	12 00	13 25
Sheets, 4 to 6 lbs.	13 00	12 50

Cut sheets, ¾c per lb. extra.
Cuts sheets to size, 1c per lb. extra.

The Lack of a Grease Extractor Cost Them $5.000.00

We can't give the actual name of the college power plant at which this neglect took place.

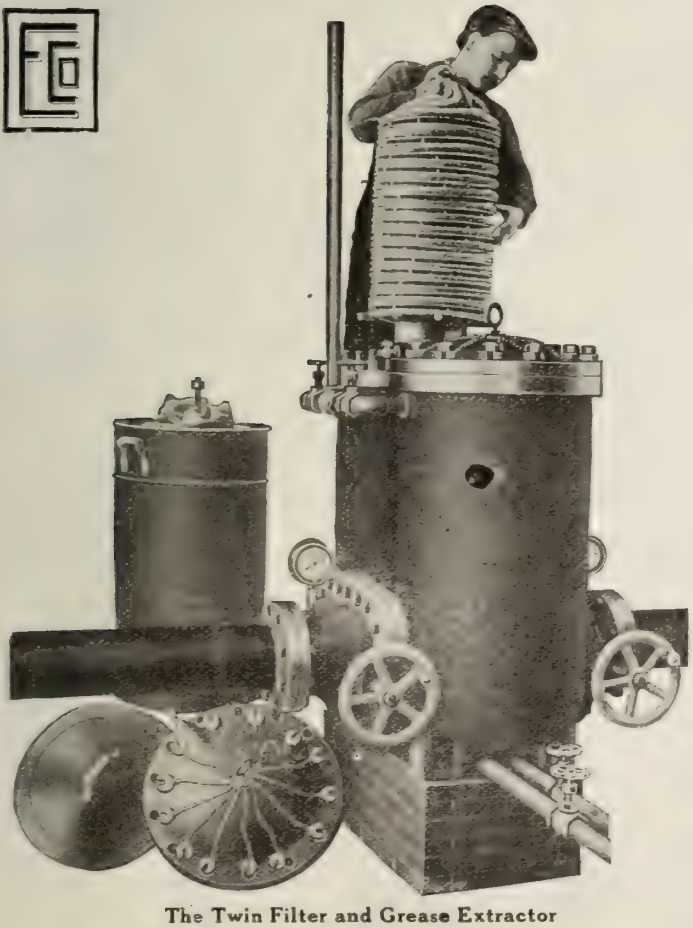
Naturally no plant wants to be connected with a true story like this.

But here are the facts:

Oil was allowed to get into the boilers and four of them were ruined by sagging—it cost $5,000—get that, five thousand in cold cash to reset these boilers.

With the reset boilers, a Twin Grease Extractor was installed and—

They have had no trouble since.



The Twin Filter and Grease Extractor

Avoid the Danger of This—Install a Twin Grease Extractor

This actual case proves again how much better it is to use the ounce of prevention. Keep oil out of your boilers thoroughly, efficiently, safely with a Twin Grease Extractor.

You'll find unusually good features in the "Twin." For instance, you can clean it easily—a very important point. But more important, the twin idea: two separate filtering chambers—while one is in service, the other can be cleaned without by-passing or interrupting the flow of water.

You'll find a complete description in our Bulletin B. Send for a copy.

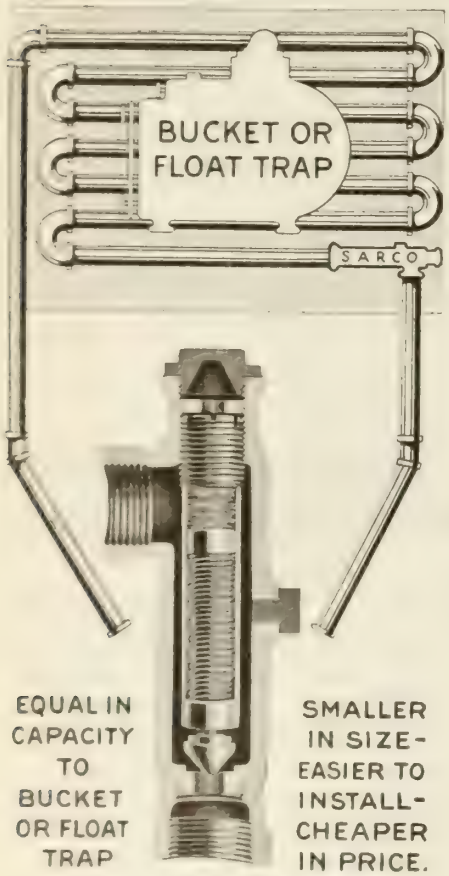
ELLIOTT COMPANY

6902 Susquehanna St., Pittsburgh, Pa.

If interested, tear out this page and keep with letters to be answered.

SARCO COMPANY
INCORPORATED
WOOLWORTH BLDG.
NEW YORK

AND ALL PRINCIPAL CITIES



EQUAL IN CAPACITY TO BUCKET OR FLOAT TRAP

SMALLER IN SIZE-EASIER TO INSTALL-CHEAPER IN PRICE.

YOU NEED THE STEAM TRAP SARCO

TRADE GOSSIP

Belleville, Ont.—The Town Council contemplate the installation of an electric pump.

Renfrew, Ont. — The Town Council contemplate the purchase of pumps for the waterworks.

Brussels, Ont.—The town is anticipating the installation of a new electric light plant shortly.

Alliston, Ont.—The Town Council propose electrifying the municipal pumping plant if the by-law passes.

Toronto, Ont.—The townships of Scarborough and Etobicoke propose to instal water distribution systems.

Valleyfield, Ont.—The power house at the Montreal Cottons, Ltd., plant was destroyed by fire on December 13.

Ingersoll, Ont.—An explosion of mysterious origin in the plant of the Ingersoll Gas Co., on Jan. 2, has almost

Sherbrooke, Que.—The City Council will build a dam at the civic power station and make permanent improvements at both power stations.

Lumsden, Sask.—The local electric light and power company will be purchased by the Town Council at a cost of $7,000.

Armagh, Que.—Plans have been drawn for the town council for waterworks costing $40,000. Engineers, Gouvin and Beauchemin, Quebec, Que

Toronto, Ont.—The contract for a new boiler house for the Swift Canadian Co., operate a faction in Toronto. Although Construction Co.

Galt, Ont.—A by-law will be submitted to the ratepayers on January 1 to provide money for extensions to the waterworks system to cost $18,558.

Toronto, Ont.—The Spruce Falls Pulp & Paper Co. have acquired pulp limits in the Kapukasing District, Northern Ontario, and will erect a pulp and paper mill.

Alliston, Ont.—A by-law will be voted on by the ratepayers on January 7 to authorize an expenditure of $6,000 for electrifying the municipal pumping plant.

Copper Cliff, Ont.—The Canadian Copper Co. have let the contracts for a new converter and building to the Allis-Chalmers Co. and the Dominion Bridge Co. respectively.

Burton Township, Ont.—The Township Council propose spending $55,000 on the purchase of necessary material and equipment for instaling an electric light system.

Kingston, Ont.—On Thursday afternoon Engineers Kribs and Johnson, of Toronto, turned on the Hydro-Electric power from the Trent at the Kingston sub-station, and everything worked satisfactorily.

Perth, Ont.—The municipality propose to raise $120,000 by municipal debentures and to purchase the local electric and waterworks plant from the present owners, the Canadian Electric and Water Power Co.

Whitby, Ont.—The following by-laws have been passed by the Town Council: $1,150 for construction of sewer laterals; $3,200 for low level pumping station; $5,700 for extension waterworks and electric light.

The Eugene F. Phillips Electrical Works, Montreal, has changed its name to that of Phillips, Ltd. The company has also been incorporated with a capital of $4,000,000 to engage in the manufacture of wire cables and electrical apparatus of all kinds.

H. Gray & Co. has been incorporated at Ottawa with a capital of $150,000 to manufacture mill supplies, cotton waste, greases, etc., The head office is at Montreal and the incorporators are E. E. Howard, J. DeWitt and E. A. Rose, all of Montreal.

The Wedgerite Piston Ring Co. has been incorporated at Ottawa with a capital of $49,000 to manufacture a patent piston packing, also engines and motors of all kinds at Montreal. The incorporators are Ulric and Ernest Duchesne and Charles A. Gareau, all of Montreal.

Mimico, Ont.—The council going in by acclamation left the only voting at Mimico in connection with a by-law to appoint a commission to take over the public utilities, the waterworks system and the Hydro. The by-law carried with a large majority. The members of the commission will not be voted on until next year.

Chatham, Ont.—Damage estimated at between $8,000 and $10,000 was caused to the plant of the Pittsburgh & Des Moines Steel Co. by fire which broke out on Sunday morning in the engine room at the plant. Heavy damage was done to the building and machinery. The roof at the west end of the building was demolished and the engine room was transformed into a mass of debris. The plant was formerly owned by the Chatham Bridge Co. and was recently taken over by the Pittsburgh & Des Moines Steel Co. as a Canadian branch.

Niagara Falls, Ont.—The Hydro-electric Power Commission of Ontario are going ahead with the construction of a new pipe line at Niagara Falls, running from the intake to the generating station, and paralleling those now in operation. It is expected this line will be completed by July, by which time also it is the intention to have extra turbine and generating equipment to the extent of some 25,000 h.p. ready for operation. Whether this will be in the form of two units similar to the latest additions to this power house, or whether one large unit will be installed, has not yet been determined.

London, Ont.—Sir Adam Beck announced here on Monday that he had awarded contracts for the construction of a 13½-foot wood stave flume with turbines and generators for the development of an additional block of 50,000 horse-power at the plant of the Ontario Power Co. at Niagara Falls. Of this additional horse-power 20,000 will be available in August next and the remainder in October. It is estimated that it will next winter save the importation of more than three-quarters of a million tons of soft coal, which at from $8 to

$10 a ton would represent an outlay of from $6,000,000 to $7,500,000.

Wallaceburg, Ont.—Damage to the extent of $100,000 was done on Dec. 11 by fire to the Wallaceburg plant of the Dominion Sugar Co. The fire followed an explosion believed caused by an explosion of gas used for reheating the dryers in the pulp building. The blaze completly destroyed the building and machinery and 7,000 bags of pulp.

Windsor, Ont.—The Water Commissioners have decided to instal at once two motor-driven pumps to obviate danger which threatened to arise as a result of the fuel shortage. It is proposed to use Hydro power to drive the pumps and to keep the present steam installation for auxiliary purposes. However, in order to relieve the load upon the Hydro system in the early evening the steam pumps will be used for an hour or two.

Chatham, Ont.—A serious situation has developed in Western Ontario on account of a shortage in supply of natural gas. The gas pressure failed in Chatham last Saturday, the available supply being hardly sufficient to keep water from freezing in the boilers. There is also very little coal in the city and a number of factories may have to close down. Unless there is a change in the temperature very little relief can be expected.

Hamilton, Ont.—At a special meeting of the Barton Township Council held last Saturday, it was proposed to enact a by-law for the purpose of raising $55,000 for the purpose of installing a Hydro system in the township. It will require $22,000 as a first investment to buy out the present system, the rest of the funds to be held for extensions, etc. The question will be placed before the electors of the township when they ballot for the municipal elections.

Niagara Falls, Ont.—A 13-foot woodstave pipe line will be laid from the river to Queen Victoria Park down to the development at the foot of the Falls. This pipe line will enable the Ontario Power plant to be developed to its full capacity, and will produce an extra 25,000 horsepower. The new pipe line will provide enough water for additional generators as well, and to utilize it tenders will be let for the installation of additional turbines, with penstock and generator complete. This will give another 20,000 horse-power available ten months from now.

North Vancouver.—The district of North Vancouver Council on November 29 passed a resolution authorizing the clerk to prepare a general loan by-law to provide the sum of $35,000 for waterworks purposes. The money, which in the event of this by-law passing at the general elections in January, is intended for the establishment of a waterworks system east of Seymour River. The principal need for such a system is to provide a steady and sure supply to the two large industries at Roche Point—the Canadian Robert Dollar Co. and the Vancouver Cedar Mills, Ltd.

CLASSIFIED ADVERTISING

RATES.

Two cents per word for first insertion. One cent per word for subsequent insertions. Count five words when box number is required. Each figure counts as one word.

CONSULTING ENGINEER

WITH 25 YEARS' EXPERIENCE IN THE following lines: Steam, mechanical, electrical, heating, ventilating and printing. Consultation, supervision and inspection. Fred J. Grant, 126 Denison Ave., Toronto. Phone College 210. p1h

SECOND-HAND ONE HUNDRED (100) horse-power locomotive boiler, and one seventy-five (75) horse-power Corliss engine. Both in first-class condition. Located at Atikokan, Ontario. Address Wm. M. O'Connell, 601 Merchants National Bank Building, St. Paul, Minnesota. (p2h)

FOR SALE

One 22" x 50" Wheelock Engine, left-hand, arranged for direct shaft coupling, with heavy balance wheel 8¼" x 14" x 17'—7" in dia.

Merchants Rubber Factory
KITCHENER, ONTARIO
p1h

CYLINDER LUBRICATION

A powerful microscope will disclose hundreds of irregularities on a bearing surface, no matter how smooth it may appear to the naked eye.

DIXON'S Ticonderoga Flake Graphite

will fill up these minute irregularities and form a smooth, durable veneer of graphite that is practically frictionless.

It will give better lubrication, cut the oil bills in half and eliminate wear and tear.

Send for Booklet No. 222-C telling more about this lubricant and method of successfully feeding dry graphite into cylinders

Made in Jersey City, N.J., by the

JOSEPH DIXON CRUCIBLE COMPANY

ESTABLISHED 1827

Sole Canadian Representative:
CANADIAN ASBESTOS CO.
Montreal, Que.

JUST LOOK THERE—

The steam user just as well might dump coal into a sewer manhole as go to the trouble of firing up his boiler and then waste the steam by exhausting it in the draw. Don't waste. Use the COLE COAL SAVER — the Cole Return Trap.

Look for this Trade Mark

GEO. W. COLE, LIMITED
New Address: 2002 Dundas St. W.
Old Address: 838 Dundas St.
TORONTO

"Clean All" Feed Water Treatment

Your Boiler Troubles are Solved and the Solution is Genuine.

We guarantee that "Clean All" if used according to directions:

To remove (not dissolve) scale already formed, and to stop further formation.

To stop pitting, corrosion and minor leaks.

To be absolutely harmless to metals, packings and fittings.

To remove oil and grease, and increase efficiency of boilers 100%.

Submit samples of water used and all particulars of conditions of boilers, etc., and let boiler specialists diagnose your case.

SOLD IN 30 or 50 GALLON LOTS UNDER 60-DAY TRIAL.

William C. Wilson & Co.
AGENTS
21 Camden St. TORONTO

NON-CORROSIVE
CYLINDER OIL
MANUFACTURED ONLY BY
E. H. KELLOGG & CO.
204-214 SOUTH ST. NEW YORK, U.S.A.
FRICTION LOSS

... wearing on the bearings, a great fric- ... to fire the boiler more often because the engine will be harder to run. In this manner you lose out. You work harder, have larger operating costs, and less power all because of your oil. Do ... Kellogg's "Non-Corrosive Cylinder Oil" a trial. Also ...

E. H. KELLOGG & CO.,
New York, U.S.A.

WALTER J. FRANCIS, C.E. M. Can. Soc. C.E. M. Am. Soc. C.E. M. Inst. C.E.
FREDERICK B. BROWN, M.Sc. M. Can. Soc. C.E. Mem. Am. Soc. M.E. Mem. A.I.E.E.
WALTER J. FRANCIS & COMPANY
CONSULTING ENGINEERS
Head Office, 232 St. James St., Montreal
Cable Address, "Waldran, Montreal"—W.U. Code.
Long Distance Telephone, Main 5643

After the War--
WHAT?

... consolidate your position by regulating ... in Canadian War Loans, that help so much to maintain present prosperity.

THE NATIONAL SERVICE BOARD OF CANADA

This space is donated by MacKinnon, Holmes & Co., Limited

Chatham, Ont.—Electrification of a section of the Chatham-Wallaceburg division of the C., W. and L. E., with the use of Hydro power is being undertaken, and it is expected that cars will be moved by the power from Niagara for the first time shortly. Because of the shortage of fuel the company has found it impossible to generate sufficient power for the entire system, which reaches from Erie Beach to Wallaceburg.

Cheaper Power at Orillia.—The Water, Light and Power Commission has made a reduction of 20 per cent. in the rates, which will mean a total saving of over $12,000 per annum. This was rendered possible by the completion of the new plant at the Swift Rapids, which provides all the power the town requires for its industries, whereas formerly a large quantity had to be purchased from other sources in addition to what was obtained from the old plant at the Ragged Rapids. The power rate is now $13.50 per horse-power per annum for ten-hour power and $18 per horse-power for a 24-hour service. The light rates are correspondingly low, the consumers having their choice of flat or meter rates.

G.T.R.'s Annual Track Inspection Completed.—The annual inspection of track over the Grand Trunk Railway System has just been completed. This inspection has occupied six weeks, and has included a thorough examination of rails, ties, etc., on the 1,145 miles of main line, and on some thousands of miles of branch lines. The inspection party travelled over the system in a specially constructed car fitted with electrically-controlled devices for registering the efficiency marks gained by the various sections for excellency of track maintenance. There was the keenest competition between the various section gangs, foremen and supervisors for the honors which are given to the section considered to represent the highest standard of maintenance work. These inspection trips serve to increase the enthusiasm of the men engaged in this important branch of railroad work, and enable the officers to give the closest supervision to the maintenance of the track in a high state of efficiency.

Saving Slack Coal.—In the Canadian semi-anthracite mines and in practically all the sub-bituminous and lignite mines, the proportion of coal wasted as slack varies from 12 to 35 per cent. Everything possible should be done to encourage the use of this class of fuel and it would seem advisable to exact a royalty on total output and rebate all or a portion of the royalty on slack coal provided the same is utilized or marketed. Under the present leasehold system, royalty is exacted on merchantable output only, which, therefore, tends to encourage the waste of slack coal. Slack is produced during mining and handling of the coal and the amount produced is lessened by the use of mining machines and by care in handling.

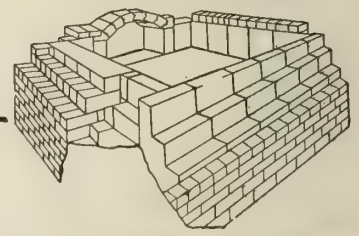
Ottawa Hydro-Electric.—The Ottawa Hydro-Electric Commission has had another successful year. The increase in revenue for 1917 over 1916 shows the total revenue for the first year of the municipal plant $35,000 in 1916. The expenditure showed only $16,000 increase and of this amount $12,000 was for power.

The Liquid Air Society will in the course of a couple of months move their head office to Toronto. For the past several years the administration of the Canadian business has been done from the Montreal office; the factory at Montreal will still be maintained as a branch, and will continue to be the main production unit of the company's several branches.

Attention, Water Power Users
FOR SALE

Four standard 55-inch Crocker Turbine Water Wheels, fitted with graduating gates, complete with shafting, gears, etc. Wheels were manufactured by Jenckes Machine Company, and guaranteed to develop 150 H.P. when horizontal shaft is running at 150 R.P.M. when working under an effective head of four feet. Have never been used and are as good as new.

H. Corby Distillery Co., Limited
CORBYVILLE, ONTARIO (p3h)



Cates Boiler Furnace
Patented 1916

Will last three times as long as ordinary good grade Fire Brick. These blocks are inter-locking, and made so that any handy man or fireman can renew them without disturbing any of the other brick work.

WRITE FOR PARTICULARS.

John W. Gates St. James St., MONTREAL, QUE.

MONCRIEFF'S "UNIFIC" WATER GAUGE GLASSES

Stand in a Class by Themselves for Quality, Efficiency and Economy
A trial will convince you. Write for Catalog

W. J. WALL, 134-136 BLEURY ST., MONTREAL
(Canadian Representative)

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

"Fairbanks Renewable Disc Valves

are strong in construction and service"

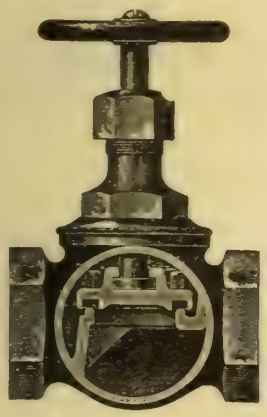
Every Engineer who has put them to a fair test will back up this statement.

In design they are very simple, containing few parts and all these interchangeable.

They are conservatively made; are heavier than the corresponding standard and heavy weights.

The Renewable Disc is the most effective ever produced. It consists of a recessed brass disc into which is spun a specially prepared Bakelite ring.

These discs can be replaced in less than a minute, without removing the valve from the line, and without the use of a single tool, except a wrench to unscrew the valve bonnet. Bakelite Discs have been proven by many experiments to have the longest life of any disc on the market.



Fairbanks will stand the hardest usage, and the most severe conditions of wet or dry steam.

The valve stems are packed with "Palmetto Twist."

Write for prices.

The Canadian Fairbanks-Morse Co., Limited

St. John	Ottawa	Winnipeg	Vancouver
Quebec	Toronto	Saskatoon	Victoria
Montreal	Hamilton	Windsor	Calgary

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

DURABLA

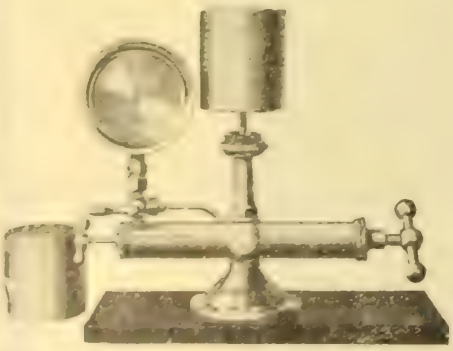
DURABLA
TRADE MARK REGISTERED

Durabla is a Giant in Strength

Many of the largest industries have adopted Durabla Gasket Material as a Standard for all new Construction Work and Repairs, using it on Steam, Air, Oil, Ammonia, Benzol and Alkalies at various temperatures and pressures, on All Flanges where a Permanently Tight Joint is required.

Claims of Superiority are easily made—comparative tests establish facts.

Durabla Manufacturing Company
NEW YORK
Distributors for Canada:
The Canadian Fairbanks-Morse Co., Limited



START THE NEW YEAR RIGHT

Make sure of the ACCURACY OF YOUR GAUGES and then arrange to make PERIODICAL TESTS during the year to see that this accuracy is maintained

THE AMERICAN DEAD WEIGHT GAUGE TESTER

simplifies gauge testing

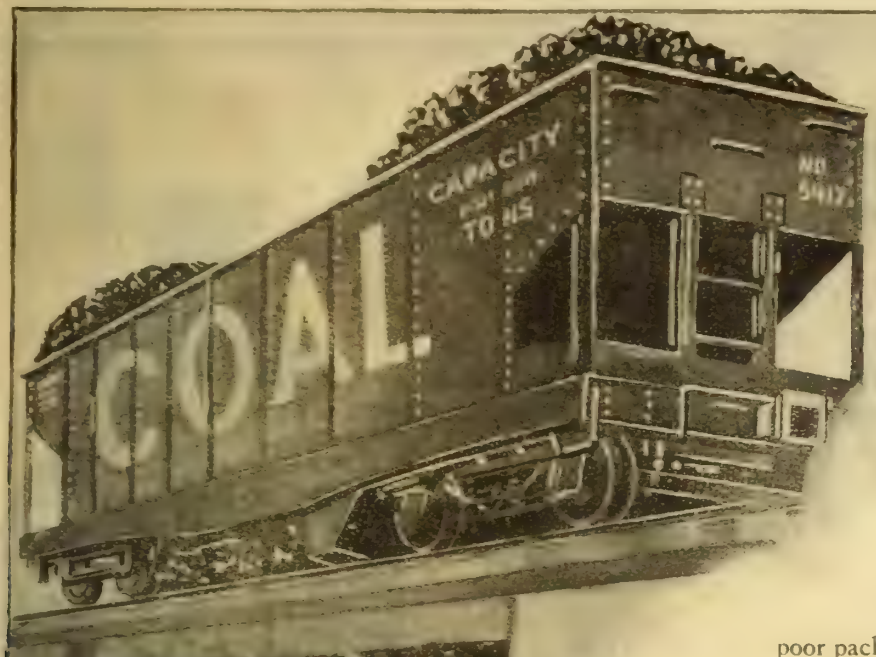
Agents for Canada: CANADIAN FAIRBANKS-MORSE CO., Limited
Montreal Toronto Quebec Calgary

AMERICAN STEAM GAUGE & VALVE MFG. COMPANY
New York Chicago BOSTON Atlanta Pittsburgh

Consult Power House Buyers' Directory

If what you want isn't advertised in this issue, consult our Buyers' Directory. If it isn't listed in our Directory, write us and we will give you the information.

THE CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED.



COAL

A GREAT SOURCE OF POWER

HARD TO GET AND HIGH IN PRICE

Then why waste power by letting steam leak through poor packing in the stuffing box?

When the production of power costs as much as it does at present you should use

TRADE MARK

"PALMETTO"

because it is a packing that can be depended upon to give the longest service under the hardest conditions known to packings--and

Because of the unusually high grade of the materials used and the superior methods of manufacture.

Free working samples to prove quality.

GREENE, TWEED & CO.,

Sole Manufacturers,

109 Duane St., New York

Representatives in Canada: The Canadian Fairbanks-Morse Co., Limited, Toronto, Montreal.

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

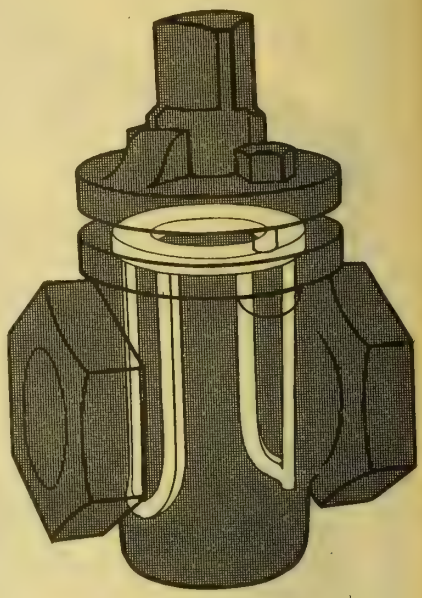
Unfailingly Tight

Know when your valve is closed that it will stay tight

The perfect bearing made by flexible asbestos solidly packed in grooves with the carefully machined plug provides a positively tight joint under high pressures and varying temperatures and insures you against costly and dangerous leaks.

This feature, found only in P. & C. cocks, makes users eager to recommend them for any service.

LET EXPERIENCE BE YOUR GUIDE.



SEND FOR CATALOGUE

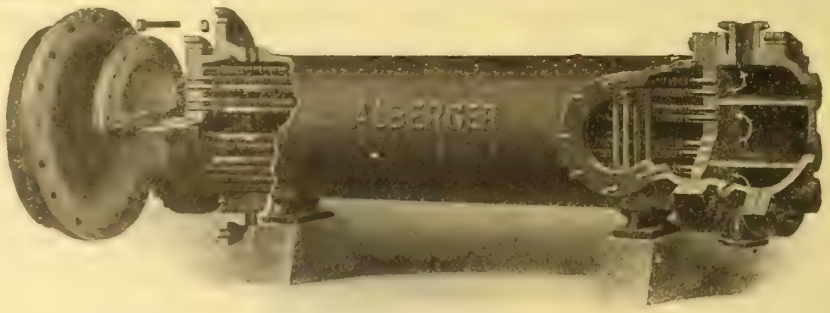
PRATT & CADY COMPANY, INC.
Makers of Valves, Cocks and Hydrants
Hartford, Conn.

GENERAL SALES AGENTS

THE CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED

St. John Quebec Montreal Ottawa Toronto Hamilton Winnipeg
Saskatoon Calgary Windsor Vancouver Victoria

See Alberger Double Floating Tube Heads



Note Alberger Corrugated Tubes of Pure Copper

ALBERGER Heater

These double floating tube heads of the Alberger Heater wholly counteract dangerous strains caused by differential expansion. They allow tubes and tube heads to expand or contract entirely independent of the cast iron shell. Thus the Alberger Heater positively overcomes the chief [illegible] mind the Alberger is the only [illegible] that the Alberger never gives trouble, and consequently serves [illegible]

is backed by a record of economical service it is to your interest to know about. Write for catalog fully describing Horizontal and Vertical Types for boiler feed water, gravity and forced heating systems, hot water service for domestic purposes, etc.

Because these Alberger pure copper corrugated tubes are always clean, they increase the heat unit 50% over straight-tube heaters. Nothing whatever can collect in Alberger tubes; scale cannot form; splitting is absolutely impossible. Bear in mind that brass tubes frequently split; that it is impossible for straight-tube heaters to equal the efficiency of this Alberger Heater.

ALBERGER HEATER COMPANY, BUFFALO, N.Y.

GENERAL SALES AGENTS:
CANADIAN FAIRBANKS-MORSE COMPANY, Limited

St. John Montreal Ottawa Toronto Hamilton Quebec Calgary
Edmonton Vancouver Winnipeg Victoria

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

GRATON & KNIGHT

Standardized Series

LEATHER BELTING

Tanned by us for belting use

There's a double tax on unstandardized belting

A belt unsuitable for the work to be done can lose money for you in two ways at once—

The first way is hard to detect. It occurs in the gradual slowing down of machines; in reducing output; in sapping production. It is simply "leaky power."

The second is a direct dollars and cents loss for expensive repairs and adjustments—an unnecessary loss if the correct belt had been installed originally.

The high cost of *unstandardized* belting was painfully discovered by a mill superintendent recently. It was necessary to replace a 24" 3-ply belt that had given long and profitable service. The superintendent shopped around—and decided to economize by getting a 2-ply belt of a different tannage. "I guess it will do all right," he said.

Here is the record of how that belt "did"—

Jan. 25	New belt installed (labor cost) - -	$26.99
Jan. 27	New belt taken up (labor cost) - -	9.06
Jan. 28	New belt found to be too light for the work. Taken off and returned to factory to have another ply added. Old 3-ply belt repaired and put back temporarily - - - - - - - - -	64.56
Feb. 15	New belt with extra ply added, cost of reinstalling - - - - - - - -	24.87
Feb. 22	New belt taken up - - - - - - -	22.87
Mar. 8	New belt taken up - - - - - - -	23.87
May 3	New belt taken up - - - - - - -	31.37
	Total expense	$203.59
May 7	Tests show efficiency of machine to be less than with the old 3-ply belt.	
May 15	Graton & Knight 24" 3-ply Heart Belt—the **standardized** leather belt for that job—installed.	

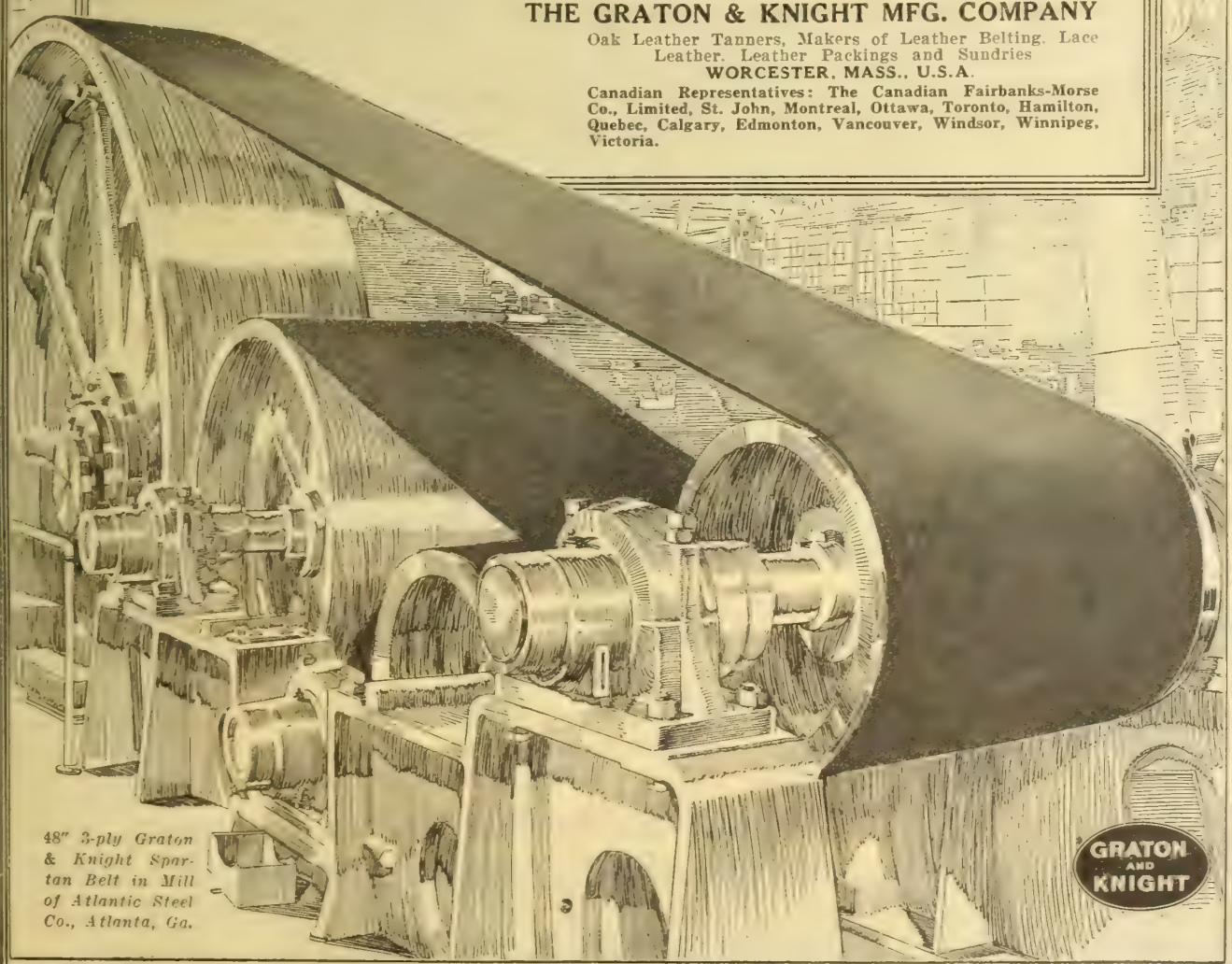
Are you being taxed by the wrong belting? If you are, the remedy is simple—standardize your belts. Let Graton & Knight representatives show you how

THE GRATON & KNIGHT MFG. COMPANY

Oak Leather Tanners, Makers of Leather Belting, Lace Leather, Leather Packings and Sundries

WORCESTER, MASS., U.S.A.

Canadian Representatives: The Canadian Fairbanks-Morse Co., Limited, St. John, Montreal, Ottawa, Toronto, Hamilton, Quebec, Calgary, Edmonton, Vancouver, Windsor, Winnipeg, Victoria.



48" 3-ply Graton & Knight Spartan Belt in Mill of Atlantic Steel Co., Atlanta, Ga.

GRATON AND KNIGHT

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

FOR Steam or Air Drill, Pneumatic Tools, Boiler Flue Cleaning, Syphon Connections, Suction Lines.

For all kinds of Oil, Gasoline, Paints, Hydraulics, Gas.

"PENFLEX" METAL HOSE

INTERLOCKING

An all Metal Flexible Hose. Manufactured in Bronze or Galvanized Steel. Will withstand highest pressures. Is unsurpassed for durability and pressure resisting qualities.

Large Stock Carried in Canada

Pennsylvania Flexible Metallic Tubing Co.

Philadelphia, Pa.

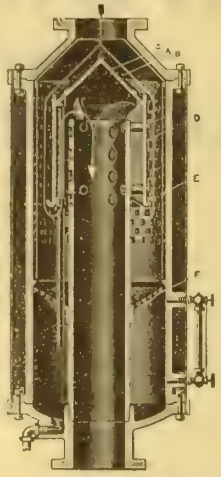
Canadian Agents:

The Canadian Fairbanks-Morse Co., Limited

St. John, Quebec, Montreal, Ottawa, Toronto, Hamilton, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria

III IMPORTANT THINGS

TO CONSIDER ABOUT A SEPARATOR.



I. THE PLAN—Is it sensible, will it work, no matter how large the Separator or how well made?

II. THE SIZE—Is it big enough regardless of plan, will it hold a good dose of water?

III. THE CONSTRUCTION—Is it strong enough, are flanges heavy, how will it look by the side of a nicely finished engine? Send for catalog and note these points in

Sweet's Separators

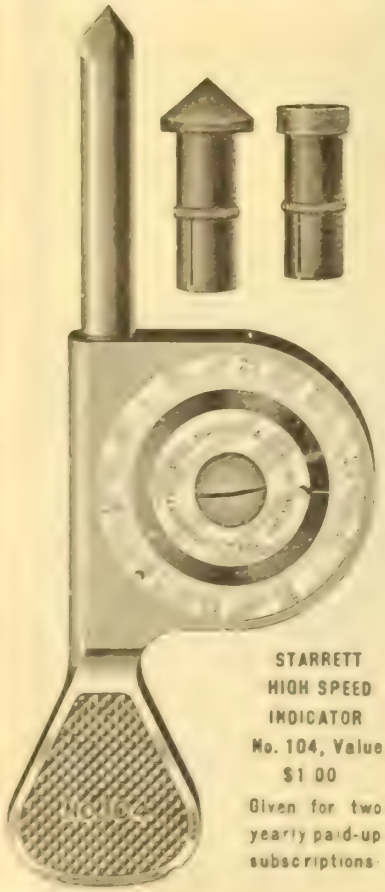
DIRECT SEPARATOR COMPANY

820 Geddes Street - SYRACUSE, N.Y.

General Sales Agents:

Canadian Fairbanks Morse Company, Limited

St. John, Montreal, Quebec, Ottawa, Toronto, Hamilton, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria



STARRETT HIGH SPEED INDICATOR No. 104, Value $1.00 Given for two yearly paid-up subscriptions

You May Have This Speed Indicator without Spending a Cent

if you are a subscriber to "POWER HOUSE." If you are not a subscriber, send in your own subscription together with two others, and the indicator you are entitled to will be mailed to you immediately.

To subscribers who send us two NEW yearly paid-up subscriptions we will send this $1.00 indicator.

"POWER HOUSE" is designed to give Canadian Engineers, Superintendents and Power Users all the latest and best information in the engineering field. A little work among your engineer friends and acquaintances will earn for you this handy indicator without any trouble. Try it and see how easy it will be.

PUBLISHED MONTHLY AT $1.00 PER YEAR

Start in TO-DAY to earn one of these Handy Tools

POWER HOUSE 143 University Ave., Toronto

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

SKF

BALL BEARING HANGERS

For full information, write

CANADIAN SKF COMPANY, LIMITED, Toronto, Ont.

SALES AGENTS

THE CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED

St. John, Quebec, Montreal, Ottawa, Toronto, Hamilton, Windsor, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria.

MACLEAN'S MAGAZINE for FEBRUARY

John Bayne Maclean — Robert W. Service
Agnes C. Laut — George Bernard Shaw
Archie P. McKishnie — Alan Sullivan, *et al.*

RAISING THE CANADIAN ARMY

The leading article in the February issue of MACLEAN'S MAGAZINE will give the inside story of the formation of the "First Thirty Thousand" and of the part **Sir Sam Hughes** played in it. It will bristle with stories never told before.

SOLVING OUR IMPERIAL PROBLEM

The second article by **George Bernard Shaw** will appear. It is headed, "The Folly of Ulster," but it lays down the basis on which the British Empire must be constituted after the war.

BEHIND THE CANADIAN LINES

A second article by a Canadian artist serving in France, **H. W. Cooper,** giving some unusual experiences and profusely illustrated with pen-and-ink drawings by the author.

FINDING THE MEN FOR WAR

An article dealing with the labor problem by **Agnes C. Laut.** It shows how acute the crisis in man power has become in Canada and the United States and suggests the remedy.

WHEN WILL THE GOVERNMENT START?

An editorial article on the need for immediate action on the part of the Government to increase food production in Canada during 1918—a strong indictment of government laxness

ROBERT W. SERVICE

Another stirring war poem in the new series by this master of martial verse, Canada's most famous poet.

SAFETY IN SUBSTITUTES

An article by **Ethel M. Chapman** on methods of food conservation during the winter months.

THE BALLAD OF THE FORTY SILENT MEN

A story of the battle of Cambrai in verse form by **Alfred Gordon,** a young Canadian poet of remarkable promise.

FICTION

THE WINNING OF YOLANDE

A delightful love story, the third and last of a series by **Ethel Watts Mumford.**

IN THE SHADOW OF OLD CREATION

A strong story of adventure by **Archie P. McKishnie.**

THE PAWNS COUNT

Another long instalment of the secret service serial by **E. Phillips Oppenheim.**

THE MAGIC MAKERS

Second instalment of the strong Canadian serial story by **Alan Sullivan.**

CAPTAIN CARLOTTA

A story of submarine chasing and of a mysterious invention by **W. Victor Cook.**

ALL THE USUAL DEPARTMENTS

The Business Outlook.
The Investment Situation
Books
Women and their Work
Review of Reviews.

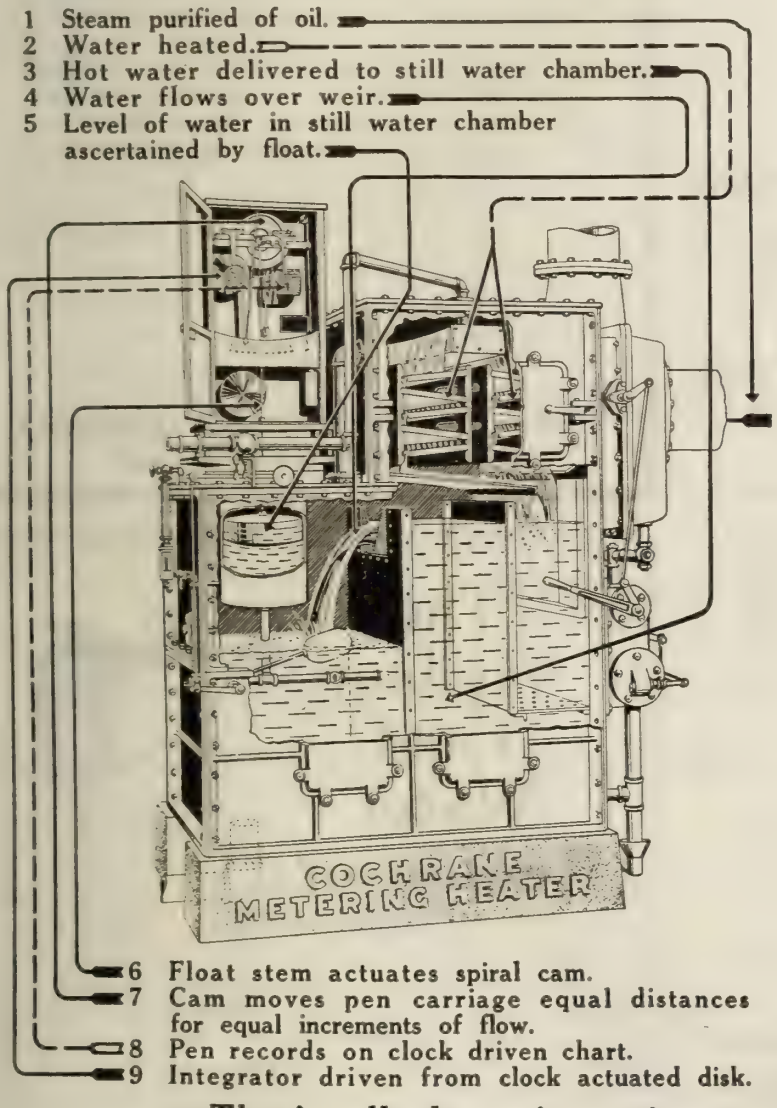
THE BEST NUMBER YET.

At All News-Stands 20c.

Finding and Stopping Waste

in

Modern Boiler Rooms


1 Steam purified of oil.
2 Water heated.
3 Hot water delivered to still water chamber.
4 Water flows over weir.
5 Level of water in still water chamber ascertained by float.
COCHRANE METERING HEATER
6 Float stem actuates spiral cam.
7 Cam moves pen carriage equal distances for equal increments of flow.
8 Pen records on clock driven chart.
9 Integrator driven from clock actuated disk.

That's all there is to it.

KEEPING BOOKS WITH THE BOILER

How many pounds of water are your boilers evaporating per pound of coal?

Are they doing 6 or 7 pounds, or just a shade better, or are they up to the top notch, say 10 or 11 pounds of water evaporated per pound of combustible?

The Cochrane Metering Heater tells how much you are getting for your money

Send for Catalogue No. 820.

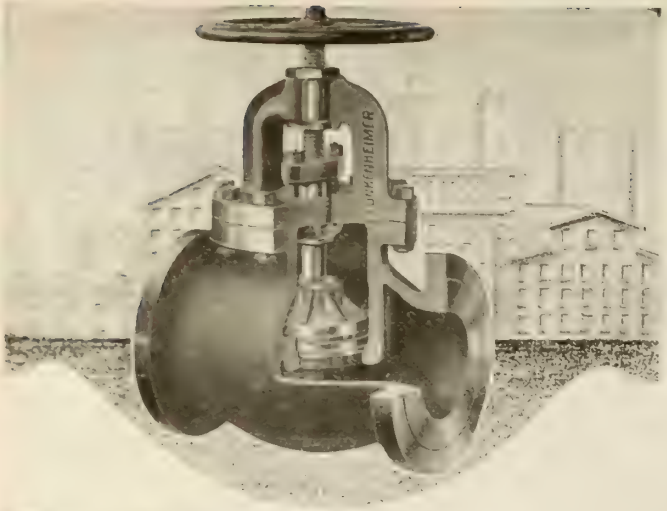
Other Cochrane aids to boiler room economy include open feed water heaters, steam stack and cut-out valve heaters and receivers, metering heaters and independent meters. Sorge-Cochrane hot process water softeners, steam and oil separators, and multiport back pressure, atmospheric relief, flow and check valves.

Head Office: Toronto. Sales Offices: Montreal, Halifax, Sydney, Ottawa, Cobalt, South Porcupine, London, Winnipeg, Calgary, Edmonton, Nelson and Vancouver.

CANADIAN ALLIS-CHALMERS

LIMITED

Power Plant Equipment, Mining, Crushing, Hydraulic and Milling Machinery, Contractors' Plant and Architectural Bronze and Iron Work.



The chief requisite for the control of steam power

LUNKENHEIMER

Iron Body Bronze Mounted

Globe, Angle and Cross Valves

possessing extreme strength and durability are particularly adapted for steam service.

Their reliability has been proven under all service conditions. They incorporate many improvements in design, including the well-known Lunkenheimer "Seat-guard," which aids in preserving the seating faces and keeping them clean. The seating surfaces are regrindable; bearings are bushed to reduce wear and all parts, including the seat ring and disc, are renewable.

The materials used and the workmanship are of that high quality which characterizes all Lunkenheimer Products.

Standard Pattern for 125 pounds; Heavy for 175 pounds and Extra Heavy for 250 pounds working steam pressure.

Buy the best—they are the cheapest. Leading dealers everywhere sell them.

Descriptive Booklet No. 570-DC illustrates all patterns. Write for a copy.

Lunkenheimer Steam Boiler Valves and Fittings are registered for use in Canada. Complete list of Registration Numbers will be sent on request.

THE LUNKENHEIMER CO.
"QUALITY"

Largest Manufacturers of High-Grade Engineering Specialties in the World

CINCINNATI, O., U.S.A.
New York Chicago Boston London

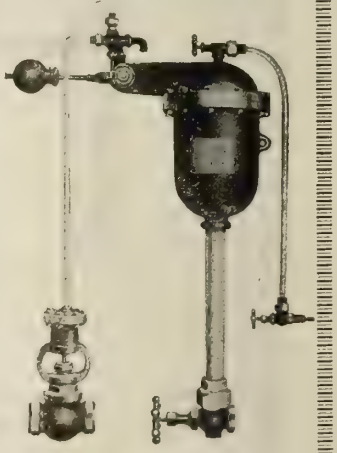
Immediate Delivery

324 H.P. B. & W. 2—42" Drums 23' 10" long. 7/16 Shell Plate. Double Riveted lap seam. 144—4" tubes 18' long. Sectional header wrought mild steel. Splendid condition.

500 H.P. Geary type. 2—48" Drums 24' 6" long. ⅝ Shell Plate. Triple riveted double butt strap, longitudinal seam. Steel headers with B.&W. ground joint tube caps. 237—4" tubes 20' long. Splendid condition.

Power Plant Equipment Company
310 Dominion Bank Building, Toronto

The Vigilant Feed Water Regulator



Perfects boiler feed regulation. With it on the job day and night, you feel no anxiety; you know it cannot fail. The Vigilant is guaranteed to keep water level within ¼" of middle gauge.

There's another reason why you need the Vigilant. It will lower your coal consumption 3 to 17%.

Send for Engineers' Data Cards To-day.

Danger Without

The Vigilant to give positive protection is ever present. Let the feed water become high or low—a needless, costly accident too frequently results.

The Chaplin-Fulton Manufacturing Company
28 Penn Avenue - - Pittsburgh, Pa.

Positively Removes Boiler Scale and Prevents Further Formation

Users say Boico does that and more. It is the perfect boiler scale remover and preventive. It also saves fuel, oil and packing. Boico does not carry over in the steam, foam or prime. It never injures packings or valves.

Boico will rid your boiler of every bit of scale.

Free trial to prove it will.

MORE HEAT

from any grade of coal, coke or wood burned on Anti-Clinker Shell Bar Grates.

Copper Asbestos Boiler Gaskets

never blow out and never stick. Made of corrugated copper, with pure asbestos cord-filled corrugations. Use them and end all leaks in pipe lines.

Shell Bar Grates

Are built on a scientific air-draft principle. Fully 50% of their total surface is air space. They provide abundant air, and abundant air commands a perfect combustion, and a perfect combustion adds 25% more heat to the fuel gases and positively prevents clinker formation. Anti-Clinker Shell Bar Grates insure more heat from less coal. They're two grates in one; always clean; and they cannot twist or warp.

Write.

Shell-Bar Boico Supply, Limited

376 Dufferin St., Toronto, Canada

LESS COAL

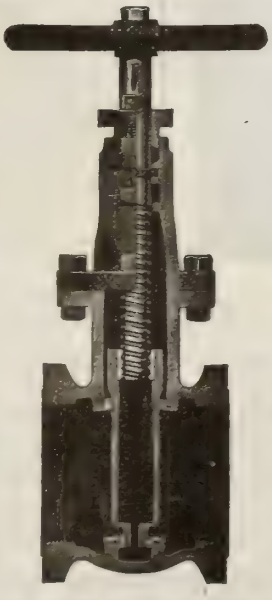
Because Anti-Clinker shell bar grates so intensify the heat that no fuel gas escapes in smoke.

Tip-It Patent Welding Process makes it possible to obtain tools with carbon shank permanently united to cutting tip of high-speed steel.

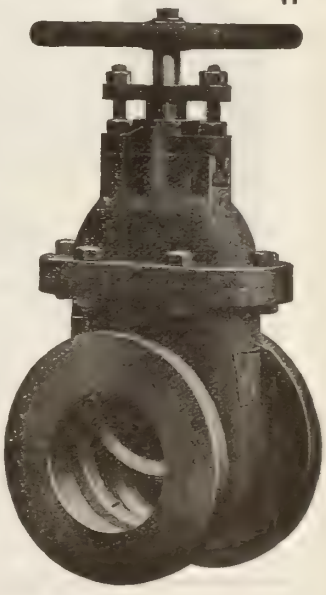
KERR

("New KEYSTONE" Pattern) GATE VALVES

If you have not used any of these New Pattern Valves, specify "KERR" in your next order. We want you to get acquainted with the most reliable valve on the market.



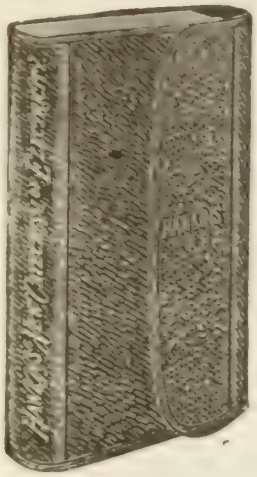
If you have been using them, we are confident that our satisfaction will bring us your repeat orders. These valves will never cause you or your customer the slightest trouble. Their high quality is consistent.



When you buy a "KERR" Valve you get a guaranteed article that is backed by a reliable firm. Many of the largest distributers of valves in Canada have sold "KERR" Valves for over 25 years, and are still recommending them as the "Best Valve." Write us for particulars.

Kerr Engine Co., Ltd., Valve Specialists **Walkerville, Ont.**

Books for the Engineer's Library



Hawkins' New Catechism of Electricity

It contains 550 pages with 300 illustrations of electrical appliances; it is bound in heavy red leather, with full gold edges and is a most attractive handbook for electricians and engineers. One-third of the book is devoted to the explanation and illustrations of the dynamo, with particular directions relating to its care and management—$2.10 post paid.

Engineers' Examinations

By N. Hawkins, M.E.

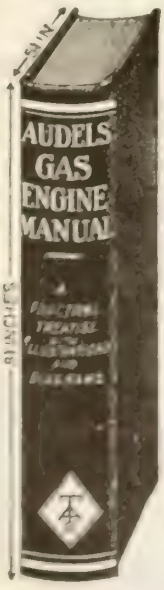
It presents in a condensed form the most approved practice in the care and management of steam boilers, engines, pumps, electrical and refrigerating machines, with examples of how to work the problems relating to the safety valve, strength of boilers and horse power of the steam engine and steam boiler.—$2.10 post paid.

Steam Turbines

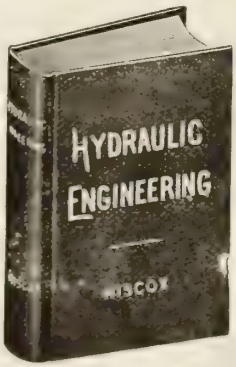
By Leland.

A reference work on the development, advantages and disadvantages of the steam turbine; the design, selection, operation and maintenance of steam turbine plants and turbo-generators. 135 pages. Illustrated.—$1.00.

Audel's Gas Engine Manual



A practical treatise relating to the theory and management of gas, gasoline and oil engines, including chapters on producer gas plants, marine motors and automobile engines.—$2.00.



Hydraulic Engineering

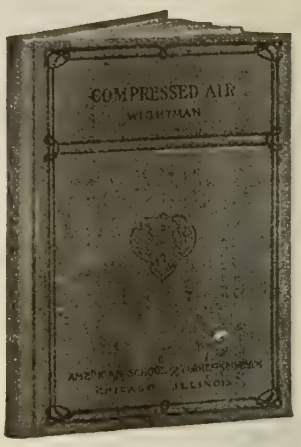
By G. D. Hiscox.

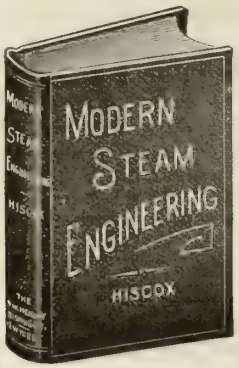
This comprehensive book of Hydraulics written by an experienced engineer, is a practical treatise on the properties, power and resources of water for all purposes, including the measurement of streams, the flow of water in pipes or conduits; the horse-power of falling water; turbine and impact water wheels; wave motors, etc. All who are interested in Water Works Development should have a copy. 320 pages, 305 illustrations. Price $4.15 post paid.

Compressed Air

By L. I. Wightman, E.E.

A reference work on the production, transmission and application of compressed air; the selection, operation and maintenance of compressed air machinery; and the design of air power plants. Illustrated.—$1.10.





Modern Steam Engineering in Theory and Practice

By Hiscox.

This book has been specially prepared for the use of the modern steam engineer, the technical students, and all who desire the latest and most reliable information on steam and steam boilers, the machinery of power, the steam turbine, electric power and lighting plants, etc. 450 pages. 400 detailed engravings.—$3.15 post paid.

Boiler Construction

By Kleinhans.

The only book showing how locomotive boilers are built in modern shops. Shows all types of boilers used; gives details of construction; practical facts, such as line of riveting punches and dies, work done per day, allowance for bending and flanging sheets and other data that means dollars to any railroad man. 421 pages, 324 illustrations, six folding plates.—$3.00.

Compressed Air, Its Production, Uses and Application. *By G. D. Hiscox, M.E.*

Comprising the physical properties of air from a vacuum to its liquid state, its thermodynamics, compression, transmission and uses as a motive power in the operation of stationary and portable machinery, in mining, air tools, air lifts, pumping of water, acids and oils and the numerous applicances in which compressed air is a most convenient and economical transmitter of power.—Price $5.15 post paid.

Boiler Accessories

By Walter S. Leland, S.B.

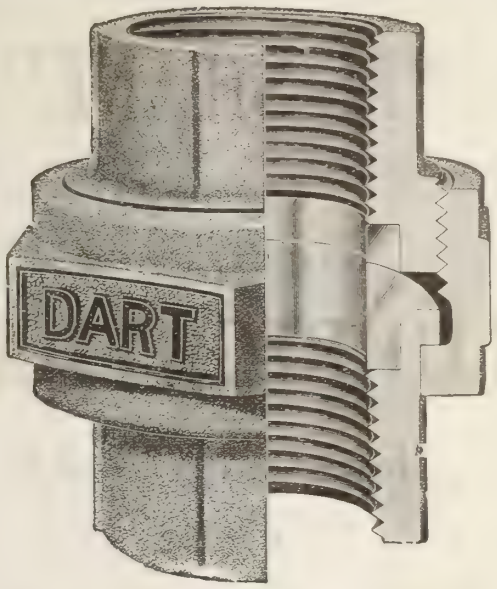
Assistant Professor of Naval Architecture, Mass. Institute of Technology, American Society Naval Architects and Marine Engineers. 144 pp., 80 illus. Cloth binding. A treatise giving complete descriptions of the various accessories of the boiler room and engine room essential to economical operation, such as evaporators, pumps, feed-water heaters, injectors, mechanical stokers, etc., with practical instruction in their use.—Price $1.10 post paid.

Technical Book Department

MacLean Publishing Company **143 University Ave., Toronto**

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

This is the Union
that Ever Stays Tight;
the Union that Never
Leaks, Never Rusts,
Never Corrodes—
because it is



Bronze to Bronze

at the Joint

This is the Union that never stretches, never pulls apart—because iron parts are non-porous and heavy.

This is the Union any one can install—because the ball-shaped seat makes it easy for least experienced hands to obtain permanently tight connections in pipe lines of every kind. It doesn't make the slightest difference whether pipes are in or out of line.

This is the Union that costs the least—because it never gives trouble.

Order from any Supply House.

Made in Canada by

DART UNION COMPANY, LIMITED

TORONTO, CANADA

For a Dart Union imperfect — Two New Ones FREE.

DART

"McSHANE"

Patent Sight-Feed

LUBRICATORS

Single or Double Feed

Double Feed

Capacities ½ pt. to 4 pts.

POLISHED BRASS
OR NICKEL PLATED

With or Without
OIL INDICATOR

Especially Adapted for the Higher Class of Engines

T. McAvity & Sons

Limited

Brass and Iron Founders
Wholesale and Retail Hardware

St. John, N.B. - Canada

Branches at
MONTREAL TORONTO WINNIPEG VANCOUVER
LONDON, England DURBAN, South Africa
Established 1834

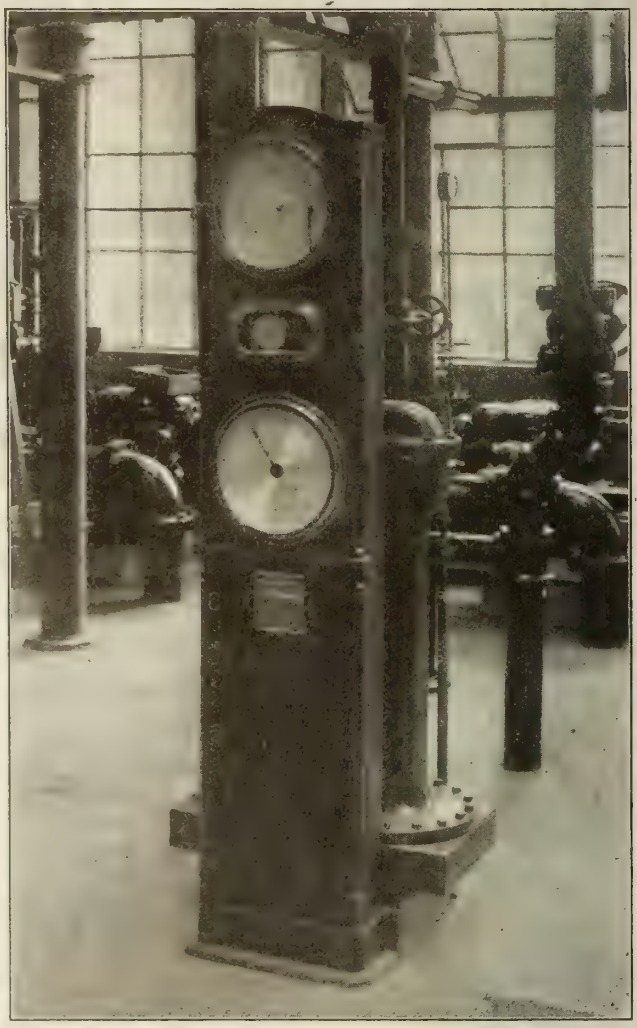
WOULD YOU

Hire a Foreman to Watch a Job and Then *Blindfold* Him?

NOW WOULD YOU?

WE SHOULD HOPE NOT.

THEN *WHY* KEEP YOUR OPERATING ENGINEER IN THE DARK REGARDING CONDITIONS IN HIS PLANT,—THINGS HE SHOULD *KNOW* ABOUT AND NOT HAVE TO GUESS AT.



VENTURI METER AT GOODYEAR TIRE AND RUBBER CO.

VENTURI

STEAM & BOILER FEED METERS

SUPPLIED THE REQUISITE DATA TO ENABLE THE ENGINEER AT THE TORONTO GENERAL HOSPITAL TO SAVE SUFFICIENT COAL IN THREE MONTHS TO PAY FOR ALL THE METERS.

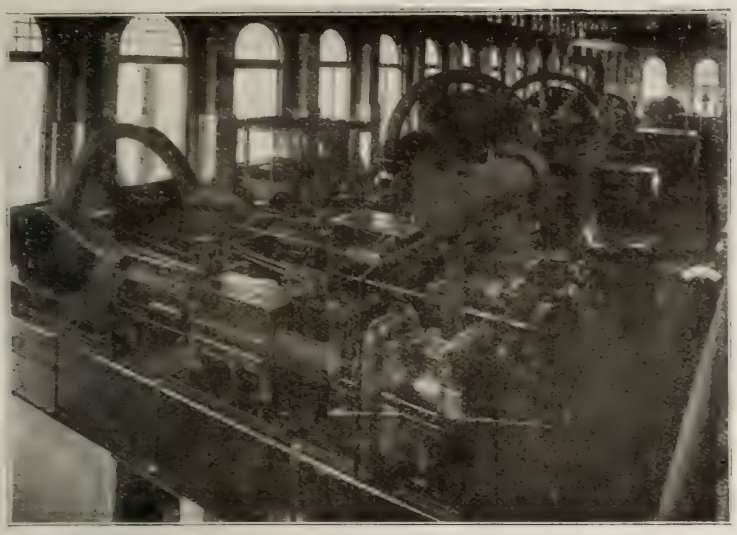
WHY NOT WRITE US NOW?

Allen General Supplies Ltd.

205 YONGE ST., TORONTO

Representing

THE BUILDERS IRON FOUNDRY



Positive Lubrication Assured

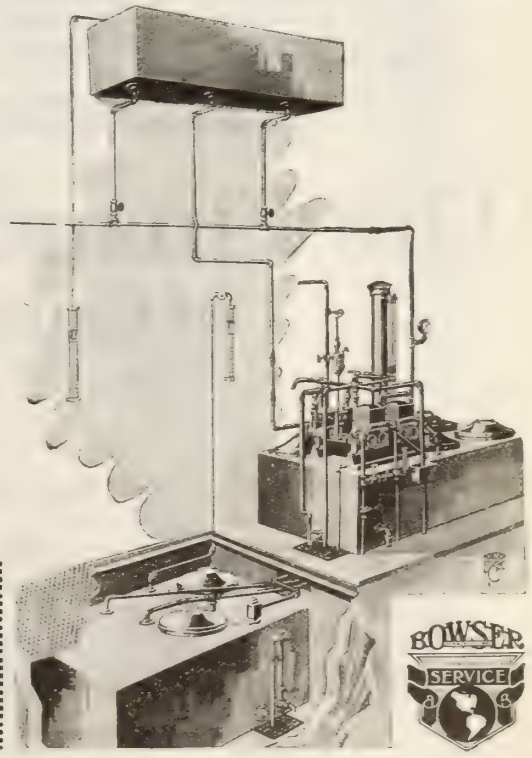
WHEN YOUR PLANT IS UNDER THE CARE OF THE

BOWSER ESTABLISHED 1885 **Lubricating Oil Circulating Filtering** **SYSTEMS** THE STANDARD ALWAYS

It is an everyday occurrence for some factories to have shut-downs once or twice a day, and the cause of this, many times, is improper lubrication. Dirt and grit gets into the oil during use. When such oil comes in contact with the bearings there is at once an unnecessary friction and "hot boxes" result—then shut-downs follow.

With the Bowser Filtration Systems shut-downs are avoided. More power is obtained from the engine and less wear and tear on the parts is assured. The dirty oil is taken by the system into its filtering compartment, where all the impurities are extracted. From this compartment the oil is returned to the clean oil tank ready for use again—as good as new. This system not only saves machinery, but it saves oil, as well. The refuse and dirty oil can be drawn from the chamber used to collect it and many uses can be found for it. This saving alone amounts to a sum worth considering.

Bowser Systems are built for any sized plant, to fulfill any requirement. The 6F shown below is especially adapted to plants whose engines are on ground floor instead of in basement, and where large volumes of water return with the dirty oil. Let us be your advisors in lubricant and power problems. Write to-day, explaining your requirements—no obligation on your part.



S. F. Bowser & Co.

INCORPORATED

Toronto, Canada

Sales Offices in All Centres

Representatives Everywhere

WRITE FOR BOOKLET

If any advertisement interests you, tear it out now and place with letters to be answered

Mr. Bruce's Counsel

SPECIFICALLY APPLIED, MR. BRUCE'S COUNSEL may be said to recommend that business men should read every week THE FINANCIAL POST OF CANADA, to inform themselves concerning current events in the realm of Canadian business and public affairs.

Frank E. Mutton, Vice-President of the International Time Recording Company, of Canada, wrote the following letter to the publishers of THE POST:

Attention, Editor:

Recently we sent you a subscription covering the delivery of THE FINANCIAL POST to each of our Sales Agents and Salesmen throughout Canada. This was prompted by the fact that, in our opinion, your paper is the best barometer in Canada of what is going on in the different industries from one ocean to the other in this country. Your paper contains information invaluable to any traveling representative of any firm.

(Signed) F. E. MUTTON.

Dated Oct. 12, 1917.

IN effect, THE FINANCIAL POST represents a Current Events Club, met weekly for the consideration and study of current affairs in Canada in relation to itself and the world at large. It represents the assembly of many, many surpassingly well-informed contributors who discuss intelligently, lucidly and proportionately, Canada's public and business affairs. No more stimulating and worth-while paper is published in Canada for the man who wants to be able to talk confidently, at the club, luncheon, board meeting, business council, public meetings, about Canadian public affairs.

THE price, $3, is nothing to the man who really wants to know. Three dollars spent for knowledge that multiplies a man's power and pleasure and satisfaction is a small, small sum to pay. We make our appeal for subscriptions to men who really want to know and who will take time each week-end to read profitably.

If you are willing to give this time, prove it by signing and mailing the coupon below

The Financial Post
of Canada

.....1917

THE MACLEAN PUBLISHING CO., LIMITED,
143-153 University Ave., Toronto.

Send me THE FINANCIAL POST. I will remit year's subscription, $3.00, on receipt of bill.

Name .....

With .....
(Name of firm, etc.)

Address .....

Talk Current Events

A Talk by H. Addington Bruce, Author of "The Riddle of Personality," "Psychology and Parenthood," Etc.

WHAT do you know about the doings in this great world wherein we live?

Do you try to form a really intelligent and well-considered opinion regarding events the world over?

Do you ever discuss their significance with friends and neighbors?

If asked what you think of any particular event, you are perhaps ready with an answer. Is your answer anything but a snap judgment, determined by prejudice rather than by reasoning analysis?

I put these questions not to be disagreeable, but because, if necessary, I want to spur you to appreciate the value that there is in discussion of current events.

Many people, fortunately, appreciate its value instinctively. Perhaps you are one of these. Many others are beginning to appreciate it.

This is shown by the growing popularity of clubs and classes on current events.

Only a few years ago such clubs and classes were almost unheard of. To-day most of our bigger cities have half a dozen of them or more.

In one city—Boston—a talented woman of my acquaintance draws an income of thousands of dollars a year from her leadership of current events classes.

Other men and women have similarly discovered that interest in current events is increasing so rapidly that they can well afford to organize classes like those conducted by the Boston woman.

Still, there remain many people—thousands of people—who never discuss current events. Many thousands more discuss only such events as come under the headings of "crime," "the theatre," and "sports."

These are the people I want to reach. They are the people I want to rouse to recognition of the practical helpfulness they will find in discussion of current events in general.

Current events clubs and classes might well be organized in every neighborhood, with weekly meetings to take up the outstanding happenings in international affairs, national politics, literature, art, music, science and industry.

Regular attendance at, and active participation in, these meetings will prove to be an education in itself.

It will enlarge the mental horizon and broaden the moral sympathies. By disciplining the mind to active thought it will raise the level of workaday efficiency.

It will make for a more alert, a more conscientious citizenship. It will give zest and color to a life which perhaps has hitherto been pathetically drab.

Unsuspected powers will be awakened With a better grasp on the realities of life, the whole personality will expand.

One evening a week is certainly not too much to give to a discussion of the day-to-day developments in our wonderful world.

It may mean doing without an evening at cards or at the musical comedy, or at the dance hall. But this, after all, is not a terrible sacrifice.

And from the occasional talk over current events will come more profit than could possibly come from any number of evenings spent in card-playing, dancing, or listening to musical comedies.—Reprinted from the Toronto Daily Star.

OLD "EXPANSION" AND "CONTRACTION"

can not get the JEFFERSON seat-ring loose

Straining and pulling to their utmost these forces are unable to even loosen the brass seat ring of a

JEFFERSON UNION

That's because it is put in right—scientifically.

First—the ring is a section of drawn brass tube—much superior to a cast brass ring.

Then it is embedded—under enormous pressure, into a recess until it is practically a part of the malleable casting itself.

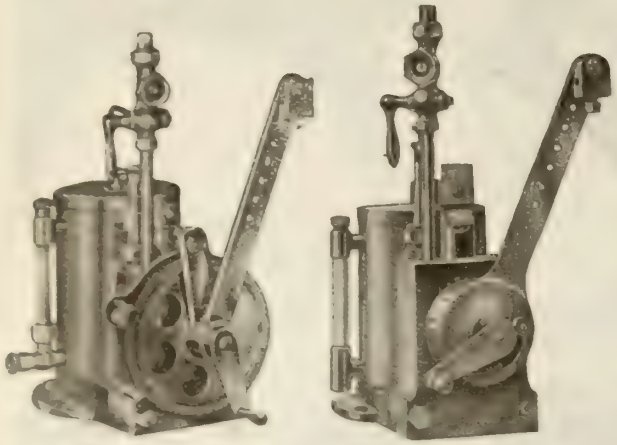
And this recess is back away from the runway and the contents of the pipe. Here lies the secret—the reason that contraction and expansion are unable to dislodge it and cause wire drawing and eventually leakage.

The other features of the Jefferson are unusual too.

The book "Unions" gives them all. Shall we send you a copy?

Jefferson Union Company, Lexington, Mass.

The Rochester Automatic Force Feed Lubricators



Ratchet Drive Pattern — Clutch Drive Pattern

Force feed lubrication is acknowledged to be the only correct method for lubricating the cylinders of all types of engines, pumps and air compressors, so that there is no need for any argument in its favor.

We recently received an unsolicited testimonial from the Chief Engineer of an Ontario Municipal plant in regard to a Rochester Lubricator. This is extremely unusual—if we were manufacturing patent medicines, unsolicited testimonials would be expected, but seeing that we are engineers, whose business it is to manufacture Pumps, Elevators, and Steam Appliances generally, why, a testimonial, especially one like this is something to be proud of.

This Engineer goes on to say:

. . . . . "I admire the Rochester Lubricator from the standpoint of simplicity, reliability, excellence of workmanship, and good materials. . . . suffice it to say, I know a good thing when I see it, hence I would not have ordered ANOTHER Rochester had it not been a satisfactory lubricator."

Note he says "another," and he tells us that this "other" has been in use for **twelve years and still going strong.**

It's too bad that we are unable to print this engineer's name and official capacity—he objects to publicity. We have it on file at our head office for reference, if necessary.

After all, this is only another proof of the excellence of our products.

Darling Brothers, Limited

120 Prince Street

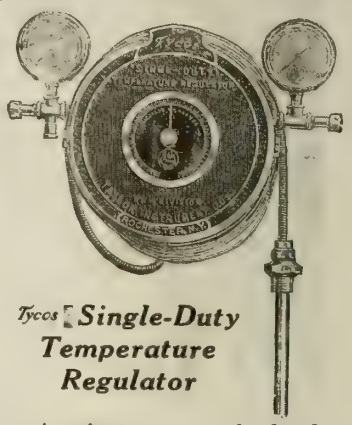
TORONTO MONTREAL WINNIPEG

Tycos

TEMPERATURE INSTRUMENTS

Indicating Recording Controlling

- Mercurial, Recording and Index Thermometers for all industrial and laboratory applications.
- Electric Contact Thermometers.
- Temperature, Pressure and Time Regulators.
- Mercury Column Vacuum Pressure and U Gauges.
- Base Metal, Rare Metal and Radiation Pyrometers.
- Fery Radiation Pyrometers.
- Hygrometers.
- Hydrometers.
- Mineral Oil Testing Instruments.
- Aneroid Barometers.
- Mercurial Barometers.
- Recording Barometers.
- Pocket Compasses.
- Surveying Compasses.
- Rain Gauges.
- Anemometers.
- Air Meters.
- Thermographs.
- Hand Levels.
- Aviation Barometers.
- Inclinometers.
- Sphygmomanometers.
- Fever Thermometers.
- Urinary Glassware.
- Thermometers of all kinds for home and general use.



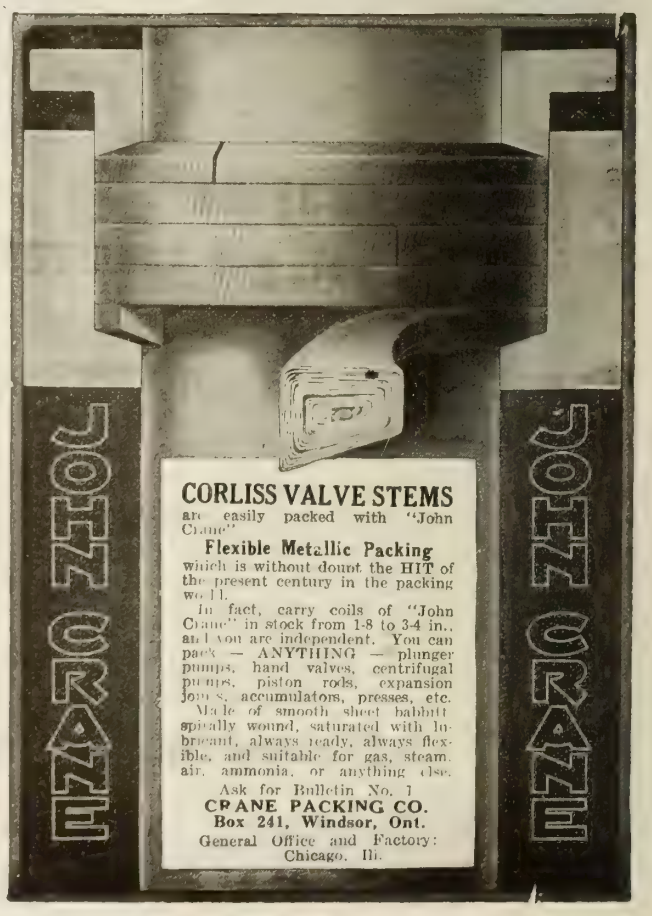
Tycos ***Single-Duty Temperature Regulator***

An instrument absolutely essential in industries where temperature control is a determining factor in production.

Our catalogue gladly sent if requested.

Taylor Instrument Companies

ROCHESTER, N.Y. C6


JOHN CRANE
JOHN CRANE
CORLISS VALVE STEMS
are easily packed with "John Crane"
Flexible Metallic Packing
which is without doubt the HIT of the present century in the packing world.
In fact, carry coils of "John Crane" in stock from 1-8 to 3-4 in., and you are independent. You can pack — ANYTHING — plunger pumps, hand valves, centrifugal pumps, piston rods, expansion joints, accumulators, presses, etc.
Made of smooth sheet babbitt spirally wound, saturated with lubricant, always ready, always flexible, and suitable for gas, steam, air, ammonia, or anything else.
Ask for Bulletin No. 1
CRANE PACKING CO.
Box 241, Windsor, Ont.
General Office and Factory:
Chicago, Ill.

JOHNS-MANVILLE Refractory Cements

JOHNS-MANVILLE SERVICE COVERS THE CONTINENT

An economical means of speeding up the boilers

IT'S an accepted axiom of good boiler practice that rapid combustion at high temperatures improves boiler economy.

But increased temperatures shorten the life of ordinary settings. The fire clay used as a mortar or bond cannot withstand high furnace heats; and in addition it squeezes out at joints when the brickwork expands. This leads to air leaks and incomplete combustion, and the boiler must be shut down every so often for setting repairs.

Johns-Manville Refractory Cements enable you to increase furnace temperatures because they are specially compounded for high temperature service. They cushion the fire-brick, absorbing expansion and contraction without displacement, and they hold their strength. A mortar of "No. 26" or "No. 31" Johns-Manville High Temperature Cement for the bond, and a wash-coating of "No. 32" over the inner face of the setting—that's what will insure tight walls and fewer shut-downs. Just give us a chance to prove it.

The CANADIAN H.W. JOHNS-MANVILLE CO., Ltd.

MONTREAL TORONTO VANCOUVER WINNIPEG

Canadian Association of Stationary Engineers

Incorporated May, 1887 — Incorporated at Ottawa, June, 1917

An organization having as its aims and objects:—

To promote the knowledge of its members in the art and science of Steam Engineering.

The dissemination of information beneficial to the members of the association in the discharge of their calling.

To further and protect the interests of competent engineers, and receive such as members of this organization.

To secure, through proper legislation, the greatest security in operation of steam plants.

To assist unemployed members to secure positions.

To maintain freedom of action between employer and employee.

The members of the Association subscribe to the above in the full belief that ability and knowledge of one's profession are necessary to insure the highest degree of success.

Labor Study Energy

These three essentials have been responsible for the success of the world's greatest men. They are no less essential for yours. We cannot all become great, but this fact does not lessen the necessity for the exercise of these essentials in our individual occupations. Cool, calm, calculating judgment characterizes the successful power house operator of to-day. The demands on the engineer of to-day are many, and the obstacles in his path are great. To assist in the overcoming of these and help the accomplishment of great works, material, moral and educational, is the desire of all our members.

The benefits accruing from association with members of his fraternity, the opportunity to benefit by their experience, and the inspiration to greater effort by reason of their success render membership in this association indispensable to all progressive engineers.

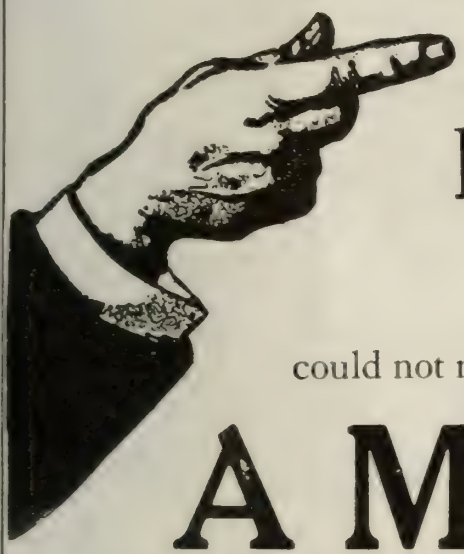
If you are interested in such an organization and live where less than fifteen engineers are located, send for a copy of our constitution and application blanks for admission to nearest branch lodge. If there are more than fifteen engineers in your community, get together and send for particulars regarding formation of a branch lodge.

J. H. HALE, General Secretary, C.A.S.E.

230 Caroline Street — Hamilton, Ont.

If it were other than Flawless Back Leather

Genuine British Oak Tanned



Even D. K. McLaren's Leather Belting

could not maintain Positive Grip at a belt speed of

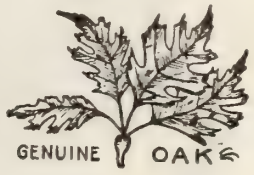
A Mile a Minute

But you can depend on D. K. McLaren's Belting *retaining* its Positive Grip at a speed much greater than a mile a minute.

D. K. McLaren's Belting is made from leather taken from the centre of selected hides. It's the nearest to stretchless belting of any belting made.

Pulling greatest loads at greatest speeds never reveals "soft places" in McLaren Belting, for the good reason that shoulder, neck and belly leathers are never used in McLaren Belting. Nothing is used but the flawless back—*the heart of the hide.*

And McLaren's Genuine British Oak Method of Tanning gives to the finished McLaren belt really marvelous toughness, greatest pulling power and literally slipless grip.



Write for Service Particulars—It's to your interest to know.

D·K·McLAREN LIMITED

TORONTO, ONT.
194 King St. West

ST. JOHN, N.B.
90 Germain St.

VANCOUVER, B.C.
849 Beatty Street

HEAD OFFICE AND FACTORY: 351 ST. JAMES ST., MONTREAL, P.Q.

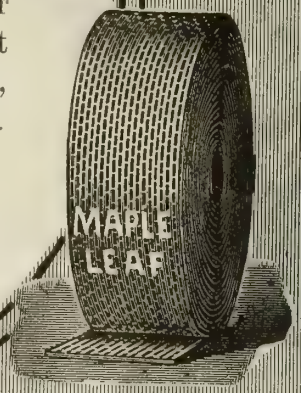
"Maple Leaf" Brand

Stitched Cotton Duck Belting

THE BEST FOR ALL KINDS OF BELTS

Is strong, durable, economical and true running. Being thoroughly waterproof, it is equally good for running in wet or dry places. As a main drive belt "MAPLE LEAF" cannot be excelled, and for conveyors is in great demand. A trial belt will convince you.

Write for prices and samples.

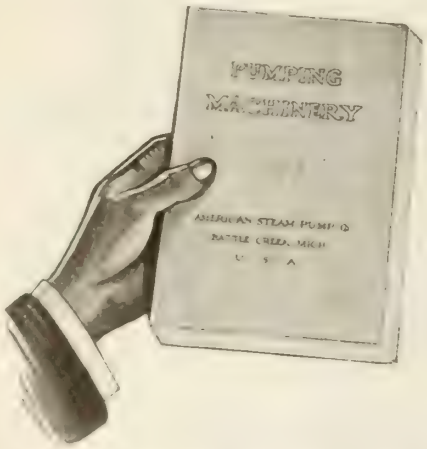


Dominion Belting Co., Ltd.,

HAMILTON, CANADA

MARSH and AMERICAN

Steam and Power Driven Pumps and Air Compressors



This book should be in the hands of every pump user. A postal will bring your copy promptly

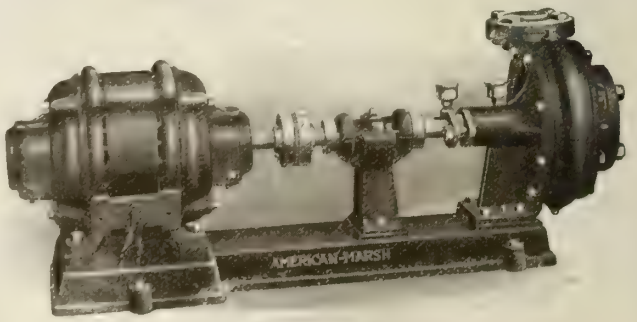
Marsh and American Pumps are especially adapted for long, hard service because they are *extra heavy* in design and of *extremely rigid construction*. Every unit is built amply strong to withstand 24-hour-a-day service and to stand up under any unforeseen strain which may be placed upon it. Piston rods on the steam pumps are extra large and made of solid bronze. The water ends are equipped with heavy cast bronze removable bushings.

This superior construction not only insures continuous and satisfactory operation, but practically *eliminates expensive shut-downs*. Marsh and American Pumps are the product of over 25 years' experience in the design and construction of high grade pumping machinery. Over 135,000 in actual service throughout the world.

The AMERICAN-MARSH LINE OF CENTRIFUGAL PUMPS is composed of both single and double suction types which are designed for heads up to 125 feet. They are equipped with wide ring oiled bearings and the single suction type has overhanging casing enabling the discharge to be taken at any angle desired.

CANADIAN AGENTS

A. R. Williams Machinery Co., Toronto.
Williams & Wilson, Montreal.
London Engine Supplies Co., London, Ont.
Stuart Machinery Co., Winnipeg.
Mechanics' Supply Co., Quebec, Que.
Canada Chain & Grinder, Limited, Edmonton and Calgary.
Taylor Engineering Co. Ltd., Vancouver, B.C.



American-Marsh Centrifugal Pump.

American Steam Pump Company

Battle Creek, Mich.

For More Than 50 Years

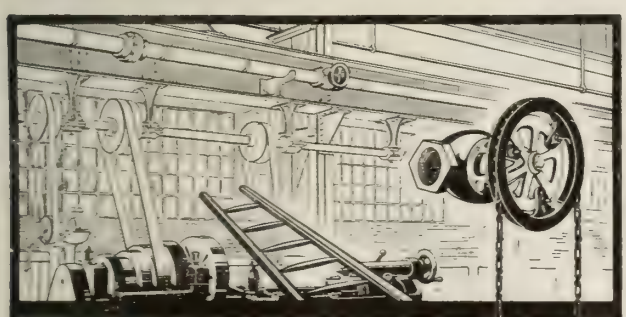
Albany Grease has given a lubrication service of great efficiency and economy on all bearings of power and industrial plant equipment. Albany Grease is the most universally used lubricant sold to-day.

ALBANY GREASE

will keep engines and all kinds of machinery and line shafting operating cool and easy at all times. It is sold by reliable hardware and mill supply stores—everywhere. We will gladly send samples upon request.

Albany Lubricating Co.

718-11 Washington Street
New York U.S.A.
Established 1868



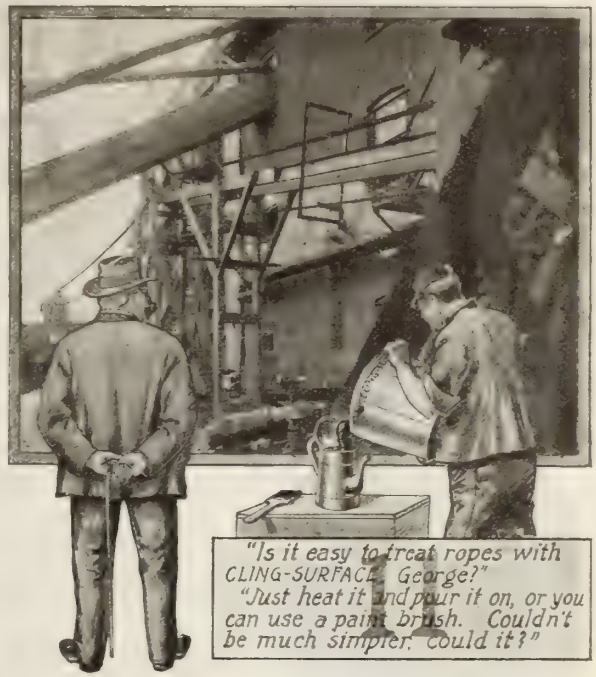
You can go to a valve with a ladder and take a chance—or you can use a

Babbitt
—Adjustable—
SPROCKET RIM

The chain-operated rim may be attached in a few minutes to any size valve wheel in any place. Its cost is not to be compared with the safety and convenience it affords.

Your dealer will be glad to show you the details of this device, or we will mail a descriptive booklet at your request.

Babbitt Steam Specialty Co.
NEW BEDFORD, MASS.


"Is it easy to treat ropes with CLING-SURFACE, George?"
"Just heat it and pour it on, or you can use a paint brush. Couldn't be much simpler, could it?"

Some of the largest manufacturers of transmission rope not only use CLING-SURFACE on their own drives, but recommend it to their customers.

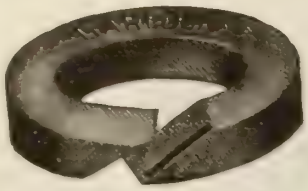
This proves its dependability, for these manufacturers, by recommending it, not only bank on CLING-SURFACE for the safety of their ropes in their customers' hands, but stake their own reputation as well.

But the best way for you to prove that this semi-liquid rope preservative, which contains no sticky or injurious materials, will quickly and easily preserve and waterproof your drives, will be to accept a can for 60 days' trial. It is understood that this is not to be paid for unless you are fully satisfied.

So write us now, or send for our Rope Folder P384.

Remember, use CLING-SURFACE and you won't need belt or rope dressings.

Cling-Surface Co
1057 Niagara Street
Buffalo New York
U S A

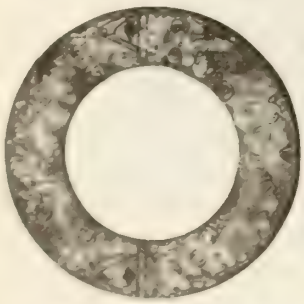


Style No. 200

High Pressure Packing will give reliable and efficient service without injury to piston rods, because it is thoroughly lubricated throughout every fibre, and the material, design and workmanship are unequalled.

Style No. 446

Medium Pressure Duo is a combination of high pressure and diagonal rings put up in sets to exactly fill stuffing box. The diagonal rings adapt themselves automatically to rods not running true, while the high pressure rings bear the brunt of the pressure and heat at bottom of stuffing box.



Style No. 950

Style No. 950 Gaskets are cut from Superheat Sheet Packing, which is made of the best quality of long fibre asbestos, built up under tremendous pressure, thus securing great tensile strength. They are not affected by extremely high temperatures, and being of a tough, non-vulcanizing material, do not need following up after being applied.

GARLOCK PACKINGS

For Packing

High Pressure Steam Rods
Use Garlock Style Number 200

Medium Pressure Steam Rods
Use Garlock Style Number 446

Low Pressure Steam Rods
Use Garlock Style Number 333

Worm or Scored Piston Rods
Use Garlock Style Number 336

Cold Water Piston Rods
Use Garlock Style Number 99

Inside Packed Plungers
Use Garlock Style Number 260

Outside Packed Plungers
High Pressure Cold Water
Use Garlock Style Number 960

Outside Packed Plungers
High Pressure Hot Water
Use Garlock Style Number 1907

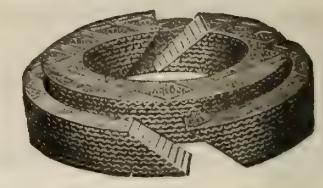
These Packings are guaranteed to give satisfactory service under the above conditions.

The Garlock Packing Co.

HAMILTON, ONTARIO

BRANCHES:

MONTREAL, - - - - 409 Shaughnessy Building
TORONTO - - - - 404 Continental Life Building
WINNIPEG - - - - - - - Galt Building



Style No. 336

Extra Sectional Ring while designed principally for worn or scored rods will give excellent service on any medium or low pressure steam rod when used alternately with solid Extra Rings, Style No. 333.

Style No. 960

Duo Hydraulic is composed of braided copper, metal wedge and waterproof hydraulic rings, and is best adapted to meet the varying conditions and temperatures to which hydraulic packing is subjected. This combination will hold a pressure of three thousand pounds.

Style No. 260

Special Hydraulic Solid Rings for plungers of inside packed pumps are unexcelled for durability and satisfactory service. They are also used in combination with our other packings for outside packed plungers working either in hot or cold water.

Fill in Blanks
AND
Tear This Out
THEN
Mail It To Us

Name.....

Name of Firm Where Employed.....

Position or Title.....

Firm's Address.....

Personal Address.....

(Give Personal Address if you want mail sent to your home)

We will put you on our mailing list for our Yearly Calendar and "The Houghton Line" and other high-class mailing matter.

It will only cost you a stamp and the trouble to mail us this information. We think you will be pleased and benefited.

Canuck Supply Co., Limited

59 Front St. East
Toronto

418 St. James St.
Montreal

FOR SAW AND PLANING MILLS

J. N. BRAY & COMPANY,
Manufacturer of
Yellow Pine Lumber, Flooring, Ceilings, Shingles and Staves
Valdosta, Ga.,

Magnolia Metal Co. Feb. 5, 1917.

Gentlemen:—

For your information wish to advise that we have been using your Magnolia Babbitt for the past several years and find it as good as any metal we have ever bought regardless of much higher priced metals. We do not hesitate to recommend it to users of babbitt metal as being a very high grade as well as economical metal.

Yours truly,
J. N. BRAY & COMPANY,
By C. C. Giddens.

PRACTICAL ENGINEER POCKET BOOK:
Over 600 pages. A valuable reference work imported from England and sold as an advertising medium at the low price of 40c post paid.
Address Montreal Office.

SOLD BY LEADING DEALERS EVERYWHERE OR BY
MAGNOLIA METAL CO.
OFFICE AND FACTORY:
225 St. Ambroise St. MONTREAL

Greater Gripping Power

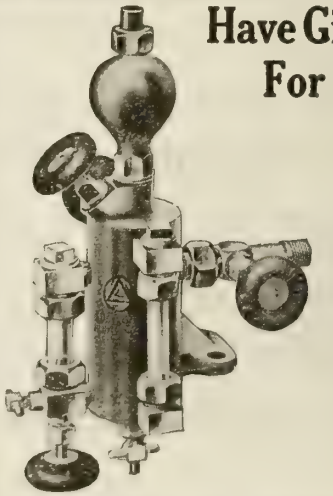
"Spiro" couplings are being used all over the United States and Canada, because their gripping power is 50% greater than any other coupling. The tightening of the bolts compresses the spiral slotted sleeve, and it grips the full surface of the shaft firmly. This sure grip eliminates any danger to your employees and helps safeguard your plant from shutdowns.

They are simple in construction, there are no keys to come loose or make quick removals difficult. Send for the "Spiro" Catalog, it's full of information concerning power appliances.

Canadian Bond Hanger & Coupling Co.,
Limited
Alexandria, Ont.

Detroit Lubricators

Have Given Satisfaction For Forty Years.



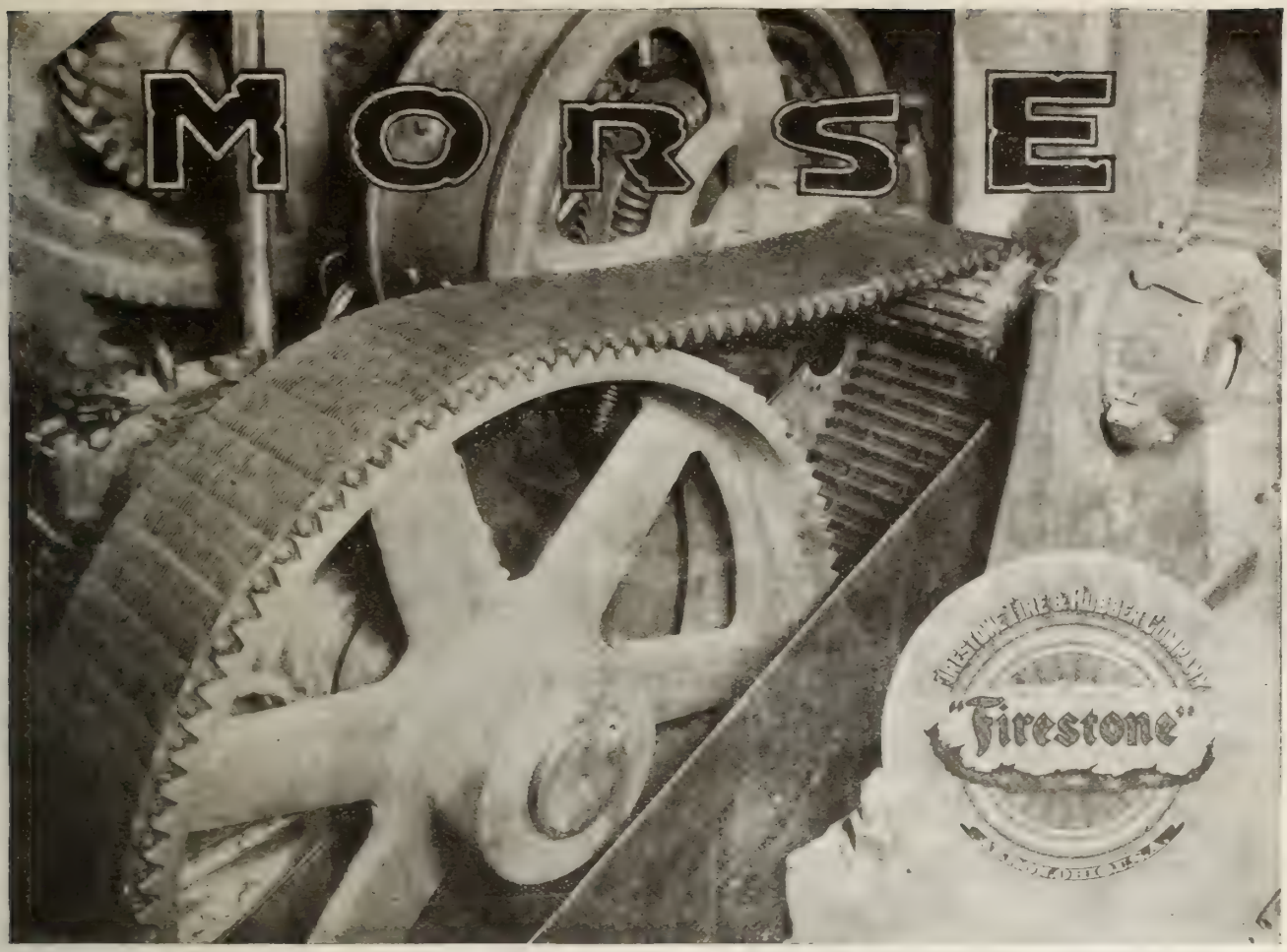
Built in a sufficient variety of styles to lubricate properly every type of steam engine, pump, gas engine, air compressor, etc.

Send to-day for catalog L 1. The information on lubricating devices contained in it will be valuable to you.

THEIR efficiency holds over half the world's trade.

Makers of Stewart Carburetors.

CANADIAN DETROIT LUBRICATOR COMPANY, LTD.
WALKERVILLE, ONT.



One of a dozen 80 H.P. drives to rubber calendars. Details: width of chain 10 inches, pitch 1.2", sprockets 17/99 teeth, 850 and 146 R.P.M.

A Silent Partner in Firestone Production

THERE are over 35 of these silent partners, totalling nearly 3,000 H. P., in the big factory of the Firestone Tire & Rubber Co. Throughout this modern plant those sturdy power transmitters are always on the job driving machines of all sorts and lineshafts.

Think of the loss which an inefficient and unreliable partner in a plant like this would entail! The "wise ones" select the surest, most compact, and most highly efficient power transmission obtainable as their productive partners. Consequently

MORSE SILENT CHAINS

Are Silent Partners in most of the Country's Successful Enterprises.

Are you sure you don't need such a partner?

Morse Chain Co., Largest Manufacturers of Silent Chains in the World, **Ithaca, N.Y.**

If any advertisement interests you, tear it out now and place with letters to be answered

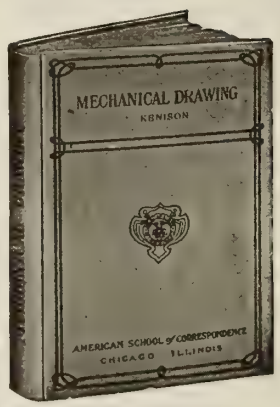
HINTS TO BUYERS

DOMINION COAL COMPANY LIMITED

"Dominion" and "Springhill" BITUMINOUS STEAM and GAS COALS

GENERAL SALES OFFICE

112 St. James St. Montreal



Mechanical Drawing

By Ervin Kenison, S.B.

Instructor in Mechanical Drawing, Massachusetts Institute of Technology

176 pp., 140 illus. Cloth binding. Gives a course of practical instruction in the art of Mechanical Drawing, based on methods that have stood the test of years of experience. Includes orthographic, isometric and oblique projections, shade lines, intersections and developments, lettering, etc., with abundant exercises and plates.

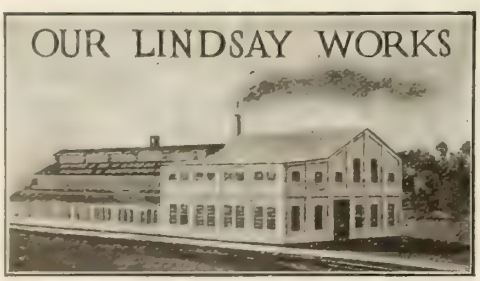
Price, $1.00

MacLean Publishing Co.

Technical Book Dept.

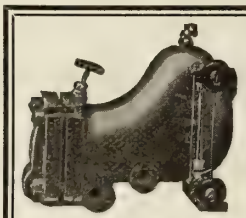
143-153 University Ave., Toronto

Water Turbines, Hydraulic Governors, Centrifugal Pumps



Boving Hydraulic & Engineering Co., Limited

LINDSAY, ONTARIO



McDANIEL IMPROVED **STEAM TRAP**

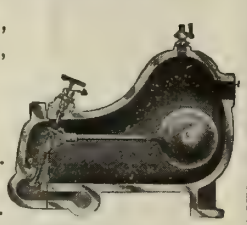
FOR HIGH OR LOW PRESSURE.

Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

MAY WE SEND ONE FOR TRIAL?

Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators.

SEND FOR CATALOGUE.



THE GARTH COMPANY

26 Craig Street MONTREAL, CAN.

WATSON & McDANIEL CO.

No. 146 N. 7th Street, PHILADELPHIA, Pa.

THE LADD VERTICAL WATER TUBE BOILER

The Goldie-McCulloch Co., Ltd.

Galt, Ontario

Canadian licencees under patents 162401 and 162402 dated May 4, 1915.

The George T. Ladd Company,

Pittsburgh, Pa.

Owners and manufacturers for the United States.

Write for new Catalogue No. 17.

NOTICE

TO

Stationary and Hoisting Engineers

Everyone operating a STATIONARY steam plant of 50 h.p. or over in the Province of Ontario must hold a Stationary Engineer's Certificate from the Board of Stationary and Hoisting Engineers. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary and Hoisting Engineers' Act.

Everyone operating a HOISTING steam plant working at a pressure of 20 pounds or over, irrespective of horse power, and used for hoisting in structural operations or excavating purposes, in the Province of Ontario, must hold a Hoisting Engineer's Certificate from the Board of Stationary and Hoisting Engineers. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary and Hoisting Engineers' Act.

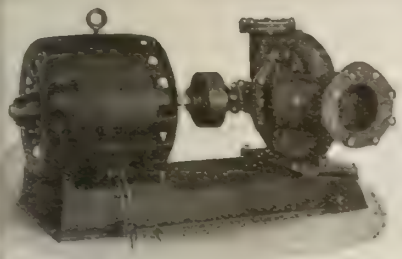
Application forms for obtaining STATIONARY or HOISTING Engineers' Certificates, may be had upon applying to the Chairman.

HON. F. G. MACDIARMID, Minister of Public Works and Highways.

W. C. McGHIE, Chairman of Board.

W. A. RIDDELL, M. A. PH. D., Superintendent, Trades & Labour Branch.

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.



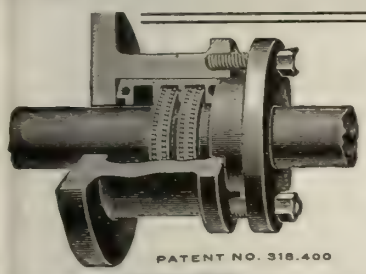
WHY

do our PUMP installations always bring repeat orders?

Find the answer in a trial order to

THE SMART-TURNER MACHINE CO.
Limited

HAMILTON, - - CANADA



PATENT NO. 318,400

PAT. NO. 500,899 ... 805,669 ... PAT. NO. 829,116 ... 1000,76

Why not Buy the Best, when in market for Packing?

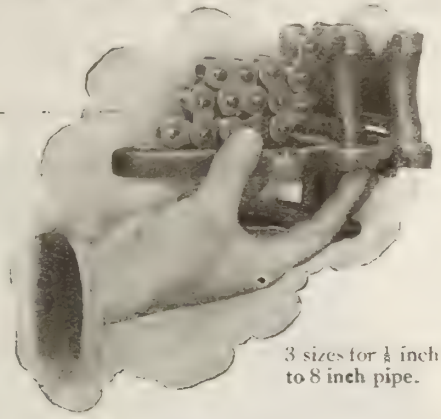
HOLMES' Metallic Packing

Is Guaranteed 3 Years

Lasts many times longer. 30 days' trial. Less oil. No cutting. Easily applied to any Steam Engine, Air Compressor or Gas Engine. Satisfaction or no pay. Write us.

HOLMES METALLIC PACKING CO.,
Wilkes-Barre, Pa.
Incorporated 1897

Placed in the Hands of Power Engineers



3 sizes for ⅛ inch to 8 inch pipe.

Williams "VULCAN" and "AGRIPPA"
CHAIN PIPE TOOLS

Readjust pipe disturbances in the beginning.

This inexpensive precaution that insures a minimum of interruptions and overtime repairs and frequently prevents heavy losses through leaks or explosions, is too vital a necessity to be ignored.

J. H. WILLIAMS & CO.
THE WRENCH PEOPLE
78 RICHARDS STREET BROOKLYN, N.Y. CITY

BOILER INSPECTION

The Steam Boiler Act, Chapter 252 R.S.O., 1914 With Amendments Chapter 58—6, George V.

STEAM BOILERS.

All Steam boilers constructed for use in Ontario must be built from designs which have been approved and allotted a registration number by the Steam Boiler Branch.

Used boilers, boilers sold or exchanged, and unregistered boilers brought into the Province must be inspected prior to being put into operation.

Notice of repairs to steam boilers, stating the nature and extent of same, must be sent to the Steam Boiler Branch, and should such repairs be considered extensive by the Chief Boiler Inspector, the boilers will require to be inspected.

In each and every case the inspections must be made by Inspectors authorized to inspect boilers under the Steam Boilers Act, who are employed only by the Steam Boiler Branch of the Department of Public Works. Official certificates with the maximum working pressure stated thereon are issued to the owners of the boilers so inspected.

STEAM PIPING.

Drawings and Specifications of all high pressure steam piping must be approved and registered by the Steam Boiler Branch before any work of installation is commenced. The drawings submitted should show clearly the dimensions and layout of the main steam lines. Full particulars should be given as to the material used in the construction of the piping, and all valves and other fittings used in connection therewith must be of approved make.

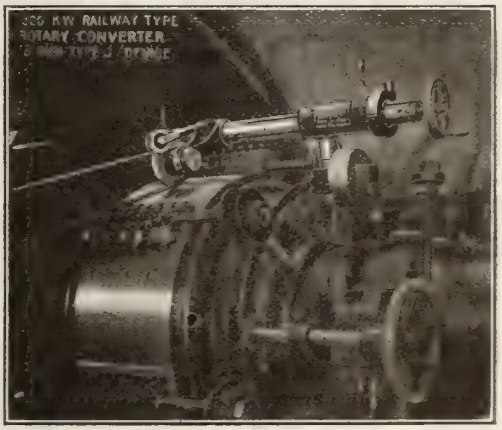
Any deviation from the above requirements shall be deemed a violation of the Steam Boilers Act.

All communications in this respect should be addressed to the Steam Boiler Branch, Department of Public Works, Parliament Buildings, Toronto.

HON. F. G MACDIARMID,
Minister of Public Works and Highways.

W. A. RIDDELL, M.A. Ph.D.,
Supt. Trades & Labour Branch

D. M. MEDCALF,
Chief Inspector of Steam Boilers.



COMMUTATOR TRUING DEVICE

Trues your commutator without removing armature from its bearings. Send for Booklet No. 5.

Jordan Bros., Inc.

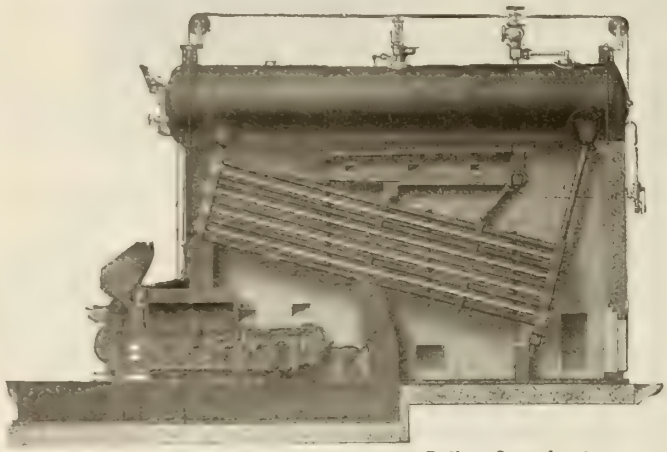
82 Beekman St. New York City, N.Y.

Canadian Representative:
CANADA SALES CO., 183 Church Street, Toronto, Canada

If any advertisement interests you, tear it out now and place with letters to be answered

"ALL BRITISH"
"B.&W." PATENT WATER TUBE STEAM BOILERS

HIGHEST ECONOMY, SAFETY, DURABILITY. OVER 17,000,000 H.P. IN USE.



Babcock & Wilcox Patent Water Tube Steam Boiler, Superheater and Mechanical Stoker.

ALSO

Steam Superheaters
Mechanical Stokers
Coal-Handling Machinery
Piping, Feed Water Heaters
Water Softeners and Purifiers
and **ELECTRIC CRANES**

BABCOCK & WILCOX, Limited

HEAD OFFICE FOR CANADA - COLLEGE ST. (ST. HENRY), MONTREAL
TORONTO OFFICE, TRADERS BANK BUILDING

STARRETT HACK SAWS CUT QUICKER LAST LONGER

The Utmost in Hack-Saw Thrift

Hack saws don't cost much—but they can waste much.

They waste mechanics' time if they are not suited to the metal or shape, just as a cross-cut saw wastes time when used as a splitting saw.

Again they waste time if they dull quickly or snap too readily. The

Starrett Hack-Saw

is characterized by the simple phrase—Cuts Quicker—Lasts Longer. They stay sharp because made of tungsten steel with teeth milled accurately and hardened just right—they cut rapidly when proper selection is made for the job.

What numbered saw to use is shown in Catalog No. 21CD. Send for it and consult page 208.

The L. S. Starrett Co.
The World's Greatest Toolmakers
ATHOL, MASS.

42-750

The Wrench of 25% Greater Efficiency

TRIMO PIPE WRENCH

Two new features have been recently added to the Trimo Pipe Wrench, namely Nut-Guards, in all sizes, and unbreakable steel frames, in leading sizes.

The Nut-Guards prevent the accidental rotation of the nut while in use.

These improvements add 25% to the usefulness of the tool.

The Trimo Pipe Wrench is made with wood handles in 4 sizes, 6-in., 8-in., 10-in., 14-in. and in steel handles in all sizes, 6-in. to 48-in. inclusive.

All Trimo Pipe Wrench parts are interchangeable.

The inserted jaw in the handle can be readily replaced when worn, thus adding to the life of the tool.

Nut with Nut-Guards

Inquiries from Importers and Dealers Solicited. Send for Catalogue No. 55.

TRIMONT MANUFACTURING CO.
Cable Address: Triwrench
Code: Western Union
Roxbury (Boston) Mass., U.S.A.

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

POWER HOUSE BUYERS' DIRECTORY

If what you want is not listed here write us, and we will tell you where to get it. Let us suggest that you consult also the advertisers' index facing the inside back cover, after having secured advertisers' names from this directory. The information you desire may be found in the advertising pages. This department is maintained for the benefit and convenience of our readers. The insertion of our advertisers' names under proper headings is gladly undertaken, but does not become part of an advertising contract.

AIR COCKS
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

AMMETERS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. H. W. Johns-Manville Co., Toronto, Ont.

AMMONIA VALVES AND FITTINGS
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Frick Co., Waynesboro, Franklin Co., Pa.
Homestead Valve Mfg. Co., Pittsburgh, Pa.
York Mfg. Co., York, Pa.

AMMONIA PURIFIERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Mfg. Co., York, Pa.

AMMONIA TANKS
Waterous Engine Works Co., Brantford, Ont.

ARCHES, COMBUSTION CHAMBER
Canadian Fairbanks-Morse Co., Ltd. Montreal.

ASH CARRYING SYSTEMS
Babcock & Wilcox, Ltd. Montreal.
Waterous Engine Works Co., Brantford, Ont.

ASBESTOS SPECIALTIES
Durabla Mfg. Co., New York, N.Y.
Garlock Packing Co., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

AUTOMATIC ICE RECORDING DOORS AND CHUTES
Jamison Cold Storage Door Co., Hagerstown, Md.

BABBITT AND ANTI-FRICTION METAL
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Hoyt Metal Co., Toronto.
Magnolia Metal Co. Montreal.
Wm. C. Wilson & Co., Toronto.

BALL BEARINGS
Can. S K F Co., Toronto, Ont.

BALLCOCKS
D'Este Co., Julian, Boston, Mass.

BATTERIES AND ACCESSORIES
Can. H. W. Johns-Manville Co., Toronto, Ont.

BELT CEMENT
Graton & Knight Mfg. Co., Montreal.

BELT DRESSING
Cling Surface Co., Buffalo.
Jos. Dixon Crucible Co., Jersey City.
Dominion Belting Co., Hamilton, Ont.
Graton & Knight Mfg. Co., Montreal.

BELT LACING, LEATHER
Graton & Knight Mfg. Co., Montreal.

BELT TIGHTENERS
Waterous Engine Works Co., Brantford, Ont.

BELT PULLEYS
American Pulley Co., Philadelphia, Pa.
Waterous Engine Works Co., Brantford, Ont.

BELTING, BALATA
Federal Engineering Co., Toronto, Ont.

BELTING, LINK
Graton & Knight Mfg. Co., Montreal.
Waterous Engine Works Co., Brantford, Ont.

BELTING, STITCHED COTTON DUCK
Dominion Belting Co., Hamilton, Ont.

BELTING, LEATHER
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Garlock Packing Co., Hamilton, Ont.
Goodyear Tire & Rubber Co., Toronto.
Graton & Knight Mfg. Co., Montreal.
D. K. McLaren Ltd., Montreal.
Wm. C. Wilson & Co., Toronto.

BELTING, RUBBER
Can. H. W. Johns-Manville Co., Toronto, Ont.
Goodyear Tire & Rubber Co., Toronto.
Jeffrey Manufacturing Co., Montreal.
Peerless Mfg. Co., New York, N.Y.

BELTING, WOVEN COTTON
Federal Engineering Co., Toronto, Ont.

BINS, COAL, COKE AND ORE
Jeffrey Manufacturing Co., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford, Ont.

BLOWERS
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Can. Sirocco Co., Windsor, Ont.
C. T. Coe Co., 10 Johnston St., Newark, N.J.
Coppus Eng. & Equip. Co., Worcester, Mass.
Sturtevant Co. of Canada, Ltd., B. F., Galt, Ont.

BOILER COMPOUNDS
Beveridge Paper Co., Ltd., Montreal, Que.
Can. Economic Lubricant Co., Montreal, Que.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Wm. C. Wilson & Co., Toronto.

BOILER COMPOUND FEEDERS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Morehead Mfg. Co., Woodstock.
Lunkenheimer Co., Cincinnati, O.

BOILER FEED PUMPS
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Ltd., Montreal, Que.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Laurie & Lamb, Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

BOILER FEED REGULATORS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Mason Regulator & Engineering Co., Montreal.

BOILER GRAPHITE
Joseph Dixon Crucible Co., Jersey City, N.J.

BOILER MOUNTINGS
Babcock & Wilcox, Ltd. Montreal.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Ltd., Montreal, Que.
Inglis Co., The John, Toronto, Ont.
Lunkenheimer Co., Cincinnati, O.
Mason Regulator & Engineering Co., Montreal.

BOILER HOUSE ACCESSORIES
Babcock & Wilcox, Ltd. Montreal.
Canadian Griscom-Russell Co., Ltd., Montreal.
Cole, Ltd., Geo. W., Toronto.
Mason Regulator & Engineering Co., Montreal.

BOILER SEAM PROTECTOR
National Boiler Seam Protector Co., Montreal.

BOILER SETTINGS
Beveridge Paper Co., Montreal.
Gates, John W., St. James St., Montreal.

BOILER TUBE CLEANERS
Babcock & Wilcox, Ltd. Montreal.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Cole, Ltd., Geo. W., Toronto.
Garlock Packing Co., Hamilton, Ont.
Liberty Mfg. Co., Pittsburg.
Laurie & Lamb, Montreal.

BOILERS, HORIZONTAL, RETURN, TUBULAR AND WATERTUBE
Babcock & Wilcox, Ltd. Montreal.
Cole, Ltd., Geo. W., Toronto.
Goldie & McCulloch Co., Galt.
Frick Co., Waynesboro, Franklin Co., Pa.
Inglis Co., The John, Toronto, Ont.
Jenckes Machine Co., Sherbrooke, Que.
Jones Underfeed Stoker Co., Toronto.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Ladd, The Geo. T., Co., Pittsburgh, Pa.
McAvity, T., & Sons, Ltd., St. John, N.B.
Waterous Engine Works Co., Brantford, Ont.

BOILERS, MARINE, LOCOMOTIVE AND VERTICAL
Babcock & Wilcox, Ltd. Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Goldie & McCulloch Co., Galt.
Inglis Co., The John, Toronto, Ont.
Jenckes Machine Co., Sherbrooke, Que.
John McDougall Caledonian Iron Works, Montreal.
Waterous Engine Works Co., Brantford, Ont.

BOOKS
Audel & Co., Theo, New York, N.Y.
MacLean Publishing Co., Toronto.

BRASS FOUNDERS
McAvity, T., & Sons, Ltd., St. John, N.B.
D'Este Co., Julian, Boston, Mass.

BRINE COOLERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

BRINE TANKS
Frick Co., Waynesboro, Franklin Co., Pa.
Waterous Engine Works Co., Brantford, Ont.
York Manufacturing Co., York, Pa.

BUSHINGS
Steel Mill Packing Co., Windsor, Ont.

CABLE
Wm. C. Wilson & Co., Toronto.

CALORIMETERS
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Taylor Instrument Co., Rochester, N.Y.

CANS, OILY WASTE
Jas. Morrison Brass Mfg. Co., Toronto.

CAST IRON FITTINGS
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.

CASTINGS, BRASS AND IRON
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Lunkenheimer Co., Cincinnati, O.
John McDougall Caledonian Iron Works Co., Ltd., Montreal.
McAvity, T., & Sons, Ltd., St. John, N.B.
Waterous Engine Works Co., Brantford, Ont.

CEMENT, PIPE JOINT
Wm. C. Wilson & Co., Toronto.

CEMENT, HIGH TEMPERATURE
Beveridge Paper Co., Montreal.
Gates, John W., St. James St., Montreal.

CEMENT MACHINERY
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Waterous Engine Works Co., Brantford, Ont.

CHAIN DRIVES
Morse Chain Co., Ithaca, N.Y.

CHAIN WHEELS
Babbitt Steam Specialty Co., New Bedford, Mass.

CHIMNEYS, STEEL
Babcock & Wilcox, Ltd. Montreal.

CHUTES, COAL
Can. Allis-Chalmers, Ltd., Toronto, Ont.

CLOCKS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Foxboro Co., The, Foxboro, Mass.

CLUTCHES
Waterous Engine Works Co., Brantford, Ont.

COAL
Dom. Coal Co., Montreal.

COAL AND ASH CONVEYORS
Babcock & Wilcox, Ltd. Montreal.
Jeffrey Manufacturing Co., Montreal.
Waterous Engine Works Co., Brantford, Ont.

COAL HANDLING MACHINERY
Babcock & Wilcox, Ltd. Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Jeffrey Manufacturing Co., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford, Ont.

COAL HOLE COVERS
Can. Allis-Chalmers, Ltd., Toronto, Ont.

COILS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

COLD STORAGE INSULATION
Armstrong Cork & Insulation Co., Montreal, Que.
Beveridge Paper Co., Ltd., Montreal, Que.

COMMUTATOR TRUING DEVICES
Jordan Bros., Inc., New York, N.Y.

CONDENSERS
Alberger Heater Co., Buffalo, N.Y.
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Toronto.
Belliss & Morcom, Birmingham, Eng.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Darling Bros., Ltd., Montreal, Que.
Goldie & McCulloch Co., Galt.
Laurie & Lamb, Montreal.
John McDougall Caledonian Iron Wks., Montreal.
Waterous Engine Works Co., Brantford.

CONDENSERS, AMMONIA AND STEAM
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

COLLECTORS, PNEUMATIC
Sturtevant Co. of Canada, B. F., Galt, Ont.

CONSULTING ENGINEERS
Walter J. Francis, Montreal.
Laurie & Lamb, Montreal.

COLD STORAGE DOORS AND WINDOWS
Jamison Cold Storage Door Co., Hagerstown, Md.

COMPRESSORS, AIR
American Steam Pump Co., Battle Creek, Mich.
Belliss & Morcom, Birmingham, Eng.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Darling Bros., Ltd., Montreal, Que.
Inglis Co., The John, Toronto, Ont.
Laurie & Lamb, Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Smart-Turner Machine Co., Ltd., Hamilton.
Taylor Instrument Co., Rochester, N.Y.

COMPRESSORS, GAS
Can. Allis-Chalmers, Ltd., Toronto, Ont.

CONDUITS
Can. H. W. Johns-Manville Co., Toronto, Ont.

CONDENSATION RECEIVER
Cole, Ltd., Geo. W., Toronto.
G. M. Davis Regulator Co., Chicago.

CONNECTIONS, FLANGED
Jefferson Union Co., Lexington, Mass.
Dart Union Co., Ltd., Toronto, Ont.

CONCRETE HARDENER
Beveridge Paper Co., Montreal.

CONTRACTORS' STRUCTURAL STEEL
Canadian Fairbanks-Morse Co., Ltd. Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.

CONVEYOR MACHINERY
Babcock & Wilcox, Ltd. Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Jeffrey Manufacturing Co., Montreal.
Waterous Engine Works Co., Brantford.

COOLER, DOORS
Jamison Cold Storage Door Co., Hagerstown, Md.

CORK INSULATION
Armstrong Cork & Insulation Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.

COTTON HOSE
Garlock Packing Co., Hamilton, Ont.

COUNTERS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Foxboro Co., The, Foxboro, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

COUNTERSHAFTS
Can. Bond Hanger & Coupling Co., Alexandria, Ont.

COUPLINGS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Jeffrey Manufacturing Co., Montreal.
McAvity & Sons, T., St. John, N.B.

COUPLINGS, BOILER, FLANGED PIPE, JOINT PIPE, UNION, STEAM PIPE
Jefferson Union Co., Lexington, Mass.
Dart Union Co., Ltd., Toronto, Ont.

COUPLINGS, SHAFT
Can. Bond Hanger & Coupling Co., Alexandria, Ont.

CRANES, ALL KINDS
Babcock & Wilcox, Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

CRANES, ELECTRIC
Babcock & Wilcox, Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

CRANES, HAND POWER
Babcock & Wilcox, Ltd., Montreal.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Smart-Turner Machine Co., Ltd., Hamilton.

CRANES, OVERHEAD TRAVELLING
Babcock & Wilcox, Ltd., Montreal.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Smart-Turner Machine Co., Ltd., Hamilton.

CRANES, POST JIB
Babcock & Wilcox, Ltd., Montreal.

CRANES, SWING JIB
Babcock & Wilcox, Ltd., Montreal.

CRANES, WALL
Babcock & Wilcox, Ltd., Montreal.

CRANK AND CROSSHEAD PIN OILERS
Lunkenheimer Co., Cincinnati, O.

CRIMPS, LEATHER
Graton & Knight Mfg. Co., Montreal.

CRUSHING MACHINERY
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Jeffrey Mfg. Co., Columbus, Ohio.

CYLINDER OIL
E. H. Kellogg & Co., New York.

DAMPER REGULATORS
Babcock & Wilcox, Ltd., Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Darling Bros., Ltd., Montreal, Que.
G. M. Davis Regulator Co., Chicago.
D'Este Co., Julian, Boston, Mass.
Elliott Co., Pittsburgh, Pa.
Mason Regulator Co., Boston, Mass.
Jas. Morrison Brass Mfg. Co., Toronto.

DISCS, FIBRE
Beveridge Paper Co., Ltd., Montreal, Que.

DISCS, LEATHER
Graton & Knight Mfg. Co., Montreal.

DISTILLING APPARATUS
Canadian Griscom-Russell Co., Ltd., Montreal.
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

DOORS, COLD STORAGE AND FREEZER
Jamison Cold Storage Door Co., Hagerstown, Md.

DOUBLE PIPE CONDENSERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

DRYING MACHINERY
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Sirocco Co., Windsor, Ont.

DUST SEPARATORS
Sturtevant Co. of Canada, B. F., Galt, Ont.

DYNAMOS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Sturtevant Co. of Canada, B. F., Galt, Ont.

ECONOMIZERS
Babcock & Wilcox, Ltd., Montreal.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Green Fuel Economizer Co., New York, N.Y.

EJECTORS
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.
Smart-Turner Machine Co., Ltd., Hamilton.

ELECTRICAL ACCESSORIES AND MACHINERY
Can. H. W. Johns-Manville Co., Toronto, Ont.
Beveridge Paper Co., Ltd., Montreal, Que.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Economy Fuse & Mfg. Co., Montreal, Que.
MacGovern & Co., Inc., New York.

ELECTRICAL SUPPLIES
Can. General Electric Co., Toronto, Ont.
Can. H. W. Johns-Manville Co., Toronto, Ont.

ELEVATORS
MacKinnon, Holmes & Co., Sherbrooke Ont.
John MacDougall Caledonian Iron Works, Montreal

ELEVATING MACHINERY
Canadian Fairbanks-Morse Co., Ltd., Montreal
Cowan & McCuaig Co., Galt
Jeffrey Manufacturing Co., Montreal
Waterous Engine Works Co., Brantford

ENGINEERS' SUPPLIES
Beveridge Paper Co., Ltd., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Ltd., Montreal, Que.
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.
Jas. Morrison Brass Mfg. Co., Toronto.

ENGINES, AUTOMATIC AND DROP VALVE
Frick Co., Waynesboro, Franklin Co., Pa.
Waterous Engine Works Co., Brantford.

ENGINES, CORLISS AND ROCKING VALVE
Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

ENGINES, DIESEL
Can. Allis-Chalmers, Ltd., Toronto, Ont.

ENGINES, GAS AND GASOLINE
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Laurie & Lamb, Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

ENGINES, STEAM
Belliss & Morcom, Birmingham, Eng.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Can. Sirocco Co., Windsor, Ont.
Goldie & McCulloch Co., Galt.
Inglis Co., The John, Toronto, Ont.
Laurie & Lamb, Montreal.
John MacDougall Caledonian Iron Works, Montreal.
Waterous Engine Works Co., Brantford.

ENGINES, HOISTING, LOGGING, CABLEWAY
Can. Allis-Chalmers, Ltd., Toronto, Ont.

ENGINES, MARINE
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.

ENGINES, SAW MILL
Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que.
Laurie & Lamb, Montreal.
Waterous Engine Works Co., Brantford.

ENGINES, SINGLE COMPOUND AND TRIPLE EXPANSION
Canadian Griscom-Russell Co., Ltd., Montreal.
Jenckes Machine Co., Sherbrooke, Que.
Laurie & Lamb, Montreal.
John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Kerr Engine Co., Walkerville.
Waterous Engine Works Co., Brantford.

ENGINES, VERTICAL
Laurie & Lamb, Montreal.

ENGINEERING BOOKS
MacLean Publishing Co., Toronto.

EXHAUST HEADS
Can. Sirocco Co., Windsor, Ont.
Darling Bros., Ltd., Montreal, Que.
Direct Separator Co., Syracuse, N.Y.
Elliott Co., Pittsburgh, Pa.
Jas. Morrison Brass Mfg. Co., Toronto.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Watson & McDaniel Co., Philadelphia.

EXPANSION JOINTS
Alberger Heater Co., Buffalo, N.Y.
Direct Separator Co., Syracuse, N.Y.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.

FANS, VENTILATING
Can. Sirocco Co., Windsor, Ont.
C. T. Coe Co., 10 Johnson St., Newark, N.J.
Coppus Engr. & Equip. Co., Worcester, Mass.
Green Fuel Economizer Co., New York, N.Y.
Sturtevant Co. of Canada, B. F., Galt, Ont.

FEED WATER HEATERS
Alberger Heater Co., Buffalo, N.Y.
Babcock & Wilcox, Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Stewart Heater Co., Buffalo, N.Y.
Waterous Engine Works Co., Brantford.

FEED WATER PURIFIERS
Stewart Heater Co., Buffalo, N.Y.

FEED WATER REGULATORS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Chaplin, Fulton Mfg. Co., Pittsburg, Pa.
Elliott Co., Pittsburgh, Pa.
Laurie & Lamb, Montreal.

FILTERS
Bowser & Co., Inc., S. F., Toronto, Ont.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.

FILTERS, WATER
Canadian Griscom-Russell Co., Ltd., Montreal.
Darling Bros., Ltd., Montreal, Que.
Frick Co., Waynesboro, Franklin Co., Pa.
Scaife & Sons, Wm. B., Pittsburgh, Pa.
York Manufacturing Co., York, Pa.

FIRE BRICK, PLASTIC
Beveridge Paper Co., Montreal.
Gates, John W., St. James St., Montreal.

FIREPROOF COLD STORAGE DOORS AND WINDOWS
Jamison Cold Storage Door Co., Hagerstown, Md.

FITTINGS, AIR, AUTOMOBILE, GAS, HYDRAULIC, PIPE, PIPE FLANGED, SCREWED PIPE, STEAM
Jefferson Union Co., Lexington, Mass.
Dart Union Co., Ltd., Toronto, Ont.

FLANGED STEAM FITTINGS
Direct Separator Co., Syracuse, N.Y.
McAvity, T., & Sons, Ltd., St. John, N.B.

FLANGES
Dart Union Co., Ltd., Toronto, Ont.
Jefferson Union Co., Lexington, Mass.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.

FLOORING COMPOSITION
Armstrong Cork & Insulation Co., Montreal, Que.

FLUE CLEANERS
Babcock & Wilcox, Montreal.
Liberty Mfg. Co., Pittsburg, Pa.
William B. Pierce Co., Buffalo, N.Y.
Wm. C. Wilson & Co., Toronto.

FLUE GAS ANALYSIS INSTRUMENTS
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Uehling Instrument Co., New York.
Precision Instrument Co., Detroit, Mich.
Penberthy Injector Co., Windsor, Ont.

FLUMES, STEEL
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.

FREEZER DOORS
Jamison Cold Storage Door Co., Hagerstown, Md.

FRICTION LEATHERS
Graton & Knight Mfg. Co., Montreal.

FURNACES, BOILER
Gates, J. W., Montreal, P.Q.

FURNACES, SMOKELESS
Babcock & Wilcox, Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Detroit, Mich.

FUSES
Can. H. W. Johns-Manville Co., Toronto, Ont.
Economy Fuse & Mfg. Co. of Canada, Montreal.

GAS ANALYSIS INSTRUMENTS, ETC.
Penberthy Injector Co., Windsor, Ont.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Uehling Instrument Co., New York, N.Y.

GASKETS, RUBBER, ASBESTOS, LEAD, COPPER AND LEATHER
Can. H. W. Johns-Manville Co., Toronto, Ont.
Durabla Mfg. Co., New York, N.Y.
Frick Co., Waynesboro, Franklin Co., Pa.
Garlock Packing Co., Hamilton, Ont.
Graton & Knight Mfg. Co., Montreal.
Peerless Rubber Mfg. Co., New York, N.Y.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Wm. C. Wilson & Co., Toronto.

GAS COLLECTORS
Precision Instrument Co., Detroit, Mich.

GAS PRODUCER PLANTS
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Laurie & Lamb, Montreal.

GAUGE COCKS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Garlock Packing Co., Hamilton, Ont.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.
W. J. Wall, Montreal.

GAUGE GLASSES
Wm. C. Wilson & Co., Toronto.

GAUGES, AMMONIA, OIL, GAS, AIR
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

GAUGES, PRESSURE, VACUUM, DRAFT AND RECORDING, AND MICROMETER
Babcock & Wilcox, Montreal.
Foxboro Company, Foxboro, Mass.
Lunkenheimer Co., Cincinnati, O.
Precision Instrument Co., Detroit, Mich.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.

GAUGES, WATER
Babcock & Wilcox, Montreal.
Jenkins Bros., Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
Penberthy Injector Co., Windsor, Ont.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

GEARS, FIBRE CUT
Beveridge Paper Co., Ltd., Montreal, Que.

GEARS, CUT, WORM, MORTISE
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

GENERATORS, STEAM TURBO
Can. General Electric Co., Toronto, Ont.
Laurie & Lamb, Montreal.

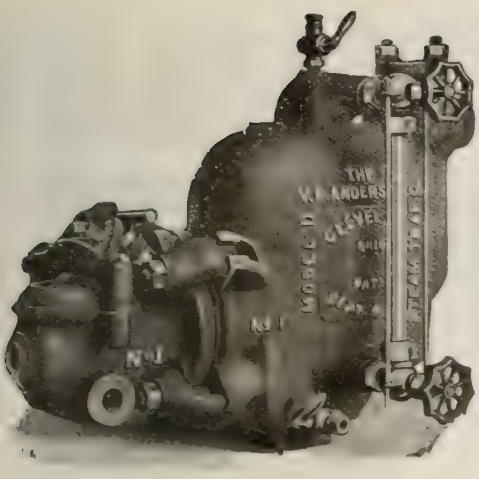
GENERATORS AND CONVERTORS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. General Electric Co., Toronto, Ont.

GOVERNORS, ENGINE
Escher Wyss & Co., Montreal, Que.
McAvity, T., & Sons, Ltd., St. John, N.B.
Waterous Engine Works Co., Brantford.

GRAPHITE, BOILER
Jos. Dixon Crucible Co., Jersey City.
Wm. C. Wilson & Co., Toronto.

GRATES, DUMPING, ROCKING, STATIONARY
Babcock & Wilcox, Montreal.
Boiler Repair & Grate Bar Co., Toronto, Ont.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
C. T. Coe Co., 10 Johnson St., Newark, N.J.
Galt Foundry Co., Galt, Ont.
Mason Regulator & Engineering Co., Montreal.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Waterous Engine Works Co., Brantford.

GREASE CUPS
Albany Lubricating Co., New York City.
Detroit Lubricator Co., Walkerville.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.



Live Steam Can't Escape

You don't want to lose live steam with fuel at the price it is—*and you can't* with this Anderson Steam Trap; for at least

3" of Water Lock the Valve

And neither sediment nor scale can possibly get into the valve. Strainer and Sediment Chamber see to that.

ANDERSON STEAM TRAP

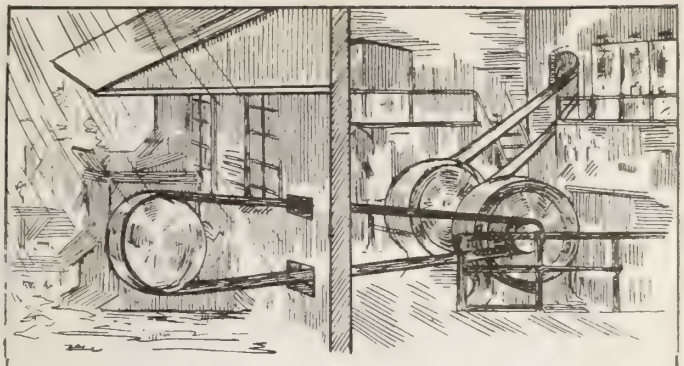
Model "D" lifts water against any back pressure 5 lbs. less than pressure at the trap. Both valve and valve seat are easily removed without breaking a steam joint or pipe connection. Every part is interchangeable. The Glass Water Gauge shows the Anderson Trap always properly working; still it's there as a safeguard.

No obligation for useful suggestions.

Write

The V. D. Anderson Co.

1935 West 96th St., Cleveland, Ohio



LANCO BALATA BELTING

A really waterproof belt—not just waterproofed. Works well on straight drives under all atmospheric conditions except those of extreme heat.

Joint can be made endless at our own plant.

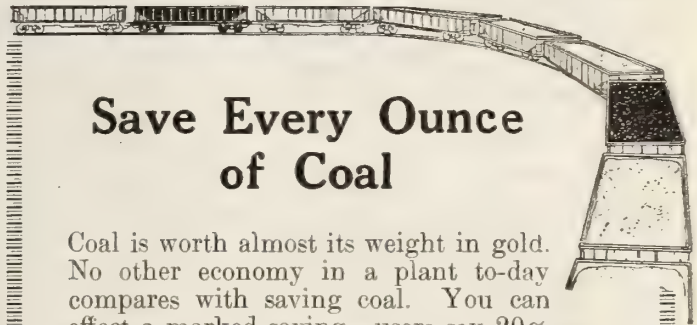
Does your belting man receive our monthly publication, "Belts"?

Sent free for the asking.

Federal Engineering Co., Limited

172 John St., Toronto

Save one out of five cars



Save Every Ounce of Coal

Coal is worth almost its weight in gold. No other economy in a plant to-day compares with saving coal. You can effect a marked saving—users say 20%—by utilizing every heat unit of your steam with the

Morehead

Back to Boiler

SYSTEM

By getting the value of every heat unit you do not have to use as much coal—and the efficiency of your plant is increased as well. There is a MOREHEAD SYSTEM that will fit your requirements. Let us give you further information and prices.

Canadian Morehead Mfg. Company

Dept. "A"

Woodstock, Ontario

GREASE AND OIL EXTRACTORS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Canadian Griscom-Russell Co., Ltd., Montreal.
Elliott Co., Pittsburgh, Pa.
Laurie & Lamb, Montreal.

GREASES
Albany Lubricating Co., New York City.
Can. Economic Lubricant Co., Montreal, Que.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Jos. Dixon Crucible Co., Jersey City.
Wm. C. Wilson & Co., Toronto.

HAND LEATHERS OR PADS
Graton & Knight Mfg. Co., Montreal.

HANGERS
Can. General Electric Co., Toronto, Ont.
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Can. S K F Co., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Goldie & McCulloch Co., Galt.
Waterous Engine Works Co., Brantford.

HEATERS
Alberger Heater Co., Buffalo, N.Y.
Babcock & Wilcox, Ltd., Montreal.
Can. Sirocco Co., Windsor, Ont.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
Laurie & Lamb, Montreal.
McAvity & Sons, T., St. John, N.B.
Scaife & Sons, Wm. B., Pittsburgh, Pa.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Waterous Engine Works Co., Brantford.

HEATERS, EXHAUST STEAM
Can. Allis-Chalmers, Ltd., Toronto, Ont.

HEATERS, METERING
Can. Allis-Chalmers, Ltd., Toronto, Ont.

HEATING SYSTEMS, FANS
Can. Sirocco Co., Windsor, Ont.

HOISTS, GRIP
Jordan Bros., Inc., New York, N.Y.

HOISTING AND CONVEYING MACHINERY
Babcock & Wilcox, Ltd., Montreal.
Waterous Engine Works Co., Brantford.

HOSE, METALLIC
Pennsylvania Flexible Metallic Tubing Co., Boston, Mass.

HOSE, STEAM, SUCTION AND WATER
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Asbestos Co., Montreal.
Garlock Packing Co., Hamilton, Ont.
Goodyear Tire & Rubber Co., Toronto.
Peerless Rubber Mfg. Co., New York, N.Y.
Wm. C. Wilson & Co., Toronto.

HYDRAULIC ACCUMULATORS
Smart-Turner Machine Co., Ltd., Hamilton.

HYDRAULIC MACHINERY
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
John McDougall Caledonian Iron Wks., Montreal.

HYDRAULIC PRESSES
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

ICE MAKING MACHINERY
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Griscom-Russell Co., Ltd., Montreal.
Frick Co., Waynesboro, Franklin Co.
Linde Canadian Refrigeration Co., Montreal.
York Mfg. Co., York, Pa.

INDICATORS, ELECTRIC—ALL TYPES
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Uehling Instrument Co., New York, N.Y.

INDICATORS, STEAM AND GAS ENGINE
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Canadian Fairbanks-Morse Co., Montreal.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Uehling Instrument Co., New York, N.Y.

INDICATORS—AMMONIA, HYDRAULIC
Can. Detroit Lubricator Co., Walkerville, Ont.

INDICATORS, SPEED
L. S. Starrett Co., Athol, Mass.

INJECTORS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

INSULATING BRICK
Armstrong Cork & Insulation Co., Montreal, Que.
Beveridge Paper Co., Ltd., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.

INSULATORS
Ed. Bennis & Co., Little Fulton, Bolton, Eng.
Beveridge Paper Co., Ltd., Montreal, Que.

IRON FILLER
Can. H. W. Johns-Manville Co., Toronto, Ont.

LACE LEATHERS
Graton & Knight Mfg. Co., Montreal.
Wm. C. Wilson & Co., Toronto.

LAMPS, ARC
Canadian Fairbanks-Morse Co., Montreal.
Can. General Electric Co., Toronto, Ont.
Can. H. W. Johns-Manville Co., Toronto, Ont.

LAMPS, ELECTRIC
Wm. C. Wilson & Co., Toronto.

LAMPS, INCANDESCENT
Canadian Fairbanks-Morse Co., Montreal.
[illegible] Toronto, Ont.
Can. H. W. Johns-Manville Co., Toronto, Ont
Can. Lacc-Philips Co., Ltd., Toronto, Ont.

LAMPS, NITRO
Can. Lacc-Philips Co., Ltd., Toronto, Ont.

LAMPS, TUNGSTEN AND NITRO
Can. General Electric Co., Toronto, Ont.
Can. Lacc-Philips Co., Ltd., Toronto, Ont.

LEATHER STRAPPING
[illegible] Montreal.

LUBRICANTS
Albany Lubricating Co., New York City.
Canadian Economic Lubricant Co., Montreal.
Jos. Dixon Crucible Co., Jersey City.

LUBRICATORS, CYLINDER
Albany Lubricating Co., New York City.
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

LUBRICATORS, FORCE FEED
Can. Detroit Lubricator Co., Walkerville, Ont.
Darling Bros., Montreal.
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

LUBRICATORS, PLAIN
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

MACHINERY INSULATION
Armstrong Cork & Insulation Co., Montreal, Que.
Beveridge Paper Co., Ltd., Montreal, Que.

MANGENESITE PASTE
Wm. C. Wilson & Co., Toronto.

MECHANICAL STOKERS
Babcock & Wilcox, Ltd., Montreal.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Detroit, Mich.

METERS, ELECTRIC
Can. H. W. Johns-Manville Co., Toronto, Ont.

METERS, STEAM
Can. Allis-Chalmers, Ltd., Toronto, Ont.

METERS, WATER
Allen General Supplies, Toronto, Ont.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Foxboro Company, Foxboro, Mass.
McAvity & Sons, T., St. John, N.B.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Precision Instrument Co., Detroit, Mich.

MILL AND MINING MACHINERY
Canadian Fairbanks-Morse Co., Montreal.
Jenckes Machine Co., Sherbrooke, Que.
Goldie & McCulloch Co., Galt.
Waterous Engine Works Co., Brantford.

MOTORS
Canadian Fairbanks-Morse Co., Montreal.
Can. General Electric Co., Toronto, Ont.

OAKUM
Wm. C. Wilson & Co., Toronto.

OFFICE RAILINGS
Jas. Morrison Brass Mfg. Co., Toronto.

OIL CUPS
Albany Lubricating Co., New York City.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

OILER, COMPOUND FEEDERS
Lunkenheimer Co., Cincinnati, O.

OILERS, GAUGE
Lunkenheimer Co., Cincinnati, O.

OILERS, MULTIPLE
Can. Detroit Lubricator Co., Walkerville, Ont.
Lunkenheimer Co., Cincinnati, O.

OIL FILTERS AND CIRCULATING SYSTEMS
Bowser & Co., Inc., S. F., Toronto, Ont.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
Jas. Morrison Brass Mfg. Co., Toronto.

OIL SEPARATORS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
Direct Separator Co., Syracuse, N.Y.
Elliott Co., Pittsburgh, Pa.
Leitch Co., Arthur S., Toronto, Ont.
Liberty Mfg. Co., Pittsburgh.
Jas. Morrison Brass Mfg. Co., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.

OILING SYSTEMS
Albany Lubricating Co., New York City.
Bowser & Co., Inc., S. F., Toronto, Ont.
Lunkenheimer Co., Cincinnati, O.

OILS, LUBRICATING
Albany Lubricating Co., New York City.
Can. Economic Lubricant Co., Montreal, Que.
Kellogg & Co., E. H., New York, N.Y.
Wm. C. Wilson & Co., Toronto.

PACKING ENGINE
Can. Asbestos Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Can. B. K. Morton Co., Toronto, Montreal.
Canuck Supply Co., Ltd., Montreal, Que.
Crane Packing Co., Chicago, Ill.
Garlock Packing Co., Hamilton, Ont.
Peerless Rubber Mfg. Co., New York, N.Y.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING FIBRE
Beveridge Paper Co., Ltd., Montreal, Que.
Can. B. K. Morton Co., Montreal, Que.
Crane Packing Co., Chicago, Ill.
Wm. C. Wilson & Co., Toronto.

PACKING, HYDRAULIC
Can. Asbestos Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Can. B. K. Morton Co., Toronto, Montreal.
Crane Packing Co., Chicago, Ill.
Durabla Manufacturing Co., New York.
Garlock Packing Co., Hamilton, Ont.
Goodyear Tire & Rubber Co., Toronto.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, METALLIC
Can. B. K. Morton Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Crane Packing Co., Chicago, Ill.
Greene, Tweed & Co., New York.
Holmes Metallic Packing Co., Wilkesbarre, Pa.
Steel Mill Packing Co., Windsor, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, ROD
Can. Asbestos Co., Montreal, Que.
Can. B. K. Morton Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Crane Packing Co., Chicago, Ill.
Garlock Packing Co., Hamilton, Ont.
Canuck Supply Co., Ltd., Montreal, Que.
Steel Mill Packing Co., Windsor, Ont.
Peerless Rubber Mfg. Co., New York, N.Y.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, SHEET
Can. Asbestos Co., Montreal, Que.
Can. B. K. Morton Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Canuck Supply Co., Ltd., Montreal, Que.
Durabla Manufacturing Co., New York.
Garlock Packing Co., Hamilton, Ont.
Jenkins Bros., Ltd., Montreal.
Peerless Rubber Mfg. Co., New York, N.Y.
Wm. C. Wilson & Co., Toronto.

PACKING, AMMONIA, STEAM AND WATER
Can. Asbestos Co., Montreal, Que.
Can. B. K. Morton Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Canuck Supply Co., Ltd., Montreal, Que.
Crane Packing Co., Chicago, Ill.
Garlock Packing Co., Hamilton, Ont.
Greene, Tweed & Co., New York.
Goodyear Tire & Rubber Co., Toronto.
Steel Mill Packing Co., Windsor, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, LEATHER
Can. B. K. Morton Co., Toronto, Montreal.
Canuck Supply Co., Ltd., Montreal, Que.
Garlock Packing Co., Hamilton, Ont.
Graton & Knight Mfg. Co., Montreal.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING PISTON
Crane Packing Co., Chicago, Ill.

PACKING, VALVE STEM
Crane Packing Co., Chicago, Ill.

PAINTS
Wm. C. Wilson & Co., Toronto.

PAINT, DAMP RESISTING
Toch Bros., Toronto, Ont.

PENSTOCKS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.

PILLOW BLOCKS
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Waterous Engine Works Co., Brantford.

PIPE COILS
York Mfg. Co., York, Pa.

PIPE COVERINGS, STEAM, BRINE, AMMONIA AND ICE WATER
Armstrong Cork & Insulation Co., Montreal, Que.

PIPE STEEL
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

PIPE VISES AND CUTTERS
Armstrong Mfg. Co., Bridgeport, Conn.

PIPE, GAS
Can. Allis-Chalmers, Ltd., Toronto, Ont.

PIPES, WATER
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

PIPING AND FITTINGS
Frick Co., Waynesboro, Franklin Co., Pa.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
York Mfg. Co., York, Pa.

PIPING, STEAM
Babcock & Wilcox, Ltd., Montreal.

PLATE WORK
Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

PLUG COCKS
Homestead Valve Mfg. Co., Pittsburgh, Pa.

PLUMBING SUPPLIES
Wm. C. Wilson & Co., Toronto.

POWER PUMPS
American Steam Pump Co., Battle Creek, Mich
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
Waterous Engine Works Co., Brantford.
Garlock Packing Co., Hamilton, Ont.
Laurie & Lamb, Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.

POWER, TRANSMISSION MACHINERY
American Pulley Co., Philadelphia, Pa.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Goldie & McCulloch Co., Galt.
Jeffrey Manufacturing Co., Montreal.
Jenckes Machine Co., Sherbrooke, Que.
MacGovern & Co., New York.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Morse Chain Co., Ithaca, N.Y.
Waterous Engine Works Co., Brantford.

PRESSES
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

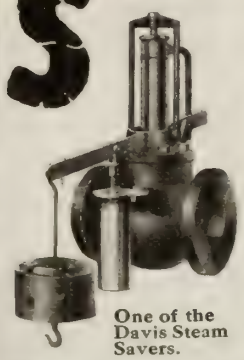
PRESSURE, BLOWERS, CENTRIFUGAL
Can. Sirocco Co., Windsor, Ont.

PULLEYS
American Pulley Co., Philadelphia, Pa.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Wm. Hamilton Co., Ltd., Peterboro.
Jeffrey Manufacturing Co., Montreal.
Waterous Engine Works Co., Brantford.

DAVIS

PRESSURE REGULATOR

Correct Pressure
and
Uniform Pressure
Insure
Efficient Operation—



One of the Davis Steam Savers.

And that means the Davis.

It is built like a pair of balance scales. The steam pressure inside is balanced by weights on the outside—the action is just as visible and accurate as the action of a pair of balance scales.

No spring pressure to vary, no packing to interfere with proper action, no delicate parts needing attention and adjustment.

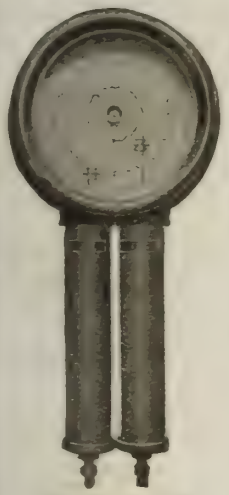
Simple and positive in action as the law of gravity—because it is controlled by gravity.

G. M. DAVIS REGULATOR Co
434 MILWAUKEE AVE., CHICAGO

UEHLING WASTE METER

COMBINED

CO_2 AND TEMPERATURE RECORDER



Record of CO_2 and stack temperature on one chart.

Does your fireman know how much fuel he is wasting? Do you know?

The **Uehling CO_2 Recorder** makes a complete 24 hr. record of your combustion efficiency and the **CO_2 indicator at the Boiler Front** holds the fireman responsible.

Get more **Steam** per pound of **Coal** and reduce your annual fuel consumption.

CO_2 Indicator for Boiler Front

Let us know the number and size of your boilers and coal consumed per year, upon receipt of which information we will be glad to send you full particulars.

Let us hear from you. We are pioneers in the manufacture of Indicators and Recorders for Power Plant purposes.

Send for our Bulletin No. 110.

Uehling Instrument Company

2008 Empire Building New York City

Niagara Power Co., Niagara Falls, N.Y. Floors protected with "R.I.W." Cement Filler and Cement Floor Paint.

"Dusting" Floors Means Injury to Machinery

The effects of "dusting" floors are far reaching. Not only does the concrete ultimately disintegrate, but meanwhile bearings, and other running parts pay a heavy toll in heating, dragging, and cutting down with grit. The rational remedy is

R.I.W. CEMENT FILLER & CEMENT FLOOR PAINT

REMEMBER IT'S WATERPROOF — REG. U.S. PAT. OFF. — PATENTED AS TO PORTLAND CEMENT FEB 27 '06

These products with a record of success behind them since 1905 penetrate the pores of cement or concrete, and harden the floor into a homogeneous surface. They are oil-proof, water-proof, wear-proof. Decorate as well as protect.

They prevent absolutely all dusting of cement or concrete floors of power plants, factories, garages and other buildings.

Valuable booklet sent on request. Address Dept. 59.

TOCH BROTHERS

Technical and Scientific Paint Makers since 1848

320 Fifth Avenue, New York

Works: New York; London, Eng.: Toronto, Can.

R.I.W.

REMEMBER IT'S WATERPROOF

REG. U.S. PAT. OFF.

STEEL NEED NOT RUST!
WOOD NEED NOT ROT!
NOR CONCRETE DUST!

If any advertisement interests you, tear it out now and place with letters to be answered

PULP MILL MACHINERY
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Jeffrey Manufacturing Co., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

PUMPING MACHINERY
American Steam Pump Co., Battle Creek, Mich
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Bawden Machine Co., Toronto.
Laurie & Lamb, Montreal.
McAvity & Sons, T., St. John, N.B.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.
Waterous Engine Works Co., Brantford.

PUMPING MACHINERY, ELECTRICAL
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Jeffrey Manufacturing Co., Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.

PUMPS, AIR
American Steam Pump Co., Battle Creek, Mich
Bawden Machine Co., Ltd., Toronto.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Montreal.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co. Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, CONTRACTORS'
Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
McAvity & Sons, T., St. John, N.B.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, ELECTRICAL
American Steam Pump Co., Battle Creek, Mich

PUMPS, FEED WATER
Can. Allis-Chalmers, Ltd., Toronto, Ont.

PUMP GOVERNORS AND REGULATORS
Bawden Machine Co., Ltd., Toronto.
Darling Bros., Montreal.
G. M. Davis Regulator Co., Chicago.
D'Este Co., Julian, Boston, Mass.
Elliott Co., Pittsburgh, Pa.
Mason Regulator Co., Boston, Mass.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.
Watson & McDaniel Co., Philadelphia.

PUMP STRAINERS
Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Darling Bros., Ltd., Montreal.
Liberty Mfg. Co., Pittsburgh, Pa.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, HAND AND POWER
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Darling Bros., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, CENTRIFUGAL
American Steam Pump Co., Battle Creek, Mich.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Darling Bros., Montreal.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Pulsometer Engineering Co., Ltd., London, Eng.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Waterous Engine Works Co., Brantford.

PUMPS, DUPLEX
Can. Allis-Chalmers, Ltd., Toronto, Ont.

PUMPS, GEARED, COMPOUND
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Ltd., Toronto.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Montreal.
Inglis Co., The John, Toronto, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, HYDRAULIC, PRESSURE
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Darling Bros., Montreal.
Inglis Co., The John, Toronto, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.

PUMP LEATHERS
Beveridge Paper Co., Ltd., Montreal, Que.
Can. B. K. Morton Co., Toronto, Montreal.
Gutta Percha & Rubber Mfg. Co., Montreal.

PUMPS, OIL
American Steam Pump Co., Battle Creek, Mich
Bawden Machine Co., Ltd., Toronto.
Bowser & Co., Inc., S. F., Toronto, Ont.
Can. Detroit Lubricator Co., Walkerville, Ont.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, STEAM TURBO
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Darling Bros., Montreal.
Fairbanks, Morse & Co., Montreal, Que.
Pulsometer Engineering Co., Ltd., London, Eng.

PUMP TANK, RECEIVER
American Steam Pump Co., Battle Creek, Mich.
Smart-Turner Machine Co., Hamilton, Ont.

PUMPS, STEAM
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Ltd., Toronto.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
Inglis Co., The John, Toronto, Ont.
Laurie & Lamb, Montreal.
Leitch Co., Arthur S., Toronto, Ont.
McAvity & Sons, T., St. John, N.B.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, TRIPLEX
Smart-Turner Machine Co., Hamilton, Ont.

PUMPS, VACUUM
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Ltd., Toronto.
Laurie & Lamb, Montreal.
Leitch Co., Arthur S., Toronto, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PYROMETERS
Foxboro Co., The, Foxboro, Mass.
Jas. Morrison Brass Mfg. Co., Toronto.
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.

RADIATOR TRAPS
Sarco Co., Inc., New York, N.Y.

RADIATOR AIR VENTS
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

RAGS
Wm. C. Wilson & Co., Toronto.

REBOILERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

RECEIVERS, AIR
Can. Allis-Chalmers, Ltd., Toronto, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.

RECORDING INSTRUMENTS
Can. H. W. Johns-Manville Co., Toronto, Ont.
Foxboro Co., The, Foxboro, Mass.
Precision Instrument Co., Detroit, Mich.
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.

REFRIGERATOR DOORS, WINDOWS, ETC.
Jamison Cold Storage Door Co., Hagerstown, Md.

REFRIGERATING MACHINERY
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Griscom-Russell Co., Ltd., Montreal.
Frick Co., Waynesboro, Franklin Co., Pa.
Linde Canadian Refrigeration Co., Montreal.
Vilter Mfg. Co., Milwaukee, Wis.
York Mfg. Co., York, Pa.

REFUSE DESTRUCTOR
Canadian Griscom-Russell Co., Ltd., Montreal.
Laurie & Lamb, Montreal.

REGULATORS, PRESSURE
Chaplin-Fulton Mfg. Co., Pittsburgh, Pa.
D'Este Co., Julian, Boston, Mass.
Jas. Morrison Brass Mfg. Co., Toronto.
Taylor Instrument Co., Rochester, N.Y.

REGULATORS, TEMPERATURE
Sarco Co., Inc., New York, N.Y.
Taylor Instrument Co., Rochester, N.Y.

RETORTS
MacKinnon, Holmes & Co., Sherbrooke, Que.

REVOVLING DOORS FOR HARDENING ROOMS
Jamison Cold Storage Door Co., Hagerstown, Md.

ROOFING
Wm. C. Wilson & Co., Toronto.

ROPE
Wm. C. Wilson & Co., Toronto.

ROPE PRESERVATIVE
Cling Surface Co., Buffalo.

ROTARY CONVERTERS
Canadian Fairbanks-Morse Co., Montreal.

RUBBER HOSE
Can. H. W. Johns-Manville Co., Toronto, Ont.
Garlock Packing Co., Hamilton, Ont.
Liberty Mfg. Co., Pittsburg, Pa.

RUBBER MOLDS
Bawden Machine Co., Ltd., Toronto.

SAFES
Canadian Fairbanks-Morse Co., Montreal.
Goldie & McCulloch Co., Galt.

SCALE REMOVERS
Babcock & Wilcox, Ltd., Montreal.
Beveridge Paper Co., Ltd., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
William B. Pierce Co., Buffalo, N.Y.

SEAM PROTECTORS, GIRTH
National Boiler Protector Co. of Canada, Montreal, Que.

SHAFTING
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

SHAKING AND DUMPING GRATES
Babcock & Wilcox, Ltd., Montreal.
Galt Foundry Co., Galt, Ont.
Waterous Engine Works Co., Brantford.

SMOKE BOXES, STACKS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

SMOOTH-ON
Wm. C. Wilson & Co., Toronto.

SPECIAL MACHINERY
Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Waterous Engine Works Co., Brantford.

SPEED INDICATORS
Foxboro Co., The, Foxboro, Mass.
Schaeffer & Budenburg Mfg. Co., Brooklyn, N.Y.
L. S. Starrett Co., Athol, Mass.

SPLICE PROTECTORS
Jordan Bros., Inc., New York, N.Y.

SPROCKET CHAIN ATTACHMENTS
Waterous Engine Works Co., Brantford.

SPROCKET RIMS
Babbitt Steam Specialty Co., New Bedford, Mass.

SPUR WHEELS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Waterous Engine Works Co., Brantford.

STACKS, STEEL
Babcock & Wilcox, Ltd., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.

STAND PIPES, STEEL
MacKinnon, Holmes & Co., Sherbrooke, Que.

STAYBOLTS, FLEXIBLE
Can. Allis-Chalmers, Ltd., Toronto, Ont.

STEAM SEPARATORS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Darling Bros., Montreal.
Direct Separator Co., Syracuse, N.Y.
D'Este Co., Julian, Boston, Mass.
Elliott Co., Pittsburgh, Pa.
Leitch Co., Arthur S., Toronto, Ont.
Penberthy Injector Co., Windsor, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Watson & McDaniel Co., Philadelphia.

STEAM SPECIALTIES
Alberger Heater Co., Buffalo, N.Y.
Canadian Fairbanks-Morse Co., Montreal.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
D'Este Co., Julian, Boston, Mass.
Liberty Mfg. Co., Pittsburg, Pa.
Lunkenheimer Co., Cincinnati, O.
Mason Regulator & Engineering Co., Montreal.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor.
Watson & McDaniel Co., Philadelphia.

STEAM TRAPS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Anderson Co., Y. D., Cleveland, O.
Canadian Fairbanks-Morse Co., Montreal.
Can. Sirocco Co., Windsor, Ont.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
Davis Regulator Co., G. M., Chicago.
D'Este Co., Julian, Boston, Mass.
Elliott Co., Pittsburgh, Pa.
J. T. Long, 84 Adam St., Montreal, Que.
Can. Morehead Mfg. Co., Woodstock.
Mason Regulator & Engineering Co., Montreal.
Nashua Mach. Co., Boston, Mass.
Sarco Co., Inc., New York, N.Y.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Watson & McDaniel Co., Philadelphia.

STEEL BARRELS
Smart-Turner Machine Co., Hamilton, Ont.

STEEL DRUMS
Smart-Turner Machine Co., Hamilton, Ont.

STEEL TANKS
Babcock & Wilcox, Ltd., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.

STOKERS
Babcock & Wilcox, Ltd., Montreal.
Ed. Bennis & Co., Little Fulton, Bolton, Eng.
Detroit Stoker Co., Detroit, Mich.
Galt Foundry Co., Galt, Ont.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Dertoit, Mich.

STRAINERS
Babcock & Wilcox, Ltd., Montreal.
Bawden Machine Co., Ltd., Toronto.
Elliott Co., Pittsburgh, Pa.
Self-Cleansing Strainer Co., Chicago.

STRUCTURAL STEEL WORK
Babcock & Wilcox, Ltd., Montreal.
MacKinnon, Holmes & Co., Ltd., Sherbrooke, Que.

SUPERHEATERS, STEAM
Babcock & Wilcox, Ltd., Montreal.

SWITCHBOARDS
Can. General Electric Co., Toronto, Ont.

SWITCHES AND SWITCH BOXES
Can. H. W. Johns-Manville Co., Toronto, Ont.

TACHOMETERS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Foxboro Co., The, Foxboro, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

TANKS, BLOW-OFF
Darling Bros., Montreal.
John McDougall Caledonian Iron Works, Montreal
Waterous Engine Works Co., Brantford.

TANKS, FREEZING, STORAGE AND WATER COOLING
Frick Co., Waynesboro, Franklin Co., Pa.

TANKS, OIL
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Bowser & Co., Inc., S. F., Toronto, Ont.
Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

TANKS, WATER
Inglis Co., The John, Toronto, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

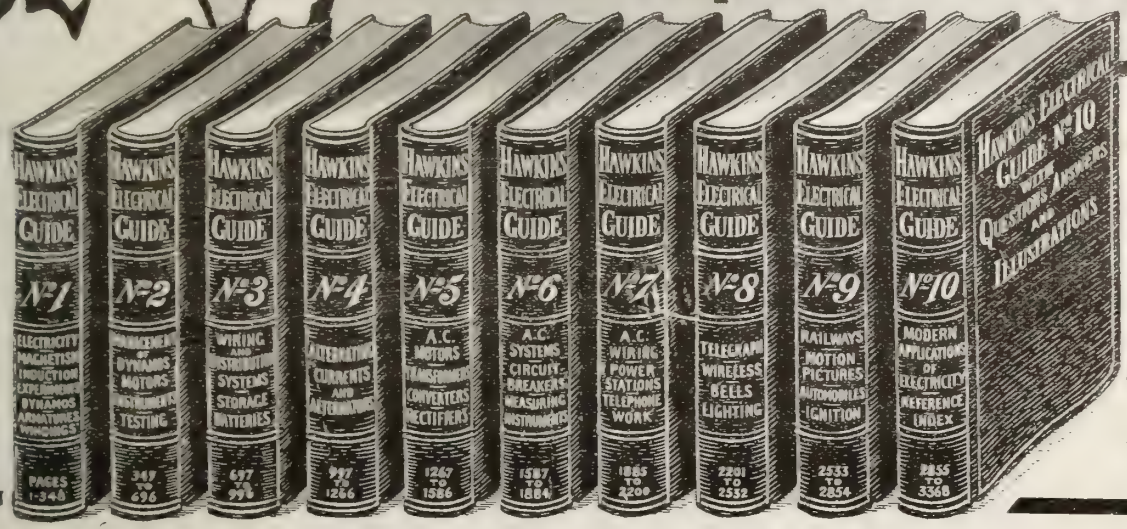
TECHNICAL BOOKS
MacLean Publishing Co., Toronto.

THERMOMETERS
Foxboro Co., The, Foxboro, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.

THERMOSTATS
Sarco Co., Inc., New York, N.Y.

TRANSFORMERS
Can. General Electric Co., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.

Every Electrical Man Wants These Books and we ship them for your inspection FREE



Flexible Covers — Handy Pocket-Size Volumes

10 Numbers — 3500 Pages — 4700 Pictures

$1 A Month — $1 A Volume

Just what you need to know to succeed in ELECTRICITY

EVERY electrician, every engineer, every mechanic should know about these wonderfully helpful instructive books, which give in plain words a complete working knowledge of electrical engineering in all its branches.

You run into some new electrical problem almost every day. The information you need to help you in your everyday work is in

HAWKINS ELECTRICAL GUIDES

These books place electricity at your finger ends. They cover every imaginable subject, principle, theory, problem, trouble, and way of doing things electrically. Every subject is indexed so that you can turn right to it. They are a study course and a reference guide in one, written in plain everyday language—no wasted words—only what you need to know—chock full of up-to-the-minute electrical knowledge. The guides are a complete course in electrical engineering. They will help you in every detail of the day's electrical work. You can't ask an electrical question that Hawkins Guides can't answer.

What Electrical Men Say

Helped Him Make Good.

"It is only right for me to recommend highly the Hawkins Guides, for they have been of the greatest assistance to me in placing me in my present position as Superintendent of Construction Department of one of Ohio's largest Electrical Companies. I would like to see every man have a set of Hawkins Guides."

Geo. Knecht, Columbus, Ohio.

In the Naval Electrical Dept.

"The Hawkins Guides are great help to me in the Naval Electrical Department, which they cover very thoroughly." C. J. Cornell, U.S. Receiving Ship, Brooklyn, N.Y.

Superintendent

"I am now superintendent of the Dunnville Hydro-Electric Systems, and Hawkins Guides were a great help to me in holding down a responsible position."

W. E. Swartz, Dunnville, Ontario.

Wireless Operators

"I have worked wireless for ten years—but I wish I had these books years ago, as they have saved me a great deal of trouble." H. Marshall. Steamer M. & B. No. 2, Walkerville, Ont.

Pocket-Size Flexible Covers

The books are small enough to slip into your coat pocket—handsomely bound in flexible black covers.

You can carry each volume with you until you have mastered its contents. 3,500 pages of actual information and 4,700 illustrations. Once you see these books and put them into actual use you will never again want to be without them. Try it at our expense.

SEND NO MONEY

It will cost you nothing to receive these books—to look them over—ask them all the questions you can think of—use them in your work—study them—pick up some information that will increase your earning ability. We will ship you the entire set of 10 volumes entirely FREE.

This is a sign of our confidence in the guides. Pure gold does not object to being tested. Keep them for seven days and if you do not decide that you can't get along without them, return them to us and owe us NOTHING.

When you decide to keep them you only have to pay $1.00 down and remit the balance of $9.00 on the easy payment of $1.00 a month till paid for.

Use this coupon to get the books. It will pay you many times over.

THEO. AUDEL & CO.
72 Fifth Avenue New York, N.Y.

READ THIS PARTIAL LIST OF CONTENTS.

No. 1 Contains 348 pages. 388 illustrations. Electrical signs and symbols—static current electricity—primary cells—conductors and insulators—resistance and conductivity—magnetism—induction coils—dynamo principles—classes of dynamos—armatures—windings—commutation—brushes, etc.

No. 2 Contains 348 pages, 394 illustrations. Motor principles—armature reaction—motor starting—calculations—brake horsepower—selection and installation of dynamo and motors—galvanometers—standard cells—current measurement—resistance measurement—voltmeters — wattmeters — watt hour meters—operation of dynamos—operation of motors, etc.

No. 3 Contains 300 pages 423 illustrations. Distribution systems—wire and wire calculations—inside, outside and underground wiring—sign flashers—lightning protection—rectifiers—storage battery systems, etc.

No. 4 Contains 270 pages, 379 illustrations. Alternating current principles—alternating current diagrams—the power factor—alternator principles—alternator construction—windings, etc.

No. 5 Contains 320 pages, 614 illustrations. A. C. Motors—synchronous and induction motor principles—A. C. commutator motors—induction motors, transformers; losses, construction, connections, tests—converters—rectifiers, etc.

No. 6 Contains 298 pages, 472 illustrations. Alternating current systems—switching devices—circuit breakers relays—lightning protector apparatus—regulating devices—synchronous condensers—indicating devices—meters—power factor indicators—wave form measurement—switch boards, etc.

No. 7 Contains 316 pages, 379 illustrations. Alternating current, wiring power stations—turbines: management, selection, location, erection, testing, running, care and repair—telephones, etc.

No. 8 Contains 332 pages, 436 illustrations. Telegraph—simultaneous telegraphy and telephony—wireless—electric bells—electric lighting—photometry, etc.

No. 9 Contains 322 pages, 627 illustrations. Electric railways—electric locomotives—car lighting—trolley car operation — miscellaneous applications — motion pictures—gas engine ignition—automobile self-starters and lighting systems, electric vehicles, etc.

No. 10 Contains 513 pages, 599 illustrations. Elevators—cranes — pumps — air compressors—electric heating—electric welding—soldering and brazing—industrial electrolysis—electro plating—electro-therapeutic—X-rays, etc.

Also a complete 126-page ready reference index of the complete library. This index has been planned to render easily accessible all the vast information contained in the 10 electrical guides. There are over 13,500 cross references. You find what you want to know instantly.

THEO. AUDEL & CO.
72 Fifth Avenue
New York, N. Y.

Please submit me for examination Hawkins Electrical Guides (price $1 each). Ship at once, prepaid, the 10 numbers. If satisfactory I agree to send you $1 within seven days and to further mail you $1 each month until paid.

Signature .....

Occupation .....

Business Address.....

Residence .....

Reference .....

Power House

TRANSMISSION MACHINERY
American Pulley Co., Philadelphia, Pa.
Boving Hydraulic & Eng. Co. Ltd., Lindsay, Ont.
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Gilson & McCulloch Co., Galt, Ont.
Jenckes Manufacturing Co., Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Waterous Engine Works Co., Brantford.

TRAPS, STEAM AND WATER-LINE
D'Este Co., Julian, Boston, Mass.

TRUCKS, FACTORY
Beveridge Paper Co., Ltd., Montreal, Que.
Canadian Fairbanks-Morse Co., Montreal.

TUBE CLEANERS
Babcock & Wilcox, Ltd., Montreal.
Elliott Co., Pittsburgh, Pa.
Liberty Mfg. Co., Pittsburg, Pa.

TUBE CUTTERS
Babcock & Wilcox, Ltd., Montreal.
Liberty Mfg. Co., Pittsburg, Pa.

TUBES, BOILER
Babcock & Wilcox, Ltd., Montreal.

TUBE EXPANDERS
Babcock & Wilcox, Ltd., Montreal.
Liberty Mfg. Co., Pittsburg, Pa.

TUBING, FELXIBLE METALLIC
Pennsylvania Flexible Metallic Tubing Co., Cleveland, O.

TUNGSTEN LAMPS
Bawden Machine Co., Toronto.

TURBINE OIL
Kellogg & Co., E. H., New York, N.Y.

TUNGSTEN LAMP (Vacuum and Gas Filled Types)
Can. Laco-Phillips Co. of Toronto, Ont.

TURBINE WATER WHEELS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Boving Co., Hamilton.
Jenckes Machine Co., Sherbrooke, Que.

TURBINES, STEAM
Bellis & Morcom, Birmingham, Eng.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Coe Co., C. T., 10 Johnson St., Newark, N.J.
Coppus Engr. & Equip. Co., Worcester, Mass.
Escher Wyss & Co., Montreal, Que.
Kerr Turbine Co., Wellsville, N.Y.
Laurie & Lamb, Montreal.
John McDougall Caledonian Iron Works, Montreal
Sturtevant Co. of Canada, B. F., Galt, Ont.

UNIONS
Canadian Fairbanks-Morse Co., Montreal.
Dart Union Company, Toronto.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.

UNIONS, BALL JOINT, COMBINATION, FLANGED PIPE, GROUND JOINT, MALLEABLE IRON, FLANGE, PIPE, SWING,
Jefferson Union Co., Lexington, Mass.
Dart Union Company, Ltd., Toronto, Ont.

VACUUM GOVERNORS
Smart-Turner Machine Co., Ltd., Hamilton.
Canadian Steam Boiler Equipment Co., Toronto
G. M. Davis Regulator Co., Chicago.
Leitch Co., Arthur S., Toronto, Ont.

VACUUM REGULATING VALVES
Darling Bros., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

VACUUM TRAPS
Can. Morehead Mfg. Co., Woodstock, Ont.
Can. Sirocco Co., Windsor, Ont.
Cole, Ltd., Geo. W., Toronto.
Nashua Mach. Co., Boston, Mass.

VALVE DISCS
Wm. C. Wilson & Co., Toronto.

VALVE LEATHER
Beveridge Paper Co., Ltd., Montreal, Que.
Can. B. K. Morton Co., Toronto, Montreal.
Graton & Knight Mfg. Co., Montreal.

VALVE RESEATING MACHINES
Darling Bros., Montreal.

VALVES
Babcock & Wilcox, Ltd., Montreal.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Frick Co., Waynesboro, Franklin Co., Pa.
G. M. Davis Regulator Co., Chicago.
D'Este Co., Julian, Boston, Mass.
Homestead Valve Mfg. Co., Pittsburg.
Jenkins Bros., Montreal.
Kerr Engine Co., Walkerville, Ont.
Liberty Mfg. Co., Pittsburg, Pa.
Lunkenheimer Co., Cincinnati, O.
Mason Regulator & Engineering Co., Montreal.
Mason Regulator Co., Boston, Mass.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor.
Pratt & Cady, Hartford, Conn.
Watson & McDaniel Co., Philadelphia.
Wm. C. Wilson & Co., Toronto.
York Manufacturing Co., Philadelphia.

VALVES, ACID RESISTING
Homestead Valve Mfg. Co., Pittsburg.
McAvity & Sons, T., St. John, N.B.

VALVES, BACK PRESSURE
Can. Allis-Chalmers, Ltd., Toronto, Ont.

VALVES, BLOW-OFF
Babcock & Wilcox, Ltd., Montreal.
Canadian Fairbanks-Morse Co., Montreal.
Elliott Co., Pittsburg, Pa.
Homestead Valve Mfg. Co., Pittsburg.
Jenkins Bros., Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Watson & McDaniel Co., Philadelphia.

VALVE CHAIN WHEEL
Babbitt Steam Specialty Co., New Bedford, Mass.

VALVES, FOOT
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Smart-Turner Machine Co., Ltd., Hamilton.

VALVES, GATE
Babcock & Wilcox, Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

VALVES, MULTIPORT
Can. Allis-Chalmers, Ltd., Toronto, Ont.

VALVES, NON-RETURN STOP
Canadian Fairbanks-Morse Co., Montreal.

VALVES, REDUCING
D'Este Co., Julian, Boston, Mass.
Leitch Co., Arthur S., Toronto, Ont.
Liberty Mfg. Co., Pittsburg, Pa.
Mason Regulator Co., Boston, Mass.
Jas. Morrison Brass Mfg. Co., Toronto.
Watson & McDaniel Co., Philadelphia.

VALVES, RELIEF
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
McAvity & Sons, T., St. John, N.B.

VALVES, RADIATOR
Jenkins Bros., Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.

VALVES, POP
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.

VALVES, PUMP
Beveridge Paper Co., Ltd., Montreal, Que.
Canadian Fairbanks-Morse Co., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

VALVES, SAFETY THROTTLE
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Detroit Lubricator Co., Walkerville, Ont.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.

VALVES, VACUUM
Sarco Co., Inc., New York, N.Y.

VAULTS AND VAULT DOORS
Canadian Fairbanks-Morse Co., Montreal.
Goldie & McCulloch Co., Galt.

VENTILATING APPARATUS
Sturtevant Co. of Canada, B. F., Galt, Ont.

VOLTMETERS
Can. H. W. Johns-Manville Co., Toronto, Ont.

WASHERS, FIBRE
Beveridge Paper Co., Ltd., Montreal, Que.

WASHERS, LEATHER
Graton & Knight Mfg. Co., Montreal.

WASTE
Wm. C. Wilson & Co., Toronto.

WATER COLUMNS, GAUGES
Babcock & Wilcox, Ltd., Montreal.
Elliott Co., Pittsburg, Pa.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.
W. J. Wall, Montreal.

WATER HOSE
Can. H. W. Johns-Manville Co., Toronto, Ont.
Liberty Mfg. Co., Pittsburg, Pa.
Pennsylvania Flexible Metallic Tubing Co., Cleveland, O.

WATER LIFTERS
Watson & McDaniel Co., Philadelphia.

WATER MOTORS
Elliott Co., Pittsburg, Pa.

WATER PURIFIERS, SOFTENERS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Laurie & Lamb, Montreal.
Scaife & Sons, Wm. B., Pittsburgh, Pa.

WATER WHEELS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Escher Wyss & Co., Montreal, Que.
MacKinnon, Holmes & Co., Sherbrooke, Que.
John McDougall Caledonian Iron Works, Montreal

WATERWORKS SUPPLIES
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
McAvity & Sons, T., St. John, N.B.

WATTMETERS
Can. H. W. Johns-Manville Co., Toronto, Ont.

WHISTLES, PLAIN OR CHIME
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

WRENCHES
Greene, Tweed & Co., New York.
Trimont Mfg. Co., Roxbury, Mass.
Williams & Co., J. W., Brooklyn, N.Y.

WATER SOFTENING OR FILTRATION
FOR BOILER FEED AND ALL INDUSTRIAL USES
WM. B. SCAIFE & SONS CO. PITTSBURGH, PA.

SAFETY PLASTIC
METALLIC PACKING
FOR STEAM, WATER, AIR, GAS, ETC.
Self-Lubricating
Practically Frictionless
Pat. Dec. 22, 1903
Highest Award World's Fair, St. Louis, 1904
GUARANTEED TO LAST THREE YEARS
WITHOUT RENEWAL
Drop us a line and let us tell you all about this Remarkable Packing.
STEEL MILL PACKING CO., WINDSOR, ONT. Established 1899
In Bulk
In Cotton Tubes

Don't buy that New Electrical Apparatus Just Yet

WE can supply you with high-grade apparatus that has been slightly used and discarded through no fault of its own, at an **immense saving in cost.** For instance, in many cases we take over entire plants simply because of changed conditions such as increased capacity, change of system, etc.

EVERYTHING IS OVERHAULED AND REFINISHED BY US AND **GUARANTEED** AS GOOD AS NEW, BOTH ELECTRICALLY AND MECHANICALLY.

Our catalogs of offerings should be in the hands of every power plant superintendent each time they are gotten out, and it will be worth while for anyone interested in this class of power plant equipment to be on our mailing list to receive **all** offerings.

Nearly all of the principal power, lighting and street railway plants in the United States are our customers.

WRITE FOR OUR LATEST CATALOG of **Power House Equipment, Street Cars, Motors, Hoists, Compressors, etc.**

MACGOVERN & COMPANY, Inc.

114 Liberty St., New York City

Continuously Efficient Service

on the most troublesome lines is obtained only thru the use of

Homestead
Quarter Turn
Valves

If you want to know what a real serviceable valve can do for you in your Plant, just try a "Homestead."

Homestead Valves will last several times as long as the ordinary valve and will save their own cost shortly after installation through eliminating wastes and leakages.

Thousands of satisfied customers daily testify to its efficiency and back up their belief in this money-saving valve by giving us repeat orders.

We will cheerfully demonstrate the superiority of the Homestead Valve by sending you one for trial.

Write to-day.

Homestead Valve Mfg. Co.
HOMESTEAD, PA.

CURTIS
Engineering Specialties

CURTIS Water Pressure Regulator

The Economy of this Curtis Water Pressure Regulator (See Illustration) lies in the fact that it greatly reduces the cost of keeping plumbing in order — This by obviating the wear and tear of water hammer or concussion in pipes.

This regulator is warranted to maintain the pressure desired, **with perfect uniformity, regardless of any fluctuations of outside pressure.** The workmanship and material of the Regulator **cannot be excelled.** Trouble from rust or clogging **is entirely avoided.** Delivery of water into service pipes at any desired pressure **is guaranteed.**

Send for special leaflet and price list to the manufacturers.

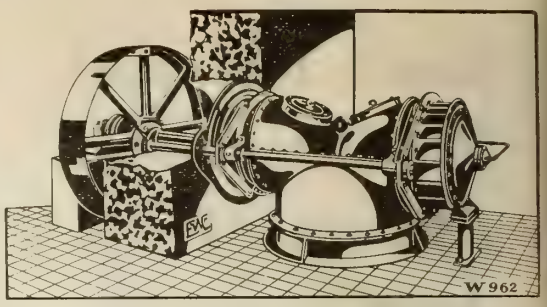
JULIAN D'ESTE COMPANY
26 Canal Street, BOSTON, MASS.

WATER - TURBINES

Francis and Tangential Wheels

GOVERNORS

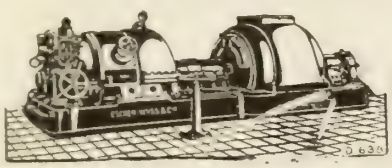
PIPELINES



ESCHER WYSS & Cie S.A.
Zurich
Switzerland

A 173

Zoelly Steam Turbines
Turbo-Pumps



MONTREAL OFFICE : **211 Coristine Building**

62-17

INDEX TO ADVERTISERS

PAGE

A

Albany Lubricating Co. 71
Alberger Heater Co. 52
Allen General Supplies, Ltd... 62
American Steam Gauge & Valve Mfg. Co. 50
American Steam Pump Co..... 70
Anderson Co., V. D. 81
Armstrong Cork Insulation Co. 11
Audel & Co., Theo 85

B

Babbitt Steam Specialty Co.... 71
Babcock & Wilcox 78
Bennis & Co., Ltd., Ed..... 4
Beveridge Paper Co. 5
Boiler Inspection Dept..... 77
Boiler Repair & Grate Bar Co., 8, 9
Boving Hydraulic & Eng. Co.. 76
Bowser, S. F., & Co., Inc..... 63

C

Can. Assoc. Stationary Engrs.. 68
Can. Bond Hanger & Coupling Co. 74
Can. Detroit Lub. Co. 74
Can. Fairbanks-Morse Co. 49
Can. General Electric Co..... 57
Can. H. W. Johns-Manville Co., Ltd. 67
Can. Morehead Mfg. Co. 81
Can. S K F Co..... 55
Canuck Supply Co., Ltd 73
Chaplin-Fulton Co 58
Cling-Surface Co. 71
Cole, Geo. W. 47
Coppus Eng. & Equip. Co. 6
Crane Packing Co..... 66

D

Darling Bros. 66
Dart Union Co. 61
Davis Regulator Co. 83
D'Este Co., Julian 87

PAGE

Direct Separator Co. 54
Dixon Crucible Co., Jos..... 47
Dominion Belting Co. 70
Dominion Coal Co. 76
Durabla Mfg. Co. 50

E

Economy Fuse & Mfg. Co. of Canada 4
Elliott Company 45
Escher Wyss & Co. 88

F

Federal Engineering Co. 81
Francis, Walter J., & Co..... 48
Frick Co. 11

G

Galt Foundry Co. 5
Garlock Packing Co. 72
Garth Co. 76
Gates, John W..... 48
Goldie & McCulloch Co. 16
Goodyear Tire & Rubber Co.. 65
Graton & Knight Mfg. Co..... 53
Greene, Tweed & Co. 51

H

Holmes Metallic Packing Co... 77
Homestead Valve Mfg. Co. ... 87
Hoyt Metal Co. 2

I

Inglis Co., John...Inside back cover

J

Jamison Cold Storage Door Co. 12
Jefferson Union Co..... 65
Jeffrey Mfg. Co. 83
Jenckes Machine Co. 2
Jenkins Bros. .....Front cover

PAGE

Jones Underfeed Stoker Co., Ltd. 4
Jordan Bros., Inc. 77

K

Kellogg & Co., E. H. 48
Kerr Engine Co..... 59

L

Ladd Co., The Geo. T. 76
Laurie & Lamb 13
Leitch Co., The Arthur S..... 6
Linde Canadian Refrigeration Works Co. 10
Lunkenheimer Co. 58

M

MacGovern & Co. 87
MacKinnon, Holmes & Co..... 48
MacLean's Magazine 56
Magnolia Metal Co. 74
Mason Regulator Co. 6
Mason Regulator & Eng. Co., Ltd. 7
McAvity, & Sons, T..... 62
McDougall Caledonian Iron Works Co. 14
McGhie, W. C. 76
McLaren, D. K., Ltd. 69
Merchants Rubber Fdy. 47
Morrison Brass Mfg. Co., Jas. Outside back cover
Morse Chain Co. 75
Murphy Iron Works 5

N

National Boiler Seam Protector Co. 3

PAGE

P

Peerless Rubber Co. ..... Inside front cover
Pennsylvania Flexible Metallic Tubing Co. 54
Power Plant Equipment Co... 58
Pratt & Cady Co. 52

S

Sarco Co., Inc..... 46
Scaife, Wm. B., & Sons Co... 86
Schaeffer & Budenberg Mfg. Co. 6
Shell-Barr, Boico Supply, Ltd. 59
Smart-Turner Mach. Co. 77
Starrett, L. S., Co. 78
Steel Mill Packing Co..... 86

T

Taylor Instrument Co..... 66
Toch Bros. 88
Trimont Manufacturing Co.... 78

U

Uehling Instrument Co..... 83

V

Vilter Mfg. Co. 10

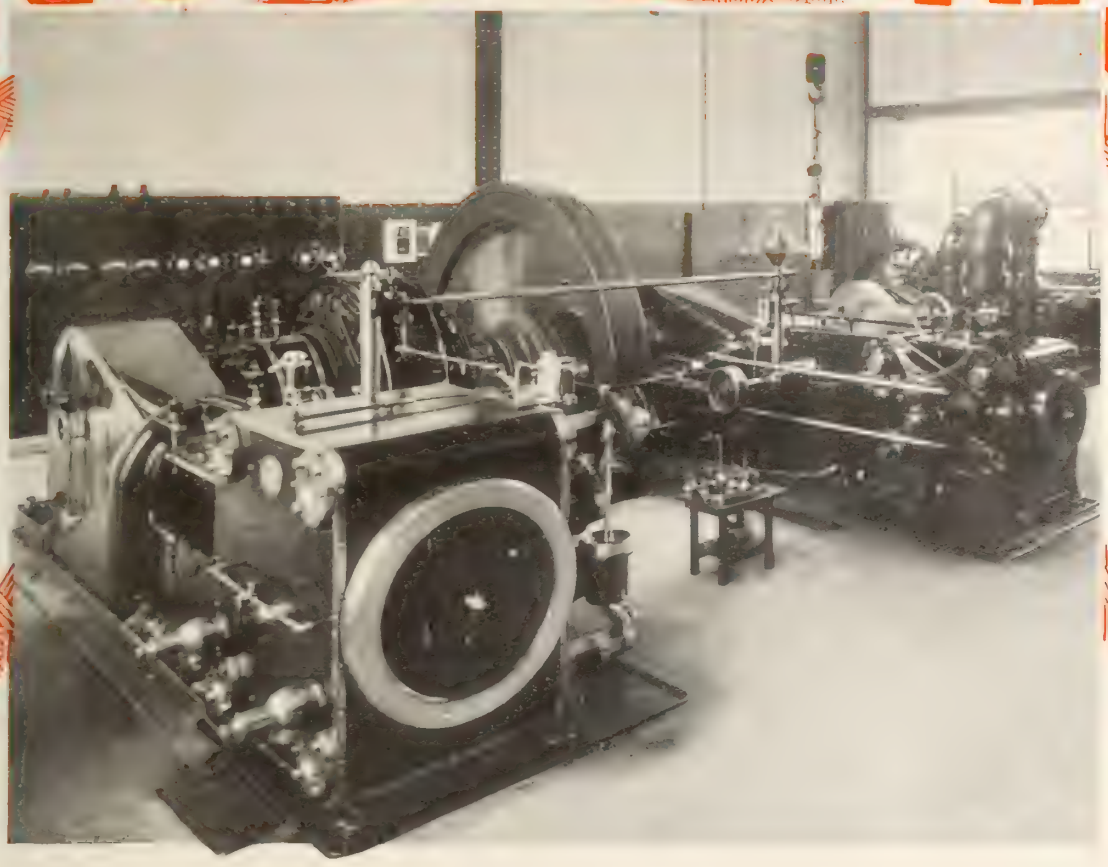
W

Wall, W. J. 48
Waterous Engine Works Co... 1
Watson & McDaniel Co..... 76
Williams & Co., J. H. 77
Wilson, Wm. C., & Co..... 47

Y

York Mfg. Co. 12

INGLIS ENGINES



An Inglis Installation

Canada's most prominent industrial concerns have shown a preference for INGLIS Engines. Illustration shows our Horizontal Cross Compound Heavy Duty Corliss Engine recently installed in the new plant of the Canadian Kodak Company, Mount Dennis (near Toronto), Ont.

Cylinders are 18 in. and 30 in. by 30 in. stroke, running at 150 r.p.m. Direct connected to a 300 k.w. Canadian Westinghouse 3-wire, 125-250 volt, d.c. compound wound computing pole type generator.

Engine operates on a steam pressure of 150 pounds, with 5 pounds back pressure. Valve Gear is operated by double wrist plates set for long range cut-off, the governor controlling both high and low pressure cylinders. Flywheel is 11 ft. in diameter and weighs 22,000 pounds.

Engineers and Boiler Makers—put your problem up to us; expert advice.

The John Inglis Company, Limited

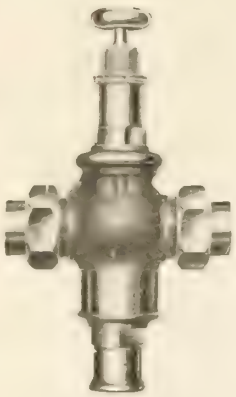
14 Strachan Avenue **TORONTO, Canada**

Canada's Standard Line

MORRISON'S

STEAM GOODS

AND SPECIALTIES



J. M. T. Reducing Pressure Valve.

J.M.T. products are thoroughly consistent with the most advanced engine and boiler room practice. Approved by Provincial Government inspection.

All goods carefully tested before leaving our factory.

Look for the "J.M.T." quality mark.

We will gladly give you the fullest information upon any of the following lines:

Stop Valves	Injectors	Gauge Board Outfits
Check Valves	Ejectors	
Gate Valves	Inspirators	Lubricators
Safety Valves	Jet Pumps	Pipe Fittings
Relief Valves	Steam Gauges	Steam Whistles
Reducing Valves	Vacuum Gauges	Engine Indicators
Steam Traps	Ammonia Gauges	Pipe, Tool, etc.
General Boiler Mountings		

Everything for the engine and boiler room. Drop us a line.

Lo-Press Safety Valve.

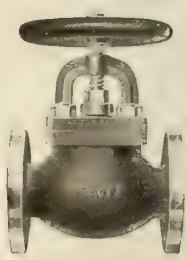
J.M.T. Improved Injector

J. T. T. Globe Valve, Renewable Disc.

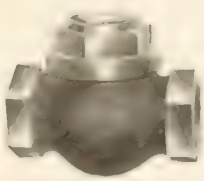
Steam Whistle

Morrison Recording Gauge.

Model C Safety Valve.



Beaver Valve.



J. M. T. Check Valve.

James Morrison Brass Mfg. Company

93-97 Adelaide Street West

TORONTO, CANADA

POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power; and to the operation of Refrigerating Machinery.

Published by The MacLean Publishing Company, Limited, 143-153 University Ave., Toronto

MONTREAL: Southam Bldg. LONDON, ENG.: 88 Fleet St., E.C. WINNIPEG: 1207 Union Trust Bldg.

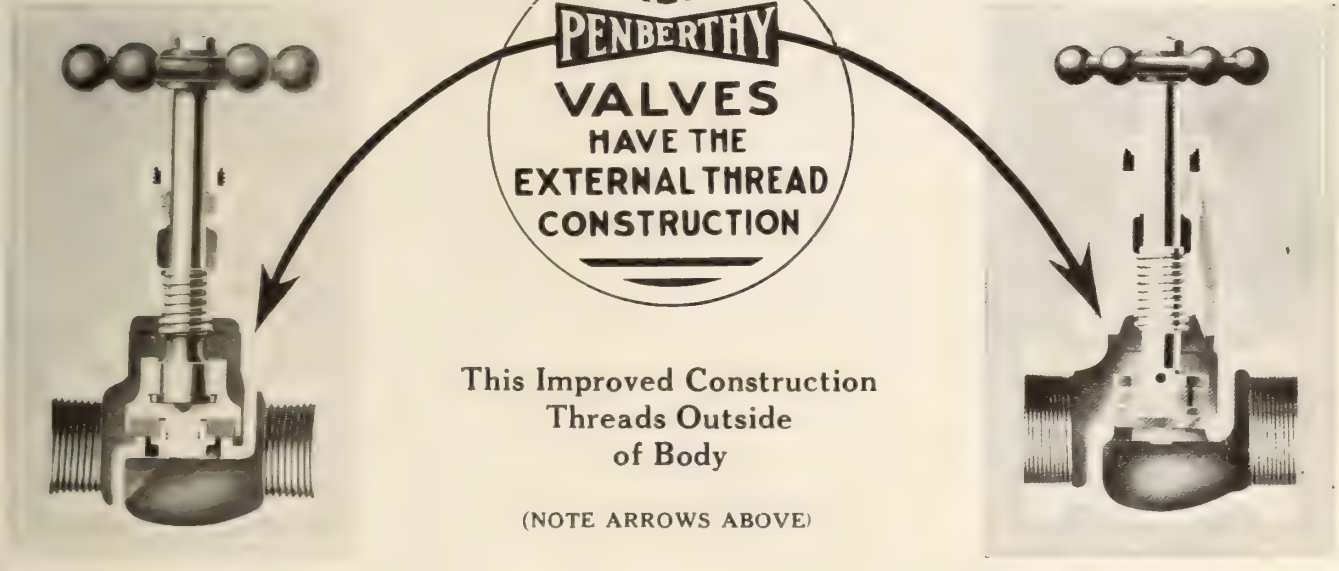
Vol XI—No. 2 Publication Office, Toronto—February, 1918 Published Monthly $1.00 per Year.

THE REASON WHY

TRADE PENBERTHY MARK **VALVES**

last longer and give so much **BETTER SATISFACTION** than other valves is due to their

SUPERIOR CONSTRUCTION



COMPODISK **REGRINDING**

Makes valve always accessible. Eliminates corrosion of threads. No corrosion prevents all strains in taking valve apart. Prevents spreading of body—causing a loose-fitting and unsafe bonnet. Makes a steam tight connection—no leaks. Permits of a more compact valve—consequently a stronger one.

For More Efficient Service Specify Penberthy

"ALL QUALITY VALVES"

Manufactured by

PENBERTHY INJECTOR CO., Limited, Windsor, Ontario

For Better Service in Mechanical Rubber Goods

THE United States Rubber Company, on January 1st, 1918, inaugurates an improved method of marketing in its *Mechanical Goods Division.*

This division includes Rubber Belting, Packing, Fire, Steam, Water, Garden and all other kinds of hose; Rubber Tiling, Mats, Matting, Jar Rings, Toys, Plumbers Supplies; Rubber Tape, Soles, Heels; Fibre Soles and hundreds of other rubber items.

Heretofore these goods have been marketed through subsidiary companies that for years have served all classes of industries, railroads, etc. These subsidiaries include:

Revere Rubber Co.
Peerless Rubber Mfg. Co.
Mechanical Rubber Co., Cleveland
Mechanical Rubber Co., Chicago
Sawyer Belting Co.
India Rubber Co.
Eureka Fire Hose Mfg. Co.

This plan will centralize the distribution of all these companies in one organization having branches and agents all over the country. This means quicker and better service everywhere for users of mechanical rubber goods.

The subsidiaries will continue to manufacture the brands, such as

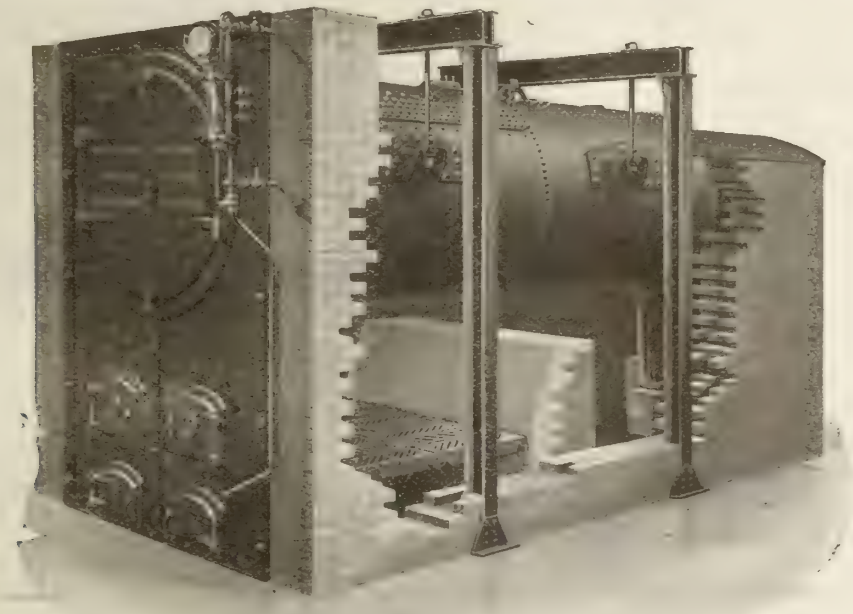
Rainbow Packing, Four Ace Belting, Giant Hose, Etc., Etc.

for which they are famous. The same high standard of quality and workmanship will be maintained. In addition the great seal of the United States Rubber Company, the hall mark of quality and value in rubber goods will identify these goods.

The assembling of all these well known brands in one selling organization makes the most complete line of mechanical rubber goods in the world. With distributors everywhere and factories in the large centers east and west we assure our customers the maximum in service and quality.

United States Rubber Company

BOILERS



WATEROUS Return Tubular Boilers are quick steaming, economical of fuel and absolutely reliable.

Power Boilers up to 165 H.P. Heating Boilers in sizes to 72″ x 16′—most standard sizes carried in stock.

We can supply brick or all-steel settings designed and dimensioned to give best results with whatever fuel you are using.

Boilers in stock for immediate shipment

1—42″ x 12′
2—48″ x 14′
3—54″ x 14′
7—60″ x 14′
5—72″ x 18′

Catalogue on Request.

Waterous

BRANTFORD, ONTARIO, CANADA

If any advertisement interests you, tear it out now and place with letters to be answered

For High Speed and Heavy Duty
FROST KING BABBITT

Backing up Frost King are the reputations of thousands of men held responsible for plant efficiency.

Backing up Frost King is the 40 years' scientific metal compounding experience of our organization, whose annual sales total over $5,000,000.

Frost King—the inexpensive babbitt—stands up to high speed and heavy duty work extraordinarily well.

For all time stop experimenting. Order Frost King to-day.

Naked Genuine is another time-tested Hoyt alloy for use in gas and gasoline engines, automobile engines and marine engines of every class. You will like it.

Hoyt Catalog clearly explains the economy of better babbitts. *Write for your copy.*

HOYT METAL CO., TORONTO

NEW YORK, N.Y. LONDON, ENG. ST. LOUIS, MO.

Announcement!

THE St. Catharines plant and business of The Jenckes Machine Co., Limited, have been acquired by Engineering & Machine Works, of Canada, Limited, newly formed for the purpose.

NO change is contemplated in the management or shop organization and the same careful attention will be paid to all enquiries and orders.

THE Head Office will be at St. Catharines and Sales Offices will be maintained at 710 C.P.R. Building, Toronto, with Mr. C. G. Horton in charge and at 344 St. James Street, Montreal, with Mr. G. L. Burritt in charge.

Engineering & Machine Works of Canada

LIMITED

General Offices and Works: ST. CATHARINES, ONT.

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

Murphy AUTOMATIC Furnace

REPEAT ORDERS!

Should convince you of merit in

MURPHY STOKERS!

For the year 1917 we received 60 repeat orders for 144 Murphy Stokers—47,000 nominal H.P.

Test data on a 550 H.P. boiler, furnace fired with 12,139 B.T.W. Coal, developed 794.6 H.P., 8½ hour run, with efficiency 75.1%, and on a one-hour run developed 994 H.P.—80 per cent. over rating—with natural draft.

For printed matter address

MURPHY IRON WORKS,

DETROIT, MICH., or BUFFALO, N.Y.

Save Fuel

Anti-Clinker Shell Bar Grates

prove clinkers a needless waste of fuel. In many cases fuel gases must be subjected to as much as 25% more heat to prevent clinker formation.

This greater heat cannot be obtained without perfect combustion. And to obtain perfect combustion there must be an ample supply of air.

That's why 50% of the total surface of Patent Anti-Clinker Shell Bar Grates is air space.

They are always clean. Burning slack, coal, coke or wood: they never warp. Cost repaid in fuel saved. **Write.**

Boico Boiler Scale Remover and Preventive

Radically different from any "compound" you have used, and as much better. Without injuring packings or valves in the slightest, it will rid your boiler of every bit of scale and prevent further formation.

SEND FOR FREE TRIAL TO-DAY

Boico will not carry over in the steam, or foam or prime. Boico is good for your boiler—and your purse. You need it to save fuel

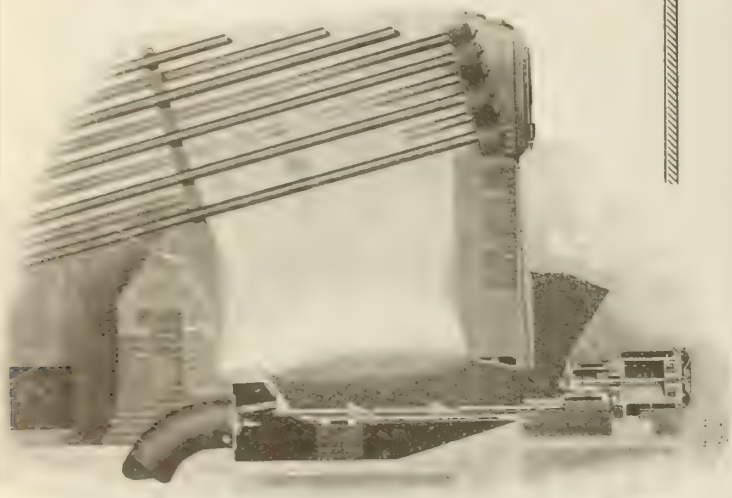
Copper Asbestos Boiler Gaskets never blow out and never stick. Made of corrugated copper, with pure asbestos cord filled corrugations. Use them and end all leaks in pipe lines.

Daniel's P. P. P. and Ebonite Packings for all Pressures. Only packing backed with scientific proof that it reduces friction. Long tests by Mechanical Engineers proved that P. P. P. saved 75% or more friction losses. Automatically regulates bearings on rod to requirements.

Shell-Bar Boico Supply, Limited
376 Dufferin St., Toronto, Canada

85 Tons

Go as far as 100 Used to



A coal saving of at least 15%—and in many cases up to 25%—follows the installation of

JONES UNDERFEED STOKER

And if you doubt the least little bit, speak to users near your own plant, whose names we will be glad to give you.

The Jones Underfeed Stoker responds instantly to load fluctuations. It automatically maintains a uniform steam pressure. It lessens labor. It prevents smoke. It is a mighty good investment.

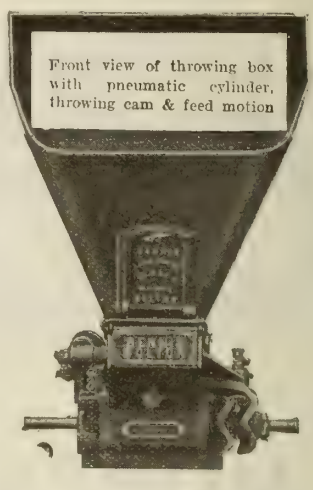
Write

Jones Underfeed Stoker Co.
LIMITED

37-41 Britain Street, TORONTO

EVERY part of a "Bennis" Stoker is scientifically designed and soundly constructed. Mechanical perfection has been our aim throughout and thousands of installations in all parts of the world testify to the success attained. Our catalogues, etc., at your disposal for the asking.

Write now and see what you can save, in coal, men, boilers and money.



Ed. Bennis & Co. Ltd.,
Little Hulton, Bolton ; 28 Victoria St., S.W. 1.

The famous "Drop-Out" Renewal Link can be had ONLY in

ECONOMY
renewable
FUSES

The famous "Drop Out" Renewal Link can be had only in ECONOMY renewable FUSES. This link is responsible for the saving of 80% of the annual fuse maintenance cost.

We are pioneers in the manufacture of renewable fuses. We have blazed the trail and staked our claims. The vital features of renewable fuse efficiency are protected by Economy basic patents. Imitations are by no means duplications.

Sole manufacturers of "Arkless"—the Fuse with the 100% Indicator. For circuits not subject to frequent overloads this is the logical fuse. This and the Economy together meet all fuse requirements.

Be prepared to handle the business that our extensive consumer advertising will bring to you. Write for Catalog 24 and free samples.

ECONOMY FUSE & MFG. CO. OF CANADA, LIMITED

UNITY BUILDING - MONTREAL

Manufacturers in Canada of "S. & C." High Potential Fuses—to 150,000 Volts

Galt Sprinkler Stokers Applied to Two 300 H.P. Water Tube Boilers

Are You Willfully Wasting Coal?

THE BUREAU OF MINES, WASHINGTON, D.C., SAYS:—

"The ordinary method of hand-firing boiler furnaces violates all the principles laid down for securing good combustion."

What Galt Sprinkler Stokers Will Really Do

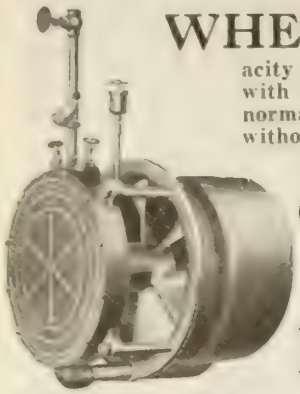
(1) Effect a saving in fuel from 10% to 20%.
(2) Give a brilliant and perfectly level fire.
(3) Give practically smokeless combustion.
(4) Increase the boiler capacity to a large degree.
(5) Operate with natural, forced, or induced draft.
(6) Operate with less repairs than other stokers.
(7) Mechanically feed and uniformly sprinkle the coal continuously over the entire grate surface—with the fire doors closed.
(8) Burn bituminous, anthracite or lignite fuel.
(9) Eliminate the necessity of expert firemen.

Send for Illustrated Catalogues

GALT FOUNDRY COMPANY - Galt, Ont.

Toronto Office: 826 Traders Bank Building **Phones: Main 4362, Junc. 3354**

WHY put in another boiler



WHEN you can increase your present steaming capacity to 200 and in connection with stokers even 300% of the normal rating of the boilers without injury to the boilers by installing a

COPPUS TURBO BLOWER

You will have all the steam you want all the time Hundreds of satisfied customers will attest to this. No drop in steam pressure when a heavy load comes on, and you can laugh at the weather man, as you can dispense with him for your draft. Besides, the blower will pay for itself in a short time, as it will burn cheaper fuel.

Cut out this Ad., put your name and address on the margin, and mail to us. Without further trouble you will get all the particulars.

500,000 H.P.

In boilers equipped with Coppus Turbo Blowers in four years. The Coppus has replaced a great many other blowers, but no other blower has ever replaced a Coppus.

Coppus Engineering & Equipment Company
167 Union Street, Worcester, Mass.
Agents for Montreal—Mason Regulator & Engineering Co.
Agents for Ontario—A. S. Leitch Co., 506 Kent Bldg., Toronto.

MASON

Reducing Valves

Pump Regulator
Balanced Valves
Damper Regulators

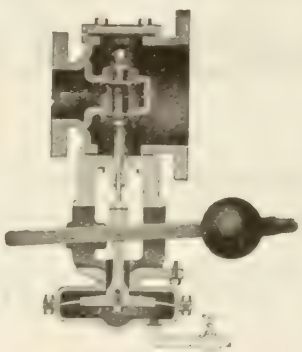
If you order a Mason you will get absolute satisfaction. This we guarantee you. You simply cannot make a mistake.

Dependable regulation under every possible condition.

Our complete catalog tells you WHY. Let us mail you a copy.

Mason Regulator Company
BOSTON, MASS.

TORONTO REPRESENTATIVES:
The Arthur S. Leitch Co.,
506 Kent Bldg., Toronto.



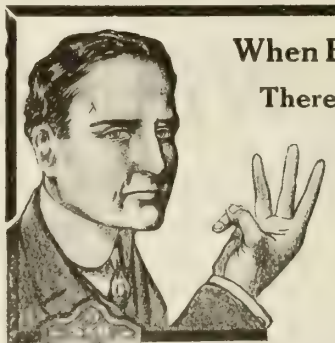
Kieley & Mueller Specialties

Regulating Valves
Back Pressure Valves
Pump Governors
Separators
Traps

FOR EVERY SERVICE

SALES ENGINEERS

THE ARTHUR S. LEITCH CO.
TORONTO



When Buying Thermometers

There's Just Three Things to Remember—

First, you must have accuracy and sensitiveness—

Second, durability is absolutely essential—

Third, the thermometer must be suitably constructed for the intended application.

Accuracy, sensitiveness and durability are absolutely guaranteed in

"Crescent" Thermometers

And with nearly seventy years of experience to our credit, we are qualified to properly interpret your needs.

Our Catalog P.H. 200 illustrates and describes "Crescent" Thermometers for every application. Also test thermometers, glass thermometers, etc.

Get a copy of Catalog P.H.-200 to-day.

The Schaeffer & Budenberg Mfg. Co.

Brooklyn, New York

Chicago
Pittsburg
St. Louis
Philadelphia
Los Angeles

Power Plant thermometers for all temperatures not exceeding 1000° F

Also—"Columbia" Recording Gauges and Thermometers, Gauges, Gauge Testers, Tachometers, Steam Calorimeters, Counters, etc.

If Quality of Manufacture and Reliability in Service

have any meaning in the Engineering World, this list of our leading specialties should appeal to the best judgment of every Engineer and Power Plant Superintendent.

Mason Standard Bronze Reducing Valve

Mason Reducing Valves (Genuine),
Mason Pump Governors,
Mason Pressure Controllers.

Bundy Steam Traps for every service,
Coppus Turbine-driven Blowers,
Sims Hot Water Generators.

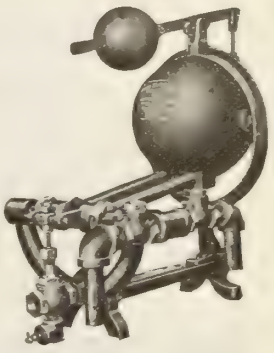
Sims Storage Heaters,
Sims Open Feed Water Heaters.

Bundy Oil Separators,
Ashton Gauges and Safety Valves.

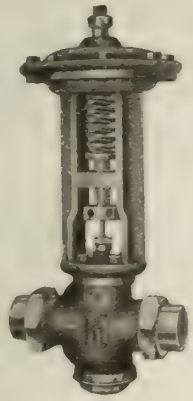
Federal Metallic Packing,
Everlasting Blow-off Valves.

Bawden Pumps (Reciprocating & Centrifugal)
Stratton Steam Separators.

Reilly Multicoil Feed Water Heaters,
Reilly Evaporators and Distillers,
Reilly Multiscreen Feed Water Filters.



New Bundy Return Trap

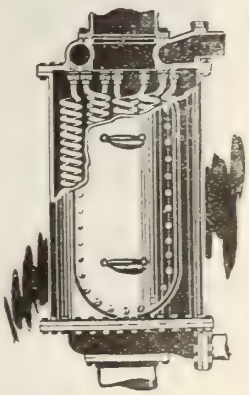


Mason No. 55 Pump Pressure Regulator

ABOVE EVERYTHING

our Sales Engineers know the *practical application* of our lines to *actual conditions,* and sell from *knowledge,* not from *catalogs.* We furnish *results,* not merely *machinery.*

THIS MEANS REAL SERVICE



Reilly Multicoil Feed Water Heater

Bulletins and full information gladly furnished.

The Mason Regulator & Engineering Co., Limited

Successors to H. L. PEILER & COMPANY

MONTREAL, 380 St. James Street — FACTORY, 960 St. Paul Street, Montreal

TORONTO REPRESENTATIVES, The Arthur S. Leitch Co., 506 Kent Building, TORONTO

This book should be in the hands of every pump user. A postal will bring your copy promptly

MARSH and AMERICAN

Steam and Power Driven Pumps and Air Compressors

Marsh and American Pumps are especially adapted for long, hard service because they are *extra heavy* in design and of *extremely rigid construction.* Every unit is built amply strong to withstand 24-hour-a-day service and to stand up under any unforeseen strain which may be placed upon it. Piston rods on the steam pumps are extra large and made of solid bronze. The water ends are equipped with heavy cast bronze removable bushings.

This superior construction not only insures continuous and satisfactory operation, but practically *eliminates expensive shut-downs.* Marsh and American Pumps are the product of over 25 years' experience in the design and construction of high grade pumping machinery. Over 135,000 in actual service throughout the world.

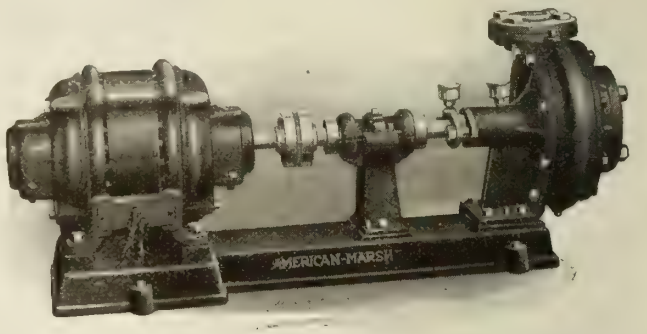
The AMERICAN-MARSH LINE OF CENTRIFUGAL PUMPS is composed of both single and double suction types which are designed for heads up to 125 feet. They are equipped with wide ring oiled bearings and the single suction type has overhanging casing enabling the discharge to be taken at any angle desired.

CANADIAN AGENTS

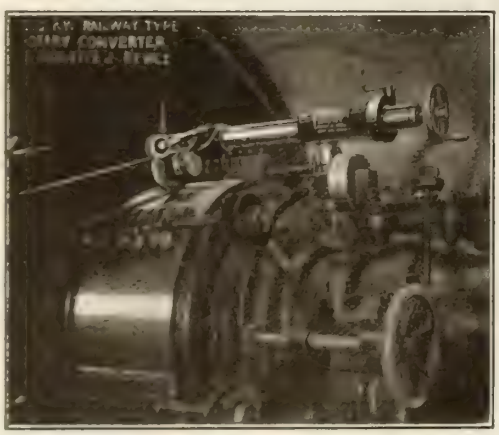
A. R. Williams Machinery Co., Toronto.
Williams & Wilson, Montreal.
London Engine Supplies Co., London, Ont.
Stuart Machinery Co., Winnipeg.
Mechanics' Supply Co., Quebec, Que.
Gorman, Clancy & Grindley, Limited, Edmonton and Calgary.
Taylor Engineering Co., Ltd., Vancouver, B.C.

American Steam Pump Company

Battle Creek, Mich.



American-Marsh Centrifugal Pump.



COMMUTATOR TRUING DEVICE

Trues your commutator without removing armature from its bearings. Send for Booklet No. 5.

Jordan Bros., Inc.

82 Beekman St. New York City, N.Y.

Canadian Representative :
CANADA SALES CO., 183 Church Street, Toronto, Canada

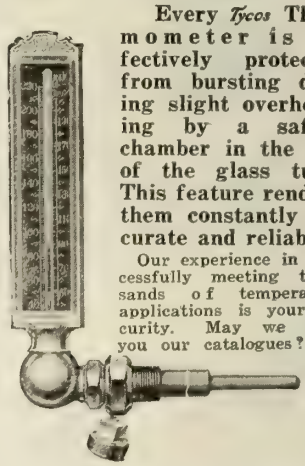
Tycos

TEMPERATURE INSTRUMENTS

Indicating Recording Controlling

Mercurial, Recording and Index Thermometers for all industrial and laboratory applications.
Electric Contact Thermometers.
Temperature, Pressure and Time Regulators.
Mercury Column Vacuum Pressure and U Gauges.
Base Metal, Rare Metal and Radiation Pyrometers.
Fery Radiation Pyrometers.
Hygrometers.
Hydrometers.
Mineral Oil Testing Instruments.
Aneroid Barometers.
Mercurial Barometers.
Recording Barometers.
Pocket Compasses.
Surveying Compasses.
Rain Gauges.
Anemometers.
Air Meters.
Thermographs.
Hand Levels.
Aviation Barometers.
Inclinometers.
Sphygmomanometers.
Fever Thermometers.
Urinary Glassware.
Thermometers of all kinds for home and general use.

Angle and Straight Stem Thermometers



Every *Tycos* Thermometer is effectively protected from bursting during slight overheating by a safety chamber in the top of the glass tube. This feature renders them constantly accurate and reliable.

Our experience in successfully meeting thousands of temperature applications is your security. May we send you our catalogues?

RIGHT SIDE FORM STEM

Taylor Instrument Companies
ROCHESTER, N.Y.
201 Royal Bank Bldg., Toronto, Ont.

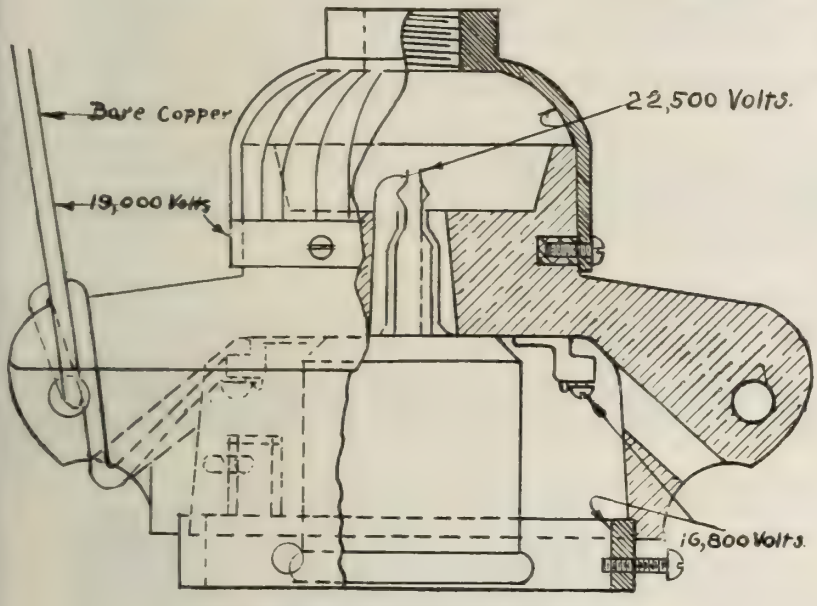
63

WHEELER

Street Lighting Fixtures

are built around

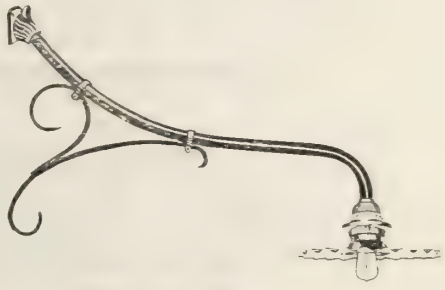
Bodies No. 3020 and 3021



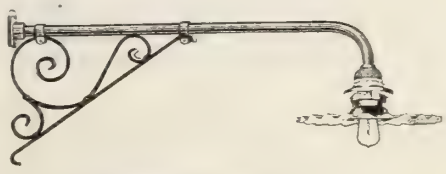
WHEELER SERIES PORCELAIN RECEPTACLE HEAD

The Self-Contained Porcelain Receptacle Head of high grade electrical porcelain, with the spring clip series receptacle moulded in one piece with it, is so designed as to provide ample insulation, with a wide margin of safety, against accidental grounding on high tension circuits.

Reflectors are designed to properly position the lamp filament with a view to the widest possible light distribution, and brackets or other supports provide a substantial suspension under all conditions of wind stress.



Fixture No. 3024
with Bracket "C"



Fixture No. 3027
with Bracket "G"

with Bracket "D"
Fixture No. 3022

Fixture No. 3088
with Suspension "Z"

For further particulars write to our nearest office

CANADIAN GENERAL ELECTRIC CO.

LIMITED

Head Office: Toronto. Sales Offices: Montreal, Halifax, Sydney, Ottawa, Cobalt, South Porcupine, London, Winnipeg, Calgary, Edmonton. Nelson and Vancouver.

"THE LINDE WAY"

IN many modern plants Linde Machines are producing refrigation economically, proving the wisdom of operating high quality equipment.

Let your first cost be your last cost.

Specify Linde Machinery and your repairs will be fractional.

THE LINDE CANADIAN REFRIGERATION COMPANY, LIMITED

37 ST. PETER STREET, MONTREAL

Manufacturers of Quality Refrigerating Machinery

Vilter Refrigerating and Ice-Making Equipment

is recognized as standard throughout the world. Our product is built in all sizes and capacities, suitable for every service to which refrigeration is applied. Write us for an estimate covering your requirements.

BULLETINS SENT UPON REQUEST.

THE VILTER MANUFACTURING CO.

242 Beecher St. Milwaukee, Wis.

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

Frick "Closed Flow" Flooded Double Pipe Condenser

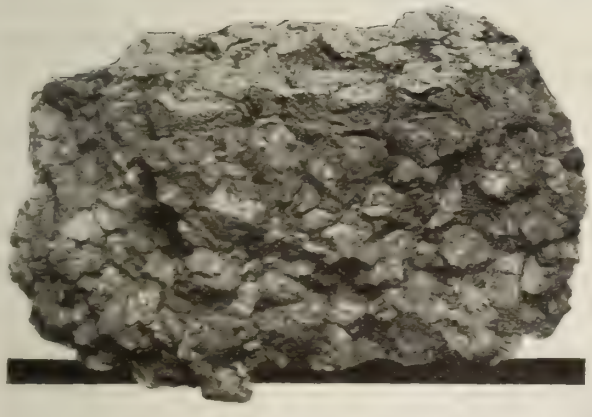
Frick Flooded Condensers are the product of years of experience and experimenting.

They have the distinctive feature of regulating valves built in the condenser proper, not found in other flooded condensers, which enables you to maintain the condenser pressure at what it should be to conform to the amount and temperature of condensing water available.

Write for Bulletin 21 describing both Open and Closed Flow "Flooded" Condensers.

Frick Company
WAYNESBORO, PA. U.S.A.
ICE MACHINERY SUPERIOR SINCE 1882

Canadian Representatives:
FRICK ICE & REFRIGERATING COMPANY, Montreal, Canada



Six Years in a Water Tank Didn't Feaze It

Six years as a float in an open water-cooling tank was the severe usage put to a sheet of Nonpareil Corkboard Insulation at the wholesale produce warehouse of Mr. Ben Ablon, Dallas, Texas. The illustration shows a piece of the sheet still firm, strong and dry inside; in fact, practically as good as the day it was put in.

Surely this shows that

Nonpareil Corkboard Insulation

For Cold Storage Rooms

is able to resist moisture—the greatest enemy of cold storage insulation. Cork is cellular in structure—not fibrous—and the pure cork granules, of which Nonpareil Corkboard is made, will not suck in moisture by capillary attraction. Furthermore, each one is coated with the natural waterproof gum or rosin of the cork by the baking process, giving an additional safeguard against the moisture of condensation. Nonpareil Corkboard is one of the best non-conductors of heat known, and, properly erected, it retains its efficiency indefinitely.

Send for the sample now. We will also include literature that will tell you all about Nonpareil Corkboard Insulation.

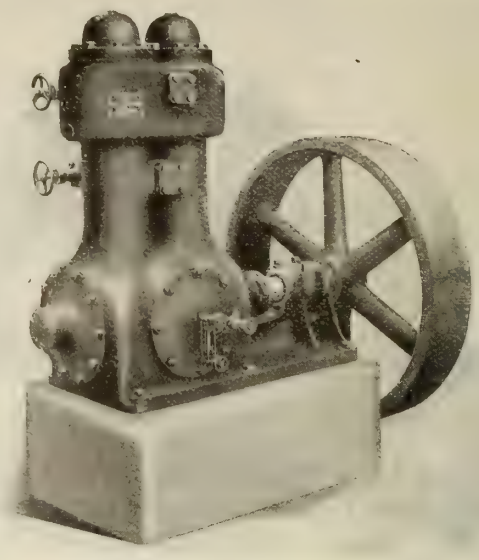
Armstrong Cork & Insulation Co., Ltd., 504 McGill Bldg. Montreal, Quebec.

Also manufacturers of Nonpareil Cork Covering for cold pipes; Nonpareil High Pressure Covering for steam lines; Nonpareil Insulating Brick for boiler settings, etc.; Nonpareil Cork Machinery Isolation for deadening the noise of machinery; and Linotile for office floors and residences.

Send for a sample of Nonpareil Corkboard and try this simple test for yourself. Break the sample of Nonpareil Corkboard in half and boil one piece for three hours. You will find at the end of this time that the boiling has caused little or no expansion, and that the granules are perfectly dry inside. Put other insulating materials to the same test and judge for yourself.

If any advertisement interests you, tear it out now and place with letters to be answered

Mechanical Refrigeration



is essential to success in many lines of manufacture, and YORK Products have played an important part in the development and expansion of these lines over the entire field.

We not only design and make a Refrigerating Plant suited to the needs of our customers, but all the details are handled by our own organization, which assures the best service possible.

YORK Refrigerating Machinery is the result of years of careful research, exhaustive tests, and the labor of experienced Engineers and competent Workmen; and for the Manufacturer who depends on the quality of his product for the continued success of his business, it is the logical equipment to buy.

Write us for information and prices.

YORK MANUFACTURING CO. - YORK, PA.

(Ice-Making and Refrigerating Machinery Exclusively)

Represented in the Dominion by

CANADIAN ICE MACHINE COMPANY

MONTREAL, 626 Coristine Building. TORONTO, 82 Chestnut Street. WINNIPEG, 85 Lombard Street

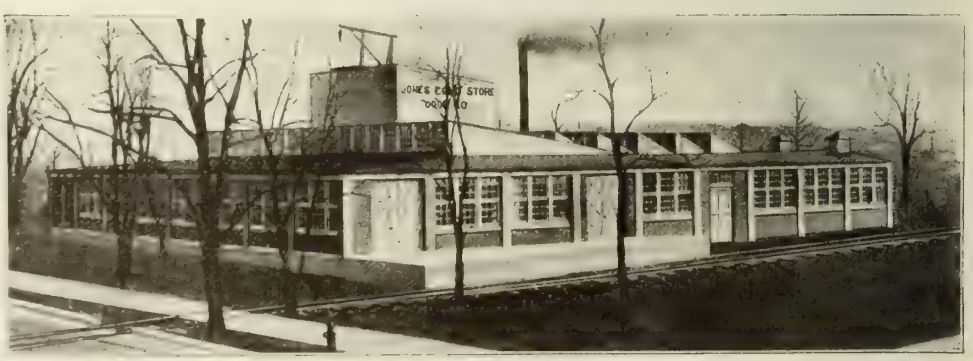
1905

Illustrative of our *progress* in EIGHT years and truly applicable proportionately to the last FOUR years.

"WHY?"

***We aim constantly to excel* in every phase of COLD STORAGE DOOR PRODUCTION.**

Satisfied users assure us of *Repeat orders* and our conscientious efforts to so serve you as to insure higher efficiency and economy—*success*—makes our progress *positive*.



1913

Careful investigation into the *relative merit* of the various makes of *COLD STORAGE DOORS* means an order for *JAMISON*—or else your LOSS.

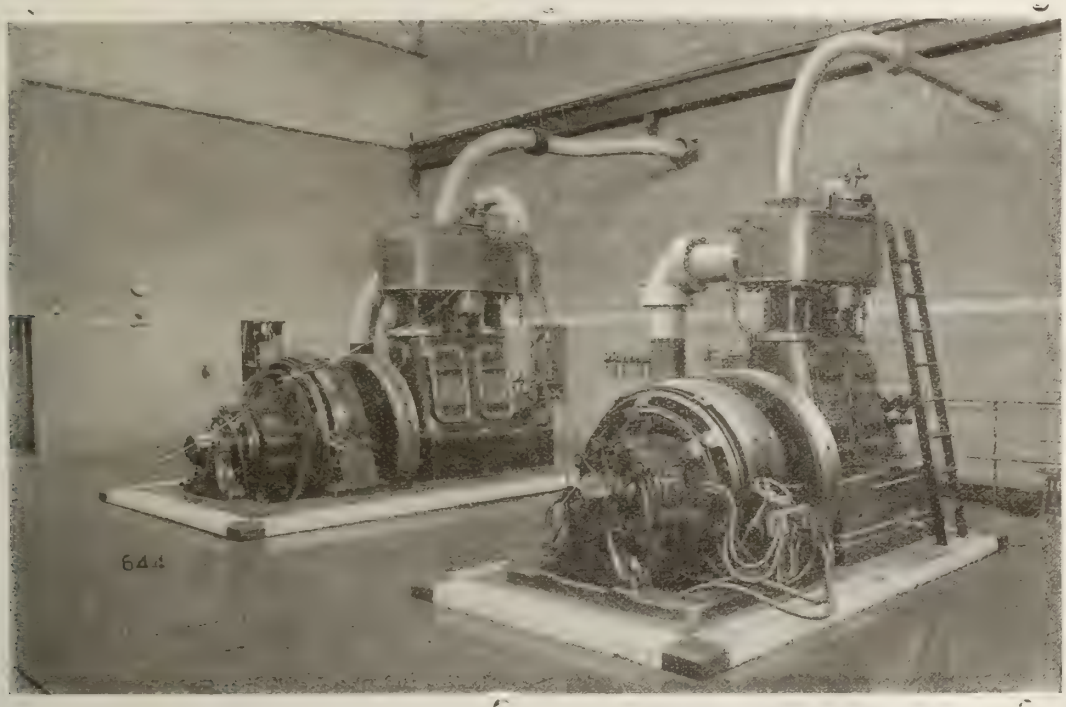
JAMISON COLD STORAGE DOOR CO., Inc.

Formerly JONES COLD STORE DOOR CO.

HAGERSTOWN, MD. - U.S.A.

P.O. BOX 93

BELLISS & MORCOM, LTD.
Engines and Air Compressors



Belliss & Morcom Engines installed in McGill University Power House
Total Horse Power, 1010 B.H.P.

We have for immediate delivery several Engine Generator Sets. Write for Particulars.

Send Us Your Enquiries For

Steam Engines	Condensing Plants	Hydraulic Pumps
Gas Engines	Centrifugal Pumps	Hydraulic Accumulators
Oil Engines	Boiler Feed Pumps	Pressure Filters
Diesel Engines	Water Wheels	Gravity Filters
Steam Turbines	Water Meters	Water Softening Plants
Air Compressors	Hydraulic Presses	Refuse Destructors

Activated Sludge Sewage Disposal Plants

Complete Power Plants Designed and Erected

LAURIE & LAMB

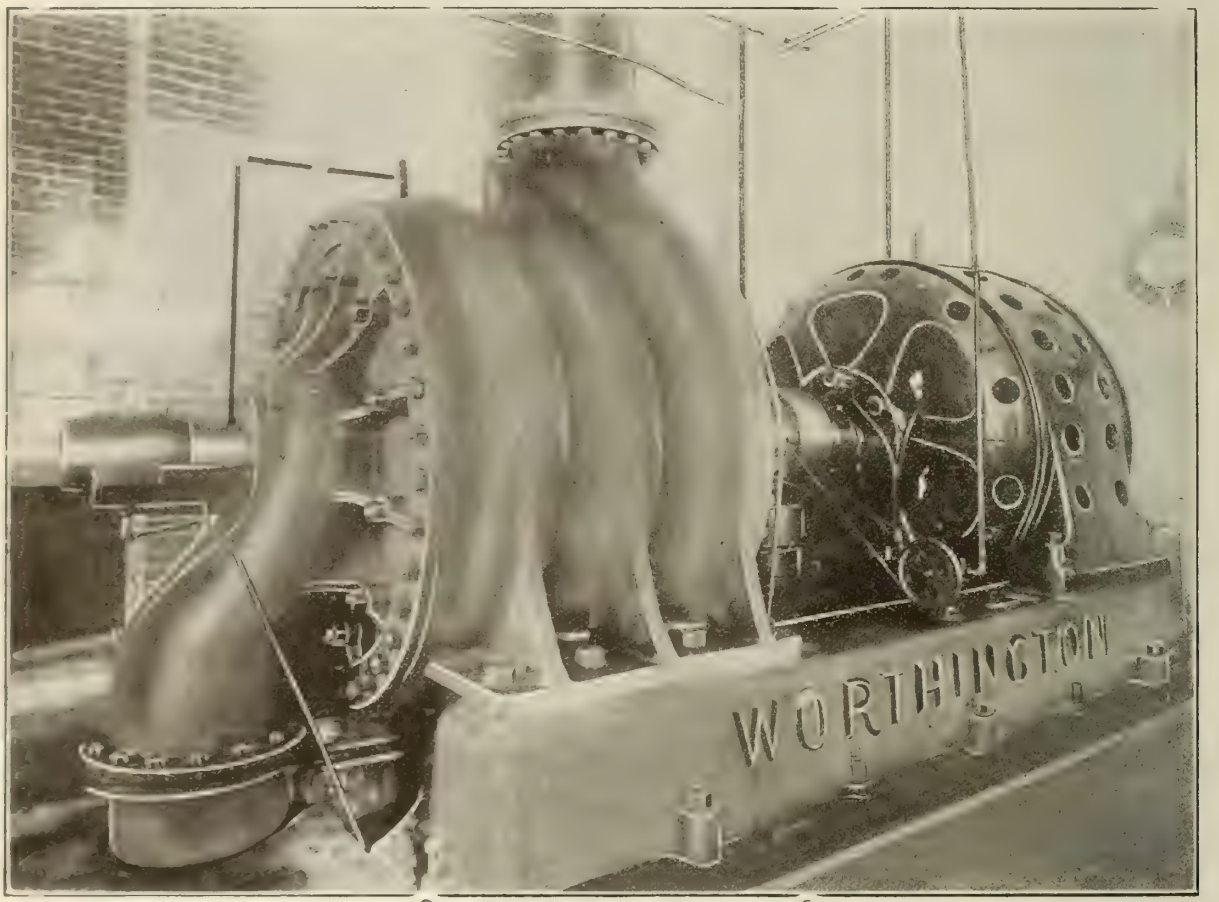
Engineers

211 Board of Trade Bldg. :-: :-: **MONTREAL**

THE JOHN McDOUGALL CALEDONIAN IRON WORKS CO., Limited

Manufacturers of Boilers, Castings, Condensers, Elevators, Engines, Filters, Forgings, Hydraulic Machinery, Pumps — centrifugal and reciprocating, Steam Turbines, Tanks, Water Wheels, Water Works Plants

Works : Seigneurs and William Streets, MONTREAL



5,000,000 gallons daily—Montreal Water Works—Driven by 400 H.P. Induction Motor.

Our Engineers have spent many years developing Centrifugal Pumps and we are now able to offer you perfected designs in any size pump from inch and a half and up for any service you may desire, and to be driven either with motor, engine or belt.

Write us for Engineering information, or prices, any time.

Sole Canadian Agents for H. R. Worthington Co.

Keeping in Stock at Montreal a large assortment of their Boiler, Feed and General Service Pumps

The Publisher's Page

TORONTO FEBRUARY, 1918

The Economy of Business Paper Advertising

By H. E. CLELAND, NEW YORK

Awarded the Higham prize at the convention of Associated Advertising Clubs, at St. Louis, June 1917. This prize is given annually to the one delivering the most constructive address in the fewest words.

(Continued from last month)

THE time is coming when the principle of intensive advertising will be universally recognized and followed.

Manufacturers of machines and material and equipment which are sold direct to the consumer in technical fields will advertise them in technical papers.

Manufacturers of merchandise sold through retailers will advertise in trade papers first and will no longer be lured into attempting to sidestep the dealer. They will do the first thing first.

Manufacturers of merchandise selling to the general public will establish consumer demand (after distribution has been properly taken care of) by the zone system, using newspapers and outdoor advertising.

Advertisers to the general public with a thoroughly established distributing system will use newspapers and national mediums of many different kinds.

And advertising will reach the high plane that it is destined for only when all advertising men place their business along these lines, and only when the salesmen of different branches of advertising recognize that predatory invasion of the other man's field is the deadliest way to destroy confidence in all advertising.

We cannot force the super-tax of advertising extravagance upon the manufacturers of the world without eventually paying for it ourselves.

No wise salesman knowingly overstocks a dealer. No wise manufacturer of machinery ever recommends the use of his machine in order to make a sale if that machine will not fit the consumer's conditions. No up-standing and honest and far-seeing man will make a contract that does not benefit his customer as well as himself.

Advertising men must follow these methods or kill the goods.

Therefore, advertising men will advocate the use of mediums that present the utmost in efficient economy for the advertiser.

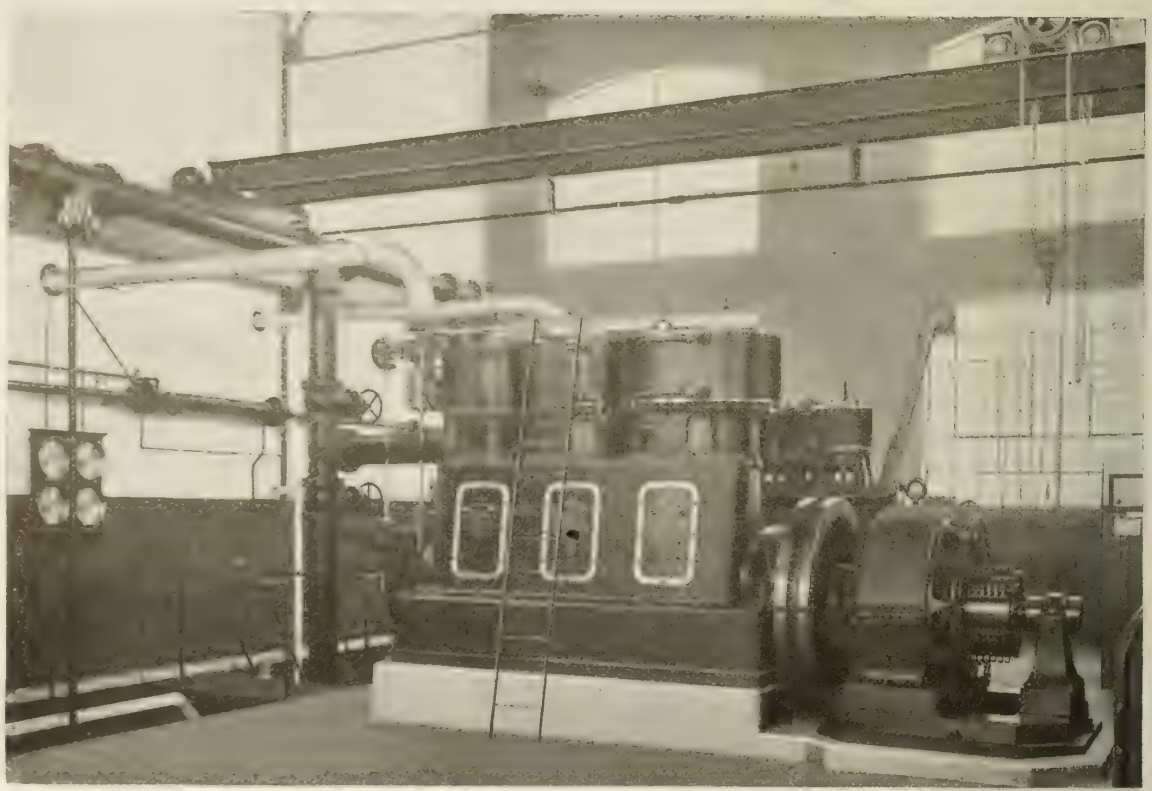
Which means that for certain classes of services, machinery, material, equipment and merchandise, the business papers will be used to their fullest extent. They must be used up to but not beyond the line of their efficiency.

And the business papers must continue the practice that all of the worth-while of them follow now—they must decline advertising which is not in the business line of the paper. To do otherwise is to destroy the principle of the specialized publication.

For those things which "belong" in a business paper—but for no others—the business paper presents the most economical method of efficient advertising.

POWER EQUIPMENT

Built to Meet Your Own Requirements



A corner in the Engine Room of our New Power Plant recently erected at our Main South Works. Equipped with G. & McC. Co. Three-Cylinder Compound and Two-Cylinder Compound Vertical Forced Lubrication Steam Engines.

G. & McC. CO. ENGINES and BOILERS

will provide your plant with

A Continuous and Economical Service

WE BUILD

Horizontal and Vertical Steam Engines; Steam Turbines; Return Tubular and Water Tube Boilers; Heaters; Tanks; Pumps and Condensers; Transmission Machinery; Safes, Vaults and Vault Doors.

The advice of our Engineering Experts, our Catalogues, Specifications, Photographs, etc., will be cheerfully supplied to interested parties.

The GOLDIE & McCULLOCH CO., Limited

Head Office and Works: GALT, Ontario, Canada

TORONTO OFFICE:	WESTERN BRANCH:	QUEBEC AGENTS:	BRITISH COLUMBIA AGENTS:
Suite 1101-2,	248 McDermott Ave.,	Ross & Greig, 412 St. James St.	Robt. Hamilton & Co.,
Traders Bank Bldg.	Winnipeg, Man.	Montreal, Que.	Vancouver, B.C.

VIEW OF PETERBOROUGH CITY WATERWORKS FROM WEST BANK OF RIVER, SHOWING UPPER FACE OF DAM.

The City of Peterborough Municipal Pumping Station

By H. R. Armstrong*

Originally installed by a private company, the plant and distributing system of the City of Peterborough were purchased by the city in 1902 and have been managed by a waterworks commission since. The efficiency of the plant and excellence of service are testimony to the intelligent management and skillful design and operation.

THE city of Peterborough receives its supply of water from the municipal pumping station, which is situated on the Otonabee River about two and a quarter miles above the centre of the city. There a massive concrete dam has been constructed to develop the power which operates the pumps. This reinforced concrete dam not only impounds the water in the river for the development of power, but also serves as storage for the supply to the citizens. It is about 300 feet long, and was constructed in 1909.

The depth of water behind the dam is about 12 ft. and affords an available head at the water turbines of about 10 ft., the suction lift of the pumps ranging from 3 to 10 ft. Provision is made to draw water from the tailrace, when frazil ice causes trouble about the dam, or when the stream is low and it is desirable to conserve the water for power. When the water is drawn from the tailrace the suction lift is about 18 ft.

Site of Plant

The pumping station occupies the western end of the dam and is a substantial building of reinforced concrete framework with brick panels. Together with the dam it was constructed by the Bishop Construction Company, being designed by William Kennedy, Jr., consulting engineer, Montreal. It measures about 125 ft. long, by 40 ft. wide, is steam heated and electrically lighted, and is thoroughly fire-proof. It houses three sets of water-driven horizontal single-action triplex pumps, a Worthington centrifugal pump and an auxiliary steam pump.

Plunger Pumps

Two sets of the triplex pumps were installed in 1893 and are of massive construction. They have three plungers each 18 in. dia. by 30-in stroke, and are operated at 20 revolutions per minute when run at full capacity. Each set is capable of delivering 2,225,000 gallons per 24 hours. The plunger heads are connected to the crankshafts carrying massive cog-wheels which are driven by pinions from a horizontal shaft that transmits the power from the water turbines through bevel wheels. The water power is developed by vertical Samson turbines with 62 in. wheels operating at 66 revolutions per minute.

Thes pumps were built by the William Hamilton Co. of Peterborough and were originally installed in the old pump house a short distance up stream from the present one, into which they were moved on its completion. After nearly 23 years of continuous service they are practically as good as new, and the cost of maintenance is infinitesimal. Judging by their present condition, if not overtaken by obsolescence they will be running fifty years from now. Their massive construction and the fact that they are slow moving are the principal reasons for their small depreciation.

The third set was built in 1909 and is a triplex pump of similar construction. The plungers are 21 in. dia. by 30 in. stroke, and are driven in like manner to the others by a Samson vertical turbine, having a 68-in. wheel running at about 80 revolutions per minute. The bevel gear reduces the speed of the pump to 22 strokes per minute. This pump has a rated capacity of 3,000,000 gallons per 24 hour.

Centrifugal and Turbine Pumps

The fourth set is a 3-stage Worthington centrifugal pump, also driven by a Samson water turbine. The water wheels rotate at about 80 revolutions per minute, and by means of accelerating gear the pump is capable of being driven at about 640 revolutions per min. The delivery from the pump is rated at about three million gallons daily. This pump was built by the John McDougall Caledonian Iron Works of Montreal and was installed in 1909. The Samson waterwheels, to which all four sets of pumps are directly connected were built by the William Hamilton Company of Peterborough.

The fifth set is a DeLaval single stage turbine pump, driven by a 400 horsepower steam turbine which operates at 6,000 revolutions per minute under 125 pounds steam pressure, The pump is driven at about 1,385 revolutions per minute by means of the usual reduction gear. This pumping unit is split horizontally for the purpose of providing easy access to all parts. The suction is 14 in. dia. and the delivery 12 in. This pump is arranged to draw water either from above the dam with a suction lift of 3 ft. or thereabouts, or from the tailrace with a lift of about 18 ft. It is rated at six million gallons per day under a total head of 228 ft.

The condensing plant consists of a Schutte-Koerting multi-jet condenser and a DeLaval centrifugal pump work-

*Office of Industrial Commissioner, Peterborough, Ont.

ing under 35 ft. head at 2,200 revolutions per minute, and discharging about 700 gallons per minute. The whole is driven by a type T.A. steam turbine, the pump and steam turbine being built by the Turbine Equipment Company.

For Engineering Use

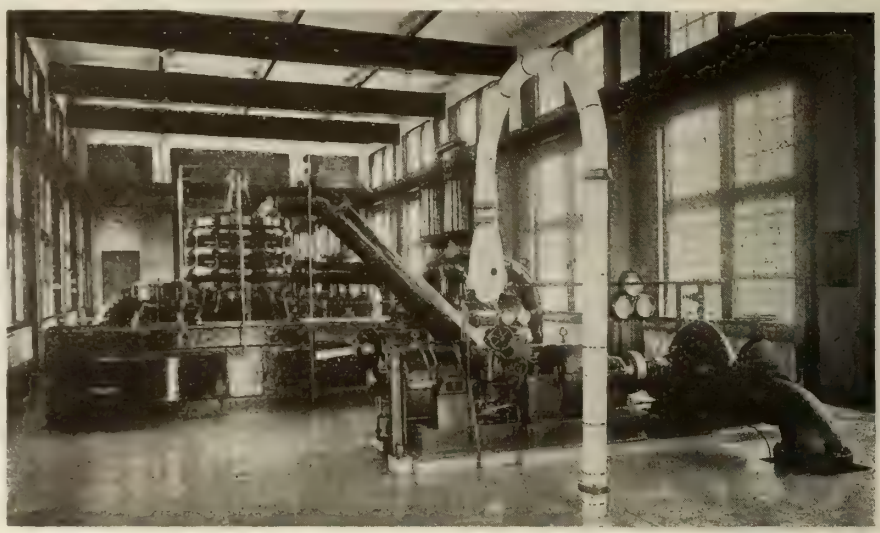
This fifth set was installed in 1915 as an emergency pump, to be used at times when the water-driven pumps cannot be used. Along with all other water power plants in this locality considerable trouble had been experienced from anchor and frazil ice. The pumps have been shut down on this account several times for considerable periods leaving the entire city in an inconvenient and exceedingly dangerous predicament. During the winter of 1914-15 this assumed a serious aspect, occurring three times with an average shut-down of 10 hours. After careful investigation of various schemes for mitigating this evil, such as steam-heated racks, covered forebay, etc., the commissioners decided to install a steam pump and have an entirely dependable remedy. A confirmation of their judgment was seen during the first winter after its installation. No less than five times was the unit called into service on account of the plugging of the water-wheels with ice. By its use an uninterrupted supply of water was delivered for domestic, commercial and protection purposes to the city during the winter.

Layout of Plant

The pumps are situated on the main floor of the building, and the pump-house is equipped with an overhead travelling crane carrying a hand operated 10-ton chain hoist.

There are two 100 horse-power horizontal return tube boilers for the steam unit, each 66 in. dia. by 16 ft. long, fitted with Cyclone shaking grates of 34 sq. ft. area. Induced draft is supplied by a fan driven by a 6-horse-power vertical steam engine, and by its use steam can be speedily generated. A 6 horse-power Foos gasoline engine is connected to the fan and is used to operate it when the boiler furnaces are being started.

The boilers are not heated until necessity arises. They are placed in a separate building to the south of the main pumphouse. The base of this is reinforced concrete with a brick superstructure and a laminated wood roof covered with 5-ply Barrett roofing. A Cochrane feed-water heater and the necessary boiler feed pumps are also installed in the boiler house, where there is storage for 75 tons of coal.



INTERIOR OF PUMPHOUSE LOOKING EAST. IN THE RIGHT FOREGROUND IS THE DELAVAL STEAM TURBINE AND PUMP AND BEHIND IT THE WORTHINGTON VERTICAL TURBINE PUMP.

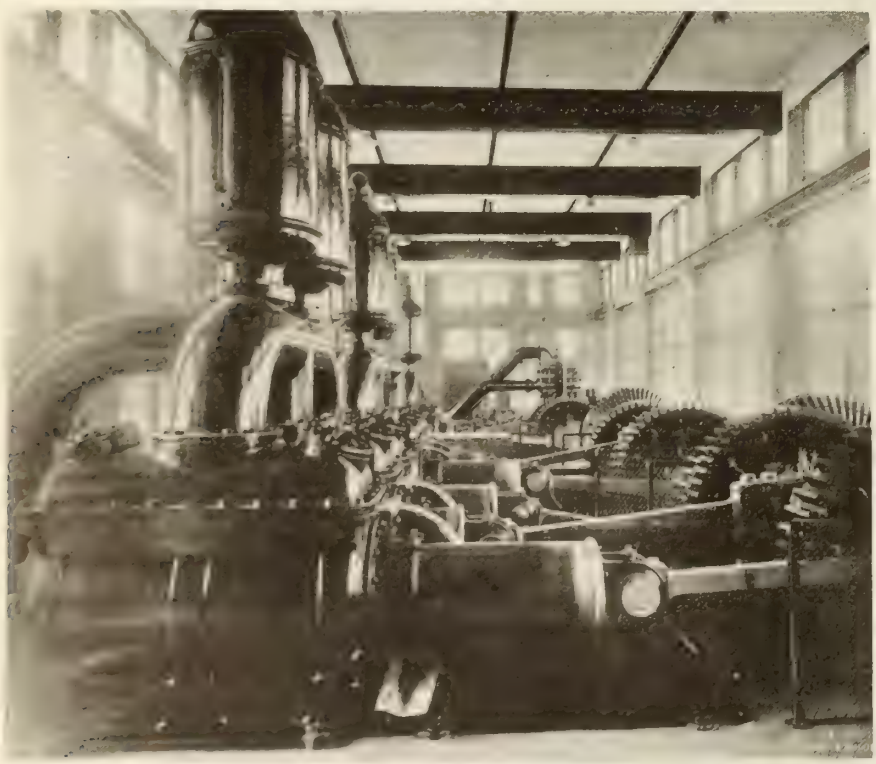
Pipe Arrangement

The water is drawn from the river through a 30-in. suction header and is discharged from the pumps through individual connections controlled by valves, into a 24-in. delivery main. In the delivery main is inserted a 10-inch Venturi meter to measure the quantity pumped. The pipe gallery is situated in the basement of the pumphouse running the length of the building. Two rows of pipes extend from end to end, one being the suction header and the other the discharge. The suction header is connected with each pump and receives the supply of water from an intake pipe extending above the dam. The discharge pipes of all the pumps are connected with the discharge header, in which is the Venturi meter for measuring the pumpage. The Venturi meter recording apparatus is in the office on the main floor, together with a self-recording Bristol pressure gauge. The meter is type M, manufactured by the Builders' Iron Foundry Company.

While on the average the river water at Peterborough is very good, at certain times of the year it becomes dangerously polluted, due to the sewage from the summer resorts in the lake above and also to the presence of river drivers on the river in the spring and early summer. As a result the Ontario Board of Health saw fit in the spring of 1916 to order the installation of a chlorinating plant as a precautionary measure. After investigating several methods and types of plants for the purpose a contract was let by the commissioners for a liquid chlorine apparatus to Wallace & Treiman, of New York.

Chlorinating Apparatus

The apparatus supplied and installed is known as type B, solution feed, automatically controlled equipment and was



INTERIOR OF PUMPHOUSE LOOKING EAST. THE TWO SETS IN FOREGROUND WERE INSTALLED IN 1893

placed in operation June 1, 1916. Owing to the variable character of the water the dose is adjusted to suit conditions. During the summer the ratio goes as high as 3 pounds per million gallons, but this is reduced as soon as the bacterial condition of the water warrants it. The average is about 1½ pounds to the million gallons. The chlorine costs about 25 cents per pound delivered at the pumphouse, inclusive of all charges.

PIPE GALLERY BELOW PUMPHOUSE. NOTE THE VENTURI THROAT AND METER IN FOREGROUND

The apparatus is connected with the Venturi tube in such a way that variations in the flow of the water are instantly followed by corresponding variations in the flow of the chlorine, so that the water does not become overdosed on some occasions and undertreated at others, as is often the case with manually controlled plants. This is accomplished by means of an arrangement whereby the Venturi throat above referred to not only measures the volume of water pumped, but also controls the operating of the chlorinating plant. The differential pressures at the inlet and throat of the Venturi meter are transmitted to the Venturi meter recorder and also to the diaphragm which controls the admission of liquid chlorine according to the varying quantity of water that is supplied.

The liquid chlorine is supplied in steel cylinders under considerable pressure and when it is decided what quantity of it must be used to sterilize the water it can be done easily by means of a glass gauge set against a graduated scale. Having noted the volume of water that is being registered by the meter, and adjusting the chlorinator scale to suit the required proportion of chlorine to be added, the differential pressures at the Venturi throat automatically regulate the chlorinator for other rates of flow. The liquid chlorine meets a small quantity of water in a glass and the resulting mixture is conveyed by a rubber pipe to the point of application on the intake pipe in the pipe gallery. In passing through the pumps it is thoroughly mixed with the main body of water. The chlorinator has been found to be compact and reliable, and has the great advantage that there are no moving parts to give trouble.

The necessary valves for the proper control of the different pumps are situated in the pipe gallery, together with the condenser and vacuum pump for the steam unit. The pump house is heated by means of a 30 horse-power horizontal return-tube boiler.

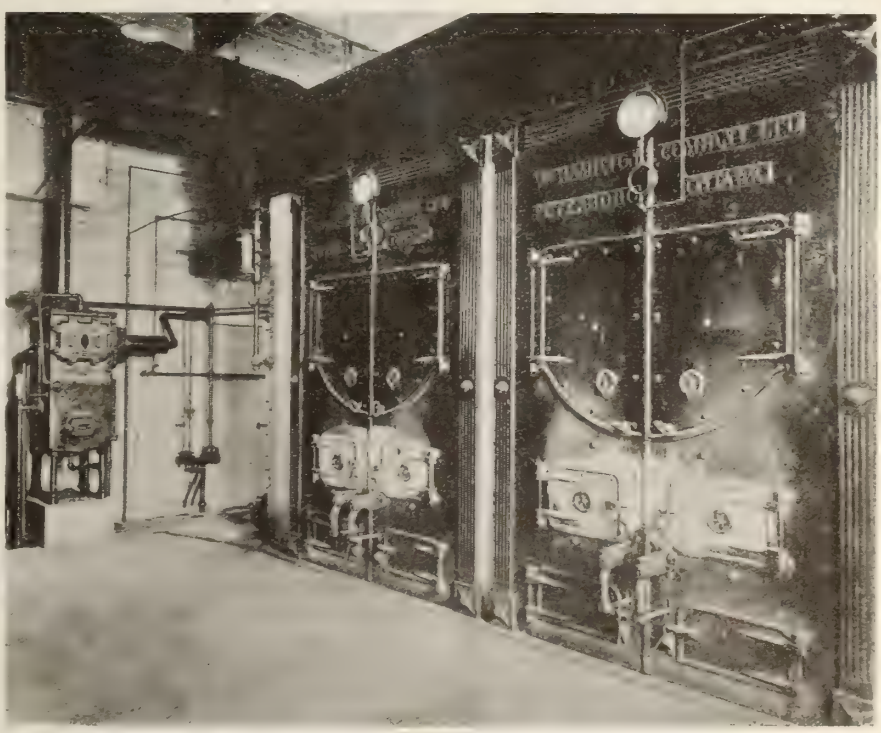
The pressure mains to the city consist of one 16-in. and one 18-in. cast iron pipe. These continue well within the city boundaries. The normal pressure at the pumps is about 70 pounds and the fire pressure is from 100 to 130 pounds per sq. in. There are about 44 miles of mains, ranging from 3 in. to 18 in. dia., all cast iron pipe. There are about 4,500 services. In 1916 the total quantity pumped was approximately 1,100,000 gallons, or an average of about 3,000,000 gallons per day. The average daily consumption of water in 1916 was about 136 gallons per capita. The cost of water, inclusive of all charges, averages about 4.95 cents per 1,000 gallons.

Late in 1917 a modern apparatus for the complete chemical and bacteriological analysis of the water was installed at the pump house.

Historical

The efficiency and completeness of equipment reflects the nature of the administrative body under which the Peterborough waterworks system has been developed and maintained. The waterworks were first installed in 1882 by a private company. In 1902 the plant and distributing system were bought by the city and put in charge of a waterworks commission. It now stands a splendid example of what intelligent commission government will do for the utilities of a city.

Mr. T. F. Matthews, the present chairman, has occupied that office since the formation of the commission. Mr. W. H. Moore, one of the present commissioners, has been a member of the commission since 1903. Mr. W. H. Hill was one of the original commissioners. He retired in 1914, and Mr. Robert Hicks, one of the present commissioners, was elected to take his place. Mr. R. L. Dobbin,



PAIR OF 100 HORSE-POWER "HAMILTON" BOILERS FOR SUPPLYING STEAM TO RESERVE UNIT.

B.A.Sc., is the waterworks superintendent, under whose supervision the auxiliary steam plant and the liquid chlorine plant have been installed. Mr. Wm. Kennedy, Jr., of Montreal, is the consulting engineer.

REPORT OF BOILER INSPECTION IN ONTARIO

THE Boiler Inspection Department of the Trades and Labor Branch, Department of Public Works for the Province of Ontario, completed its year on Oct. 31. The annual report prepared by D. M. Medcalf, chief inspector of steam boilers, shows that a large amount of work has been done by the department during the past year.

Work of Inspection by this Branch of the Department of Public Works, for the Fiscal Year Ending October 31, 1917.

New boilers inspected in the Province of Ontario	235
New boilers inspected in the United States	53
New boilers inspected in Renfrew, Scotland	18
Used boilers inspected for use in the Province of Ontario	869
[illegible] inspected	2
Rendering tanks inspected	1
Digesters inspected	2
Sterilizers inspected	5
[illegible] inspected	1
Tanks inspected	2
Drums inspected	1
Pipe lines inspected	2
New boilers inspected in the Province of Ontario for use in British Columbia	3
Heating certificates issued	185
Designs of boilers surveyed and registered	74
Designs of boiler fittings surveyed and registered	31
Designs of digesters surveyed and registered	2
Designs of dryers surveyed and registered	2
Designs of pipe lines surveyed and registered	40
Designs of tanks surveyed and registered	1
Designs of retorts surveyed and registered	1
Designs of steam pans surveyed and registered	1
Designs of steam kettles surveyed and registered	1
Designs of superheaters surveyed and registered	8
Designs of steam domes surveyed and registered	1

GAS SUPPLY DEPLETED

THE investigation into the natural gas situation in Western Ontario before the Ontario Railway and Municipal Board at Chatham, Ont., last week, revealed the fact that the Tilbury-Raleigh gas field is being rapidly depleted, and that it will not be possible to supply all the demands being made on the producing companies for gas both for manufacturing and domestic purposes.

F. W. James, Superintendent of the Union Gas Co., in his evidence stated that with all manufacturing concerns cut off there will be a domestic supply good for some few years, but the supply is going down fast. He declared that for his company to cut off manufacturers and allow other producing companies working in the same field to send gas out for manufacturing would not materially lengthen the life of the field.

Gas from this field is sent as far east as Hamilton and Brantford by the Southern Pipe Line Co. and the Glenwood Oil & Gas Co., while the Union people send gas to Windsor, Chatham, Sarnia and a few smaller places in Essex and Kent counties. The Canadian Gas Co. also supplies gas for Wallaceburg and some for the Sarnia line.

It also develops that there are a number of contracts regarding the supply from the field and these will cause confusion. The Beaver Oil & Gas Co. had certain contracts, the Volcanic Oil & Gas Co. certain other contracts, the United Fuel & Supply Co. still others, and then the Union Oil & Gas Co. practically an amalgamation of all has still other contracts.

Contracts affect not only leases of land for production purposes, but also the delivery of gas to certain municipalities. It is contended that Sarnia, Windsor and Chatham each has original contracts with some one or other of the companies which give the right to all gas from certain sections.

The question which now arises is whether or not the original wells are exhausted and what the position of the Union Gas Co. is regarding these contracts, so far as wells are concerned which were drilled after the companies were all united.

CANADA GETS COAL SUPPLY

THERE has been much comment and speculation regarding how Canada would be treated under the restrictions recently placed on coal shipments by Dr. Harry A. Garfield, American Fuel Administrator. It was first thought that Canada would receive an allotment for the first three months of this year equal to the actual shipments during the first three months of last year. Later it was learned that licenses had been issued to American shippers for the export to Canada of only 40 per cent. of last year's actual shipments and that the Canadian Fuel Controller. C. A. Magrath, held licenses for another 40 per cent. of the amount, but these latter had to be approved by Dr. Garfield before they were valid.

Licenses for Coal

A letter enclosing licenses for specified quantities sent to American shippers by the American Fuel Administration clears up the situation. Licensees are requested to "note especially the following points:"

"(1) C. A. Magrath, Fuel Controller of Canada, Ottawa, by arrangement with the United States Fuel Administration, has been granted a considerable tonnage, and he has the privilege for the period mentioned to call on this Administration to issue permits to any shippers who apply to him.

"(2) All coal leaving a United States port of exit after midnight December 31st. 1917, will be reckoned as part of your alloted tonnage for the months of January, February and March, 1918.

"(3) Shippers are required to report to the Fuel Administration each shipment of coal to Canada at the time of its leaving the port of exit from the United States. Please give date of exportation and state quantities in tons and whether anthracite or bituminous (anthracite 2,240 lbs., bituminous, 2,000 lbs.).

"(4) No export licenses are required for individual shipments of coal, but the allotments as given in the enclosed permit limits the amount of coal you are at liberty to export to Canada during the period stated."

THE EKENBERG PEAT PROCESS

EXPERIMENTS on the treatment of peat by a modified Ekenberg process are being conducted at Chateauneuf, in the Departement Ille-et-Vilaine, Bretagne, France. According to a paper, published in the "Comptes Rendux" of September 3, and Octover 1 (errata), 1917, by C. Galaine, C. Lenorm and C. Houlbert, the peat is first compressed in presses of the Mabille or Aurep types to reduce the water in the peat from about 90 per cent. to 60 per cent.; the peat is then treated with superheated steam at 160 deg. C. for 25 minutes, and then either compressed again or at once dried, which is best done in special chambers, though air-drying may be applied. The product, which is called tourbon, still contains from 20 per cent. to 25 per cent. of moisture, but does not absorb moisture, as it would do if the cellulose in the peat had not been destroyed by the steam heat. The calorific value is stated to be raised by 10 per cent. over that of dried peat: the tourbon yields 61 per cent. of volatile matter, 36 per cent. of fixed carbon, and 3 per cent. of ashes. With suitable arrangement of the batteries of autoclaves and utilisation of exhaust steam, a heat efficiency of from 85 per cent. to 91 per cent. is claimed to be realised in this process, which can be worked throughout the year. The tourbon is fired directly, or sent to the gas works (with ammonia recovery), or converted into power gas for internal-combustion engines; the last-mentioned utilisation has so far proved most satisfactory elsewhere, we believe.

MARKET FOR PUMPS IN PARAGUAY

HENRY H. BALCH, United States consul at Asuncion, reports that there is a good market for small pumps in Paraguay. Inasmuch as there is no water-supply system for the city of Asuncion, which has about 80,000 population, or for any of the other cities or towns of the Republic, there is a constant demand for a limited supply of hand pumps, windmill pumps, electrical, and gas pumps to be used in wells for the purpose of supplying water to residences, business houses, public buildings, etc., in Paraguay. Aside from two breweries, three ice plants, three sugar refineries, some small bottling plants, and a very few other small plants which require pumps a little larger than those used by the average family, there is practically no market for any class except those used in supplying water from wells for ordinary family needs. The total value of all pumps imported into Paraguay in a year averages about $6,000, of which more than half represents imports from the United States. Germany hitherto has been the nearest competitor, followed by England.

The Preventable Waste of Coal in the United States*

By David Moffat Myers**

While asserting that the saving or waste of one-fourth of the coal consumption of any industrial plant depends entirely on the efficiency of the management, the author emphasizes the fact that this fraction of the consumption relates exclusively to the boiler plants and does not include the large economies possible in connection with its distribution and use.

As a means of far-reaching economy the Government of the United States should at this time apply intelligent and direct-acting efforts to the conservation of fuel at the industrial plants which are responsible for its greatest consumption.

The mining and distribution of the coal have been placed under the supervision of the War Coal Board in order more nearly to meet the crying needs in these directions, to use the railroad facilities more efficiently so that the present car shortage may be minimized and to apportion the coal in quantity and to uses deemed most expedient.

While this organized effort to bring about efficiency in the production and distribution of coal is being made, no parallel measures have been adopted to bring about a normal and practical efficiency in its use. The hundreds of large plants which are consuming fuel wastefully, in many cases more wastefully and carelessly than ever before, are directly and needlessly causing a large fraction of the existing car shortage.

Preventable Waste of Fuel

The preventable waste of fuel in the boiler furnace of one steel mill which I investigated amounted to 40,000 tons per year, which at $5 a ton would cost $200,000. This was a comparatively modern plant. The efficiency of boilers and furnaces in a 14-day test was 55 per cent. The load factor was unusually favorable to high efficiency and could readily be raised to 70 per cent or over. This is only one example, and there are many more extreme cases. In one hand-fired plant the evaporation was raised from 6 to 9 lb. in a few days of instruction and continuously kept close to this higher mark with the help of coal and water measurements which were inaugurated. The saving was due exclusively to instruction and consequent better operation.

The saving or waste of one-fourth of the coal consumption of any industrial plant depends entirely upon the efficiency of its operating management. Let me emphasize that this fraction of the consumption relates exclusively to the boiler plants, that is, the production of steam, and does not include the large economies possible in connection with its distribution and use.

For well-known reasons the boiler plant offers the more lucrative field for producing economies, and these with a minimum of alteration in physical equipment.

Under present conditions a plant which carelessly operates at an efficiency of 40 to 50 per cent. receives from the Government the same consideration in the delivery of coal as the one whose efficiency is 70 to 75 per cent. This obviously is unfair and wasteful.

The government hands over, say, 200,000 tons of coal a year to a plant owner, but asks for no accounting as regards its consumption, nor any questions as to the amount of steam it is made to produce.

There is no doubt that very important economies in the use of food have already been effected by educational campaigns. These economies are largely the result of educating the ultimate consumer. The requisite propaganda does not attempt to teach the intricacies of food chemistry or the complex action of the gastric juices.

TABLE I.—TOTAL COAL PRODUCTION, BITUMINOUS, LIGNITE AND ANTHRACITE, YEAR 1915.

	Net tons	%
1. Bituminous and lignite...	443,462,509	85.2
2. Anthracite	76,906,431	14.8
3. Total	520,368,940	100.0

The object of this paper is to open a discussion which, it is hoped, will ultimately lead to the formulation of definite fuel conservation recommendations, to forward these recommendations to the proper governmental authorities as an official communication of this society, and to offer to the Government the services of the society for the organization, furthering and, as far as possible, the execution of the plan which may as a consequence be adopted.

There are, I think, two plans of operation worthy of consideration. The one might be termed the autocratic method. This would involve use of authority to compel coal consumers to execute such measures of economy as the proper authorities might prescribe for any given case, limits to be set as to expense to the user. Such limits might be in terms of a percentage of his present yearly coal bill. Alterations should be directed chiefly, as previously implied, to purely operating improvements. Many objections would probably be made by consumers against this plan, but once in effect the majority would no doubt realize its pecuniary advantage to themselves. But its tendency may be too strongly opposed to democratic principles.

The other plan would be largely an educational one, in which patriotism and efficiency would furnish the motive forces required. The teaching must be accomplished with the utmost simplicity and directness. Above all it must be in such form as to be readily comprehended and applied.

The requisite information must reach the owners and managers of industries, and there must be simple instruction sheets for the engineers and firemen. The vital importance of daily accurate records of coal and water must be taught and information given regarding practical appliances for automatic measurements of both.

Blank forms might be sent in advance to plant owners in order to be advised by them, first, whether they would be willing to co-operate with a governmental organization offering to assist them in reducing their coal consumption, and second, to obtain such data as to size, type, equipment, operation and fuel consumption of the plants as would enable a classification that would permit a government board of experts to send such instructions as would include the information needed for any one class of plants.

This work would be very greatly aided by a staff of experts ready to visit plants when so requested by owners, and make investigations and recommendations and keep in touch with the progress of economies. Included in such a staff must be men intimately familiar with practical operating economies, whose duties would be the delivering of lectures or talks which should be planned so as to reach directly not only managers and owners of the industries, but also the chief engineers and firemen of the boiler plants.

The United States Bureau of Mines has for a number of years engaged in obtaining and disseminating scientific information regarding the mining and consumpton of coal, and the results of the work have been of great value to technical engineers who are able to use and apply it.

Six hundred million tons of coal was mined in the United States last year. It is predicted that 700,000,000 tons will be mined this year, and next year's production will likely be still greater. Of this quantity approximately 67 per cent, or 469,000,000 tons, will be burned for steam-making purposes on land, assuming the same percentage consumption for steam production as existed in the year 1915.

The saving or wasting of one-quarter of this coal, that is, over 117,000,000

*Presented at the annual meeting, December, 1917, of the American Society of Mechanical Engineers, New York.

**Consulting Engineer, New York City.

tons, depends on the efficiency with which we operate our boiler furnaces. If we actually saved by proper methods only 50,000,000 tons per year, this economy would result in freeing for other important service the use of 1,000,000 fifty-ton freight cars per year. The significance of such an economy may be realized when it is stated that the number of cars thus released for other service would be equivalent to 15 per cent more than the combined yearly coal-carrying capacity of the Baltimore and Ohio and Southern Railway systems; approximately equal to that of the Pennsylvania R.R. system on lines east of Pittsburgh, or 1 2-3 times the number of coal cars hauled by the Norfolk & Western. The direct saving to our industries would be $250,000,000 worth of coal per year, if figured at $5 per ton.

This saving would be $\frac{50,000,000}{469,000,000} =$

10.65 per cent of the coal now burned for steam production. It is impossible to state the present average efficiency of boilers and furnaces, but I have personally spent sixteen years of concentrated study in the investigation and improvement of steam and fuel conditions in factory power plants, and I have never visited a plant of this class where a saving in coal of at least 10 to 12 per cent could not easily be made. The poorer the conditions found the easier it is to make an attractive saving in fuel.

TABLE II.—PERCENTAGE DISTRIBUTION OF BITUMINOUS COAL AND LIGNITE PRODUCED IN THE UNITED STATES AND IMPORTED IN 1915, BY USERS

	%
1. Railroad fuel	28.0
2. Steamship bunker fuel—tidewater	2.0
3. Steamship bunker fuel—Great Lakes	0.3
4. Manufacture of beehive coke	9.3
5. Manufacture of by-product coke	4.3
6. Manufacture of coal gas	1.0
7. Domestic and small steam trade	16.0
8. Industrial steam trade	33.0
9. Exported	4.0
10. Steam and heat at mines	2.0
11. Special uses	0.1
12. Total bituminous and lignite	100.0

NOTE.—Imports were only a little over one-tenth of one per cent. and are, therefore, neglected.

No information is available for complete classification of the distribution of the anthracite, but it is estimated in report on "Coal in 1915*" from which Tables I. and II. are made, that 40,000,000 net tons of anthracite were used in 1915 for "heating households, apartment houses, hotels, and office, school and other buildings." This leaves about 27,000,000 net tons or 35 per cent. for industrial uses, principally steam making. If we eliminate households we may assume that 25,000,000 tons of the 50,000,000 tons are used for making steam, so that of the total 77,000,000 tons of anthracite, we may say that 52,000,000 tons, or 67.5 per cent., are used for [illegible]

*"Coal in 1915," by C. E. Sesher, published by the U. S. Geological Survey; Part A on production, Part B on distribution.

Table IV shows to what point the efficiency of a plant must be raised to obtain the saving of 10.65 per cent. upon which these economies are based. The poorly run boilers would of course be susceptible to the greatest improvements. Hundreds of boiler plants operate at no greater than 58.07 per cent efficiency, and it is a comparatively simple matter to bring them up to an efficiency of 70 per cent or higher. The latter would result in a saving of over 17 per cent of the coal.

If we do not limit our action to coal used for steam generation, but extend it to include economy with which the steam itself is utilized and applied, the predicted saving could be doubled, so that we might save 2,000,0000 fifty-ton carloads of coal per year. There is, for instance, widespread ignorance to a surprising degree in regard to the value of exhaust steam in heating and process work. The coal-consuming public should be taught that a heating system which requires 100 boiler horsepower may insert a steam engine between boiler and heating main and obtain nearly 100 mechanical or electrical horsepower in addition to the required heating for about the same consumption of fuel.

Steam plants are under the immediate management of chief operating engineers. The examination requirements for licenses in this profession call for practically no knowledge of steam and fuel economics. These examinations deal chiefly with matters of safety, repair and maintenance of equipment and neglect almost entirely the subject of coal economy. This is a very serious defect in our present system and is directly responsible for a large preventable waste of fuel.

The mining and distribution of our coal supply, the regulation of prices and the adjustment of financial and labor problems have already been placed under official administrative attention. But no parallel measures have been adopted looking toward reduction of waste in connection with the utilization of this coal.

Discussion of the Paper

Walter N. Polakov: The invitation to discuss the means and methods for reducing waste of coal is very welcome since all that has been said and done so far has failed to produce tangible results.

Last April I brought out the impending danger of a fuel famine and soon afterward the movement was on the way affecting at that stage only coal production, transportation and prices.

Being limited in its scope and nature, it did not embrace at that time the third group of my original recommendations concerning the use of fuel. My editorial in "Coal Age" of July 14 and articles in other magazines emphasized this paramount task "to start at once the movement for the efficient utilization of every available supply of fuel."

A couple of months later Mr. Garfield publicly admitted that the principal hope for a solution of the coal problem lies with the people themselves: "They must save every possible bit of fuel."

Saving may be carried out along two lines—either on the principle of German "Spar Kasse," inevitably limiting the industrial productivity and impairing the health of the people, or on the principle of more efficient utilization of fuel, producing more power and heat with less coal. Only this latter means of saving is to be considered.

The inauguration of efficient management of power plants cannot be accomplished overnight. It requires study in each plant of its peculiar conditions. It requires careful training of firemen and other employees. It necessitates an adequate stimulation of employees to continually maintain the highest degree of efficiency. To do it no capital investment is needed. It is not a matter of better furnaces, of mechanical stokers, or other cures preached by salesmen. It is a matter of knowledge and method.

There are already many plants that have reduced their coal consumption from 20 to 40 per cent for the same output by better organization of power-plant work. There is no need to here describe these principles and their results. "Task Setting for Firemen," a paper presented before this society in 1913, "Planning the Power Plant Work," a paper delivered before the Taylor Society, and numerous other contributions describe the nature of my work and fundamental principles more or less at length. Van H. Manning, Director of the Bureau of Mines, recently took the view advocated by me for years. Said he: "The immediate problem is a difficult one. We cannot scrap all out-of-date power plants. We must start by doing the best with what we have. We must begin saving coal at once. The problem is a peronal one. It deals with the human elements. We must reach the man with the shovel."

Mr. Myers presents for discussion two plans. The first one is unfortunately worded so as to create prejudice against it. It reads " . . . . the use of authority to compel coal consumers to execute such measures of economy as the proper authority might prescribe in any given case." It sounds Prussian. But is it? Does it mean imperialistic, arbitrary authority or an authority of an expert based on scientific knowledge of facts, similar to the authority of a doctor prescribing treatment?

TABLE III.—COAL USED ON LAND FOR STEAM PRODUCTION IN PERCENTAGE OF TOTAL PRODUCTION

Bituminous—	%
1. Railroads, item 1, Table II	28.0
2. Domestic and steam trade, assume only one quarter of item 7, Table II.	4.0
3. Industrial steam trade, item 8, Table II.	33.0
4. Steam and heat at mines, item 10, Table II.	2.0
5. Total bituminous	67.0
Anthracite—	
6. To steam making	67.5

Hence it may be assumed that 67 per cent. of all the coal produced is used for making steam on land.

To save 10.7 per cent. of the coal consumption necessitates the raising of any combined efficiency of boiler and furnace from that shown under Old Efficiency in Table IV. to the corresponding value under New Efficiency in the same table.

The strength of England, France and even the Central Powers is due to the co-operation in industries. Those who fail to render the service to the common cause are denied the privilege to mismanage their plants. True enough, this co-operation is regulated by the state

and at times compulsory as is conscription or commandeering of productive facilities or commodities. The voluntary co-operation for which we long will come only after the war as a result of new social readjustments. But we cannot wait. The problem is of to-day. To-morrow may be too late.

In other words we must create conditions stimulating voluntary co-operation even under individualistic regime.

The plan therefore means the abolition of privilege to waste fuel in inefficiently conducted plants, by giving priority in coal deliveries to those who prove that they use it efficiently.

At present a wasteful plant gets an excessive amount of coal, while the highly economical one stands an equal risk of being shut down for the lack of coal. If the efficiency is protected by priority, it will work also as a stimulus for the wasteful ones to find means to improve their methods and then ask for a new rating.

Such encouragement of efficient plants, rendering good service to the country and stimulating the inefficient to seek their salvation through the means beneficial to the country can be accomplished along the following lines:

Rating by experts (nominated by the national engineering societies and supported by public opinion and Government) of plants in the indispensable industries who are entitled, because of coal-saving methods in use, to the priority in coal supply.

Receiving of applications by the special service bureau of American Society of Mechanical Engineers, from the low-rated plants for assigning the expert help.

Serving the needs of such inefficient plants by offering services of recognized experts in power-plant management for direction of the work.

Organizing a staff of steam, electrical and combustion engineers, whose members will be assigned to carry out the work in the plants of the applicants under the direction and supervision of experts.

Charging for such services an adequate compensation to cover the expenses involved (salaries, traveling and office) but no profit.

Mr. Myers' second plan, "an educational one, in which patriotism and efficiency would furnish the motive forces required," is in my opinion doomed to failure for the following reasons:

Teaching efficiency by a correspondence-school method will accomplish little good, is incompatible with the professional dignity of this society and lacks the personal touch.

Endless variety of equipment, grades of fuel available, personality of men, nature of load, climatic conditions, etc., make the preparation of "simple instruction sheets for engineers and firemen" impossible and if made they are so general as to be useless. Failure of the Massachusetts fuel board in such an attempt is a joke among power-plant men in this section.

No instructions of real value could be given unless examination of the plant was made. Selling patent medicines curing all diseases ranks with fake only too often not to make one careful.

Keeping records, logs, etc., necessitates instrument equipment and measuring devices; all of this is good only when the data are used and interpreted by a trained man and this is done continually. Too many plants have no instruments at all; most of those that have keep them as ornaments owing to the lack of proper organization.

If the regular employees failed to secure high efficiency it is not because of the lack of "circularized education," but chiefly on account of lack of time to carry on investigations and tests, all the time being absorbed by routine duties; absence of instruments, facilities or encouragement; lack of experience in this highly specialized line of research work.

The education must begin with owners and managers, not with the firemen.

The very principle of "teaching" and "instructions" given to manufacturers and plant owners by the society is undemocratic and un-American. They do not want or need "to get something for nothing." Producing for the country but not without profit they can prefer to pay for what they get if the benefit is commensurate with the expenses.

"Educational" talks and circulars usually degenerate rapidly into debating societies, wasting time needed for deeds.

Any half-measures with good intentions falling short of accomplishing valuable results are dangerous as they chloroform the public conscience, creating a belief that something real is being done while there is little behind the words that make all content.

To sum up, the problem is to be solved by groups and individuals availing themselves through this society of services of those who know how more power can be gotten out of a pound of coal. There is no necessity to compel plant owners to improve their methods since in such a step lies their self-preservation. But there is an urgent necessity from the national viewpoint to conserve the fuel by preventing its waste by ignorance or indifference. The valuation of plant methods to establish ratings for priority in coal deliveries is therefore recommended.

Albert A. Cary: Mr. Myers endeavors to focus our minds upon this panacea in the statement that "the saving or wasting of one-fourth of the coal consumption of any industrial plant depends entirely upon the efficiency of its operating management," and this seems to be the text upon which the balance of his paper is founded.

To secure the desired conservation of fuels in such plants, Mr. Myers advises the services of the expert in operating management. Provided he understands his business, such an expert can undoubtedly secure desirable fuel savings; but results depend largely upon the co-operation he receives from the plant owners and their employees, as well as their willingness to equip plants with the needed apparatus and to use them continuously after the expert concludes his work.

TABLE IV.—INCREASE IN COMBINED EFFICIENCIES OF BOILER AND FURNACE NECESSARY TO EFFECT A 10.7 PER CENT. SAVING IN COAL

Old Efficiency Per Cent.	New Effciency Per Cent.	Old Efficiency Per Cent.	New Efficiency Per Cent.
44.67	50	62.54	70
49.14	55	67.	75
53.60	60	71.47	80
58.07	65	....	..

$$\text{Saving of coal with same output of steam} = \frac{\text{New Efficiency} - \text{Old Efficiency}}{\text{New Efficiency}}$$

$$\text{and increase of steam production for same coal} = \frac{\text{New Efficiency} - \text{Old Efficiency}}{\text{Old Efficiency}}$$

To illustrate, I will refer to the plant of one of my clients, the Tennessee Copper Co. By redesigning the furnaces in this plant and adapting them to the fuel used and by substituting machine-fired grates, they have since succeeded in obtaining the same amount of steam with but 64 per cent of the Jellico coal formerly used. This plant, when completed, was turned back to same management that it had before with no further instructions. There were installed facilities for continuously determining the weight of the coal, ash and water used as well as the analysis of the furnace gases.

In another large industrial plant a similar saving in coal was effected. This plant has an aggregate capacity of over 7,000 nominal boiler horsepower, divided into 22 units. It was formerly operated with hand-fired shaking grates for which machine-fired grates were substituted with properly designed furnaces. The plant is now being operated continuously at 150 per cent. rating and is using no more fuel than it formerly did when being operated at two-thirds of its present output. The boiler-room force required to operate this altered plant is less than half of the number of men formerly required. No change has been made in the management of this plant.

Proper furnace design and construction, flue and draft-producing equipment adapted to the use of the particular kind or quality of fuel used is the keynote of the question of fuel conservation.

Furnish the mason with complete instructions for "laying up" the brickwork and properly bonding the interior and exterior walls of the furnace so that the large difference in temperature between the two sides will not, by unequal expansion and contraction, rapidly destroy these furnace inclosures and so waste fuel by infiltration of air.

The selection of material used and its method of erection should never be left to the mason, as it is safe to say that fully 90 per cent of the masons erecting furnace settings are hopelessly un-

qualified to produce a proper setting. After equipping the plant with proper furnace settings which are adapted to produce the highest possible efficiency with the particular fuel available, the expert in operating management can come into the plant to instruct the men.

To meet the present emergency, I propose that the War Coal Board bring all the firemen in this country under its control by requiring them to take out United States licenses. The various state, county or municipal governments can assist them in this work. The applicants for these licenses must show some qualifications that would entitle them to hold such privileges, but it is doubtful whether it would be possible, at the beginning, to have all these applicants examined before qualified examination boards.

Future applicants should be required to pass an examination before such boards and qualify in a satisfactory manner before receiving their licenses. Any operator of a coal-burning plant (domestic plants, of course, excepted) who operates his equipment without a licensed fireman should be liable first to fines and finally to more severe penalties.

Each license should be issued for the applicant to operate in a definite, described plant and nowhere else. Should the fireman leave this plant for any good reason, rather than for incompetence, he can take his license to the proper authorities and have it transferred to another plant where he has found re-employment.

Should the fireman be found to be incompetent, his license should be revoked and future applications be denied.

Inspectors appointed by the War Coal Board might visit from time to time the various coal-burning plants, and should they find any of them using fuel wastefully, a notice should be served upon the owner. If this is not followed by prompt action to reduce or stop the waste, the fireman's license should be revoked.

The foregoing is proposed as a war measure.

Professor L. P. Breckinridge told of the methods used in Connecticut to conserve coal, stating that meetings were held to which the public was invited, to be told how to burn coal economically in house and power-plant boilers. Norman Reinicker believed that fuel economy was much more a matter of design than education of firemen. E. N. Trump emphasized the value of bonuses to firemen to give incentive for economical use of coal.

GAS FIRING AND REGENERATIVE SETTINGS

By T. J.

IN the earlier days of gas firing, as applied to retort settings, there were some rather vague ideas current as to the economy just effected. The saving of fuel consumption and the higher working temperatures attained in the retorts were often too hurriedly attributed to the recovery of waste heat. Waste heat is, of course, recovered, and returned to the setting in the preheated secondary air, but all the advantage does not lie merely with this recovery.

The advantages of gas firing as ordinarily practised are chiefly in three directions:—(1) The application of heat. High temperatures are generated in close proximity to the retort, and not as with direct firing at a considerable distance away, where much of the heat applied is in the form of much cooler and rapidly cooling convection currents of gaseous products. The study of flames may be applied with advantage to the question of gas firing of retorts, which is really a question of the application of flames. (2). The regulation of air. This can be accomplished to a very fine point so as to avoid the drop of available temperature due to the admixture of a large excess of air. (3). Regeneration or recuperation. Much heat is in waste products, i.e., gaseous products of combustion (mixed with air), which have passed the retorts and are on their way to the chimney. Any of the contained heat that can be transferred to the incoming air (usually the secondary air) is so much pure gain.

In Europe regeneration and recuperation of heat are used pretty much as interchangeable terms. In America recuperation is applied to the process by which (as in retort settings) the heat of the waste gases is transmitted through the walls of a flue and is given up to the air in an adjoining flue, while regeneration is there chiefly confined to the recovery of heat from heated chequer work over which the hot waste gases are first passed, and then by a change-over valve the incoming cold air is led over the same chequer work. Regeneration in this sense was tried on gas works, but its use was not long continued, though the same arrangement is successfully used on some coke-ovens, notably the Simon-Carves type.

Recovering Waste Heat

It is often too rashly assumed that all the heat taken to the combustion chamber by the secondary air of an ordinary retort is this recovered waste heat. It is usefully applied heat, but not necessarily all waste heat. Some of it may be initial heat. In cases where the secondary air travels are placed between the waste gas flues and the furnace, some of the heat in that air will undoubtedly be derived from the furnace. As the air is ceaselessly passing through these flues, and thus tending to cool them, this constitutes a drain upon the heat resources around the flues, and thus will certainly withdraw some of the furnace heat. Whether this procedure may be right or wrong may be open to discussion.

It is all to the good to get the secondary air as hot as possible; but no mistake should be made by considering the heat it withdraws from the neighboring furnace as recovered waste heat. It is abstracted initial heat, and its loss tends either to increase the fuel consumption or to lower the temperature of the producer gas. It may seem unnecessary to labor or even to mention the point, but the heat that can be produced from a given weight of a given coke is fixed and unalterable, whether the coke is burning direct to the carbon dioxide, as in direct firing, or first to the monoxide and then to the dioxide, as in gas firing. Still the idea lurks around in some minds that gas firing actually produces more heat from the fuel.

What gas firing really does is to transfer much of the heat production from the generator to the actual setting some 70 per cent. of it. In the same way the use of water on the fire bars, which when vaporized and passed through the furnace generates some water gas, does not furnish any new source of heat. Whatever heat is given out by its combustion exactly balances the heat abstracted in its formation. All that is gained in a thermal sense is the transference of heat from the lower part of the fire, where a high temperature favors the formation of clinker, to a high zone where it is more useful and less likely to entail harmful secondary effects, such as fusing the ash into clinkers.

WILL WOOD FUEL TAKE PLACE OF COAL?

DURING the current season, the unfortunate dependence of Canada on the United States for its supplies of coal has been brought into vivid prominence and, as a result, there has been much searching for possible substitutes. Naturally, wood was one of the substitutes to attract attention. The fuel value of good hardwood compares unfavorably with anthracite coal, a pound of such coal being equal to approximately two pounds of hardwood. For this reason, in markets that are far removed from sources of supply, wood is more expensive than anthracite, so long as the prices and available supplies remain as now.

The southern portions of Manitoba, Saskatchewan and Alberta have no large supplies of wood. Up to a few years ago, wood, cut locally, was used to some extent, but, with the gradual exhaustion of these supplies, the demand for coal is increasing yearly. The cordwood used in the Prairie Provinces comes from the Rainy River district of Ontario, southeastern Manitoba, the western shores of Lakes Winnipeg and Manitoba, the vicinity of Prince Albert, the Kootenay district of British Columbia and Minnesota.

These sources of supply are at a considerable distance from the centres of population, and, as cordwood is bulky, the long freight haul to market largely increases the price. Even in certain of the areas mentioned supplies of cordwood are becoming exhausted, and it is evident that, under present conditions of transportation, there is no likelihood of its being used to any greater extent than at present.—W. J. D. in "Conservation."

Emergency Repairs on Damaged Engine Parts

Special Correspondence*

Power house accidents involving damage to engines and boilers on a large scale are comparatively infrequent. In most cases they are pure accidents and the damage can be ascertained by ordinary inspection. The malicious damage sustained by the engines and boilers of interned German steamers had to be repaired rapidly, and the nature and extent of the damage, together with the successful repairs executed, possess instructive interest for all engineers in charge of steam plants.

ALL the damage done to 109 German ships by their crews, prior to their seizure by the United States Government when war was declared, has been repaired and these ships are to-day in service, adding more than 500,000 gross tonnage to the transport cargo fleets in war service for the United States.

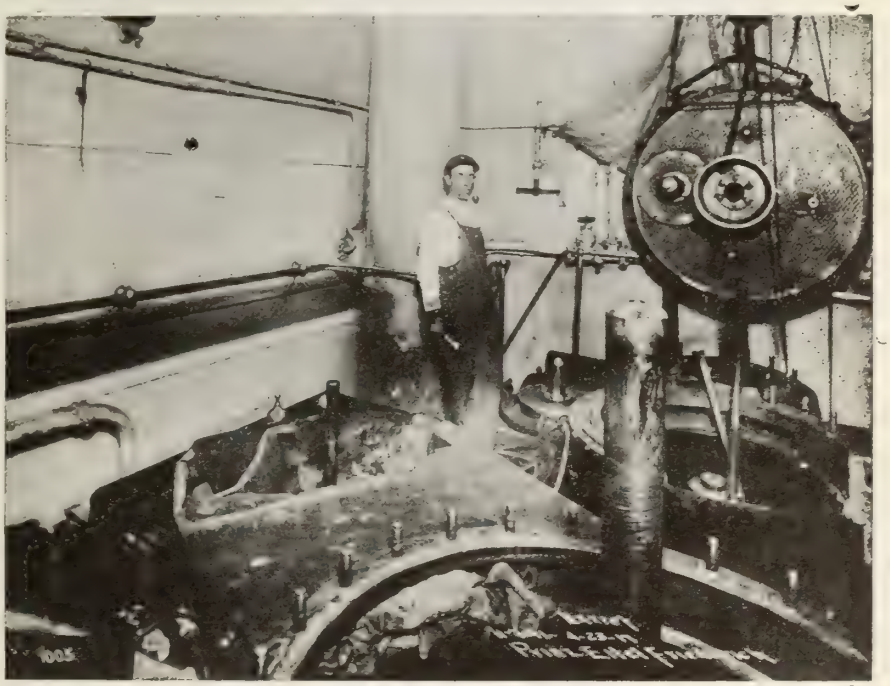
There is evidence that a German central authority gave an order for destruction on these ships, effective on or about February 1, 1917, simultaneous with the date set for unrestricted submarine warfare and that the purpose was to inflict such vital damage to the machinery of all German ships in our ports that none could be operated for from 18 months to 2 years.

German Purpose Signally Defeated

This purpose has been defeated in signal fashion. In less than eight months all the ships were in service.

The destructive campaign of the German crews cunningly comprehended a system of ruin which they believed would necessitate the shipping of new machinery to substitute for that which was ruthlessly battered down or painstakingly damaged by drilling or dismantlement. There is documentary proof that the enemy believed the damage irreparable.

To obtain new machinery would have entailed a prolonged process of design, manufacture, and installation. Urged by the necessity of conserving time the engineers of the Navy Department succeeded, by unique means, in patching and welding the broken parts and replacing all of the standard parts which the Germans detached from their engines and destroyed or threw overboard.



BROKEN VALVE CHEST AND SCORED PISTON ROD OF THE OSTWEGO, FORMERLY THE PRINZ EITEL FRIEDRICH.

Copyright by Committee on Public Information

*Published by permission of the Committee of Public Information, Washington, D.C.

INTERIOR OF CYLINDER ON U.S.S. AGAMEMNON, FORMERLY THE KAISER WILHELM II. THE LINER WAS CRACKED AND IS BEING PREPARED FOR REPAIRS BY WELDING.

Copyright by Committee on Public Information

Scheme of Ruin Shrewdly Devised

The mechanical evidence is that the campaign of destruction was operated on these ships for more than two months and that the Germans were convinced that they were making a thorough job of it. Their scheme of ruin was shrewdly devised, deliberately executed, and it ranged from the plugging of steam pipes to the utter demolition of boilers by dry firing.

When the United States Shipping Board experts first surveyed the ruin the belief was expressed that much new machinery would have to be designed, manufactured, and installed, making 18 months a fair minimum estimate of the time required. However, at the Navy Department, where the need of troop and cargo ships was an urgent issue, officers of the Bureau of Steam Engineering, having faith that the major portion of the repairs could be accomplished by patching and welding, declared it was possible to clear the ships for service by Christmas, and the last of the fleet actually took her final sea test and was ordered into service as a Thanksgiving gift to the nation.

Special Workmen on the Job

To accomplish this end the Navy Department secured the services of all available machinery welders and patchers, many of them having been voluntarily offered by the railroads.

Although explosives were not used in the process of destruction, the engineers of the Navy Department were always conscious of the danger of hidden charges of high explosives which might become operative and disastrous when the machinery was put to a test. Instances of artful pipe plugging, of concealing steel nuts and bolts in delicate cylinders, of depositing ground glass in oil pipes and bearings, of cunningly changing indicators, of filling fire extinguishers with gasoline and similar means of spoliation, were common enough to induce the engineers to make a rule calling for thorough overhauling. On each ship there was no boiler that was not threaded through every pipe for evidence of plugging, no mechanism of any sort that was not completely dismantled, inspected, and reassembled before it was finally passed as safe.

BROKEN VALVE, BROKEN VALVE CHEST AND BROKEN FLANGE ON THE OSTWEGO, FORMERLY THE PRINZ EITEL FRIEDRICH OF HAMBURG-AMERICAN LINE.
Copyright by Committee on Public Information

Record of Damage Found on One Ship

A memorandum written in German was picked up on one of the ships which gave a complete record of the destruction on that ship. Investigation revealed that the list, which had evidently been left through an oversight, was correct in every detail. The following is a translation of excerpts from this memorandum:

"Starboard and port high pressure cylinder with valve chest: Upper exhaust outlet flange broken off (can not be repaired)."

"Starboard and port second intermediate pressure valve chest: Steam inlet flange broken off (can not be repaired)."

"First intermediate pressure starboard: Exhaust pipe of exhaust line to second intermediate pressure flange broken off (can not be repaired)."

"Starboard and port low pressure exhaust pipe damaged (can not be repaired)."

The parenthetical optimism of the German who was so confident of the thoroughness of his mutilation is now the source of much glee among naval engineers, inasmuch as every one of the supposedly irreparable parts was in fact speedily repaired and those engines are to-day as powerful and serviceable as when they left the hands of their makers.

The method of patching and welding broken marine engines had never before been practised, although the art has been known in the railroad industry for 15 years. Three methods of patching were used; electric welding, oxy-acetylene welding, and ordinary mechanical patching, the latter often later being welded. Following the repairs tests of the machinery were first made at the docks, where the ships were lashed firmly to the piers while the propellers were driven at low speed; and later each ship was taken to sea for vigorous trial tests. The patches and welds were reported as having given complete satisfaction.

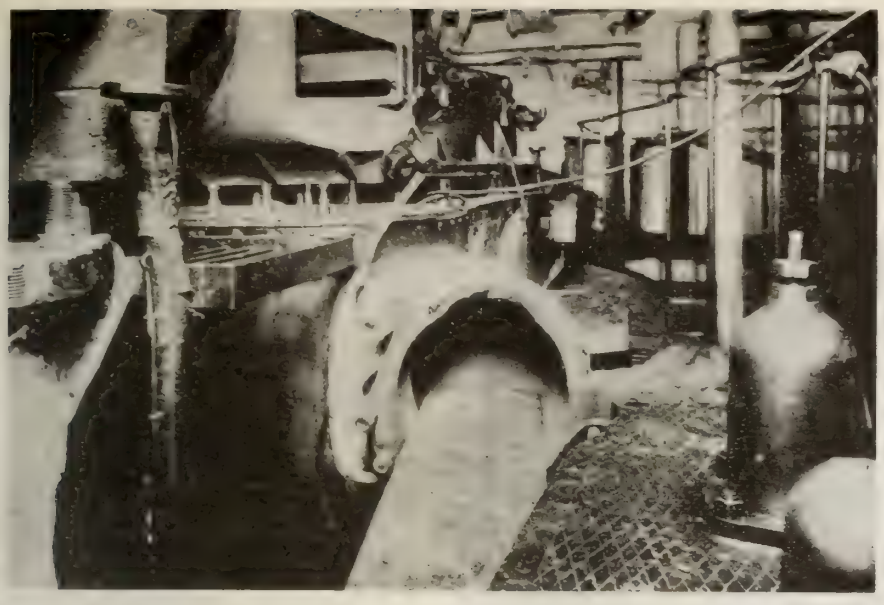
When the Leviathan, formerly the Vaterland and the largest ship afloat was put into commission by the United States Government and sent to sea for a trial run, her commander, a young American naval officer, was ordered to "exert every pound of pressure that she possesses, for if there is any fault we want to know it now." The Leviathan stood the test. She was one of the ships least mutilated, due to the fact that she was in bad repair and it was believed that she would not be fit to put to sea for many months. The navy engineers found it necessary to overhaul and partially redesign and reconstruct many important parts of the engines.

Ships Now in United States Navy

The larger German ships which have been repaired and are to-day in commission as a part of the United States Navy,

TYPICAL BREAK IN CYLINDER. THE PHOTOGRAPH SHOWS IT AFTER THE PART HAD BEEN PREPARED FOR WELDING.
Copyright by Committee on Public Information

NEW CAST IRON PATCH INSERTED IN BROKEN CYLINDER BY OXY-ACETYLENE
Copyright by Committee on Public Information



SHOWING THE DESTRUCTION OF A STEAM PIPE ON THE U.S.S. MADAWASKA FORMERLY THE S.S. KOENIG WILHELM II.
Copyright by Committee on Public Information

with their former German and their new American names are as follows:

German Name	American Name
Vaterland	U.S.S. Leviathan.
Amerika	U.S.S. America.
Andromeda	U.S.S. Bath.
Barbarossa	U.S.S. Mercury
Breslau	U.S.S. Bridgeport.
Cincinnati	U.S.S. Covington.
Frieda Leonhart	U.S.S. Astoria.
Frederic der Grosse	U.S.S Huron.
Geier	U.S.S. Schurz.
George Washington	U.S.S. George Washington.
Grosser Kurfurst	U.S.S. Aeolus.
Grunewald	U.S.S. Gen. George W. Goethals.
Hamburg	U.S.S. Powhatan.
Hermes	U.S.S. Hermes.
Hohenfelde	U.S.S. Long Beach.
Keil	U.S.S. Camden.
Kaiser Wilhelm II.	U.S.S. Agamemnon.
Koenig Wilhelm II.	U.S.S. Madawaska.
Kronprinz Wilhelm	U.S.S. von Steuben.
Kronprinzessin Cecille	U.S.S. Mount Vernon.
Leibenfels	U.S.S. Houston.
Locksun	U.S.S. Gulfport.
Neckar	U.S.S. Antigone.
Nicaria	U.S.S. Pensacola.
Odenwald	U.S.S. Newport News.
Praesident	U.S.S. Kittery.
Praesident Grant	U.S.S. President Grant.
Praesident Lincoln	U.S.S. President Lincoln
Prinzess Irene	U.S.S. Pocahontas.
Prinze Eitel Friedrich	U.S.S. Dekalb
Rhein	U.S.S. Susquehanna.
Rudolph Blumberg	U.S.S. Beaufort.
Saxonia	U.S.S. Savannah.
Staatssekraetar Solf	U.S.S. Samoa.
Vogensen	U.S.S. Quincy.

Repaired by Shipping Board

The ships taken over and repaired by the Shipping Board, with their German and American names, are as follows:

German Name	American Name
Allemannia	Owasco.
O. J. D. Ahlers	Monticello.
Adamsturm	Actaeon.
Arnallas Vinnon	Chillicothe.
Atlas	(No name.)
Armenia	(No name.)
Arcadia	(No name.)
Andalusia	(No name.)
Adelheid	(No name.)
Bulgaria	(No name.)
Borneo	Nipsic.
Bohemia	Artemis.
Bochum	Montpelier.
Bavaria	(No name.)
Calabaria	(No name.)
Carl Diederichsen	Raritan.
Clara Jebsen	Tioga.
Clara Mennig	Yodkin.
Cobelenz	Sachem.
Constantia	(No name.)
Dobek	Monongahela.
Darvel	Wamsutta
Elmshorn	Casco.
Elsass	Appelas.
Esslinger	Nyanza.
Farn Gerraux	Farn Gerraux.
Gouverneur Jaeschke	Watoga.
Holsatia	Tippecanoe.
Harburg	Pawnee.
Indra	Tonawanda.
Johanne	Iosco.
Koln	Anphion.
Kurt	Mochulu.
Loongmoon	Ceosa.
Lyceemoon	Quantico.
Mark	Suwanne.
Mia	Oconee.
Madgeburg	Neuse.
Mattador	Montauk.
Marudu	Yazoo.
Nassovia	Isonomia.
Neptun	Minnow.
Ottawa	Mus ota
Olivant	(No name.)
Ockenfels	Pequot.
Prinz Eitel Friedrich (Hamburg-American Line)	Ostewgo.
Prinzess Alice	Matoika.
Pennsylvania	Manasemond.
Pisa	Ascutney.
Pongtong	Quinnebaug.
Portonia	Yucca.
Prinz Joachim	Moccasin.
Prinz Oskar	Orion.
Prinz Sigismund	General Gorgas.
Prinz Waldemar	Wacouta.
Pommern	Rappahannock.
Rajah	Rajah.
Rheatia	Black Hawk.
Sachsen	Chattahoochee.
Sachsenwald	General Ernst.
Sambia	Tunica.
Savoia	General Hodges.
Serrapis	Osage.
Setos	Itasca.
Staatssekretar Kraetke	Taconv.
Steinbek	Arapahoe.
Suevia	Wachusett.
Camilla Rickmers	Ticonderoga.
Tsin Tau	Yuma.
Jubingen	Seneca.
Wasgenwald	Wasgenwald.
Wiegand	Midget.
Willehad	Wyandette.
Wittekind	Iroquois.

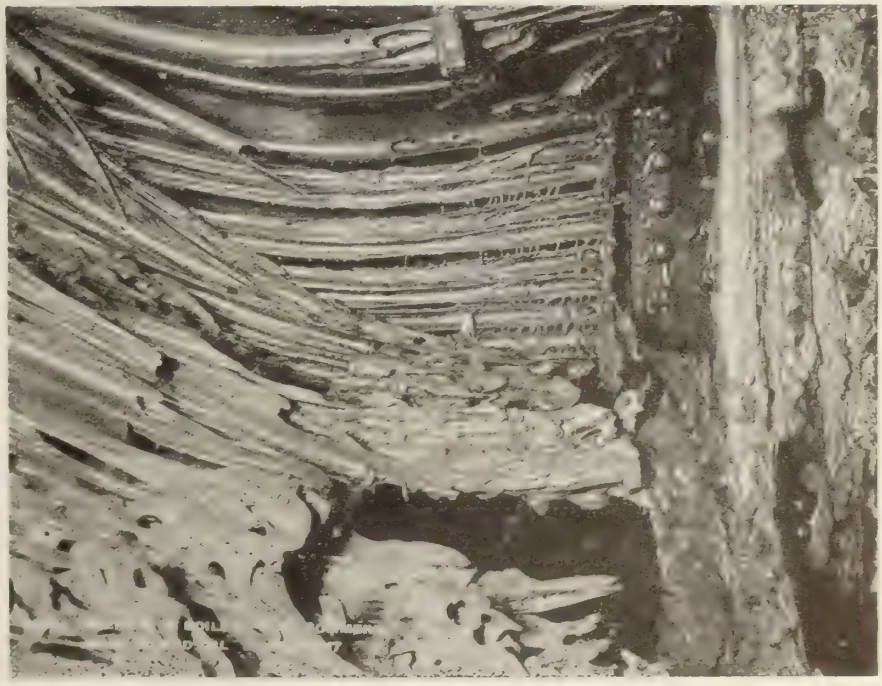
Every one of these ships was found to be either deliberately damaged or rendered useless through ravages of neglect before they fell into the hands of the United States Government.

The most serious typical damage was done by breaking cylinders, valve chests, circulating pumps, steam and exhaust nozzles on main engines, and by dry firing boilers and thus melting the tubes and distorting the furnaces, in at least one instance probably using thermit to make the destruction complete.

There were many instances of minor and easily detectable destruction, such as cutting piston and connecting rods and stays with hack saws, smashing engine-room telegraph systems, and the removal and destruction of parts which the Germans evidently believed could not be replaced. The most insidious sabotage was that which was concealed. In plugging a steam pipe the method was to disjoint the pipe and insert a solid piece of brass which would be sawed off flush with the joint. The pipe would then be reconnected, showing no evidence of having been tampered with.

Fire Extinguishers Filled With Gasoline

Indicators were astutely reversed in



INTERIOR OF BOILER OF THE S.S. POMMERN NOW THE U.S.S. RAPAHANNOCK. SHOWING HOW THE GERMAN CREW MELTED DOWN THE BOILER BY DRY FIRING. PROBABLY USING "THERMIT" TO INTENSIFY THE HEAT. THESE BOILERS WERE REMOVED.
Copyright by Committee on Public Information

many instances. Numerous fire extinguishers were found to be filled with kerosene and gasoline. Piles of shavings and refuse were strewn about where fires might be started, open cans of kerosene being found in several of these incendiary traps. There had evidently been a plan to burn the ships under certain conditions and it is believed that the German crews were seized and interned somewhat in advance of their expectations.

TYPICAL VANDALISM ON THE GERMAN SHIPS. WITH A BATTERING RAM OR A SLEDGE, THE VANDALS SMASHED THIS CIRCULATING PUMP CASING WHICH WAS DULY REPAIRED BY THE ELECTRIC WELDING PROCESS

Copyright by Committee on Public Information.

Case of Vaterland Distinctive

The case of the Vaterland was quite different from that of any other ship. Engineers of the Navy Department who examined the big liner declared that inferior engineering had been practised in her construction. She has four turbine engines ahead and four astern on four shafts. All of the head engines were found in good condition and all of the astern engines were found damaged.

The major portion of the damage was credited more to faulty operation than to malicious intent. Cracks were found in the casing of the starboard high-pressure backing turbine of such size as to make it certain that the engine had not been used on the vessel's last run. Certain documentary evidence found on the ship corroborated this belief. It also indicated that the Vaterland on her last trip had made less than 20 knots.

There was just enough evidence of mutilation to warrant full investigation and the vast mass of machinery, electric apparatus, and piping in the Vaterland was patiently and doggedly examined before she was sent to sea. Original defects in her engine equipment were corrected, she was overhauled and in many respects refitted, and on the whole she was declared a better ship when she entered the service of the United States than when she took her maiden voyage.

SELLING AND BURNING FUEL

By J. H. R.

FEW problems at the present time are more pressing or more difficult of solution than that of the economic utilization of fuel for industrial and domestic purposes. That the question is of vital significance has been amply demonstrated during the past few weeks by the drastic measures taken by the government fuel controllers, for the utmost conservation of coal in every line of manufacture. In an effort to comply with current regulations and assist in relieving a situation that was rapidly developing into the famine stage, users of fuel were both anxious and willing to co-operate to the fullest extent for a reasonable solution. The essential need of maintaining production was however a feature that invariably prevented a plant from curtailing on the consumption of fuel, for operating the equipment at maximum capacity.

An interesting experience in connection with coal conservation was related to the writer a short time ago, where an institution with a large power plant was induced by the official salesman of a gas concern to use coke for firing the boilers. The engineer of the plant was not consulted regarding the new developments, as the agreement to "give the coke a trial" was made in the office. The salesman for the gas company interviewed the manager respecting the adoption of coke for the aforementioned purpose. Owing to the poor quality of the coal they had been getting and the convincing persuasion of the salesman, respecting the high efficiency of coke as a heat producing medium, the manager finally decided to give the coke a trial, and placed an order for several tons for immediate delivery.

When the engineer was advised that a quantity of coke would be delivered the following day, the jig was up. The manager was informed right off the bat that it was utterly impossible to burn coke on the particular style of mechanical grate installed in the boilers. Nothing would do however but that the engineer should make ready to receive and store the supply of coming coke. He nevertheless refused to have anything to do with the "test" and suggested that the gas people supply the fireman for the demonstration, as he would be very willing to learn anything new regarding the firing of a boiler on any class of fuel. So it happened that the next day saw a number of carts discharge their load into the waiting bunkers, and with the arrival of the "demonstrator" the test was commenced. Previous to becoming an interesting onlooker, the engineer went the rounds of the different departments and advised them to be prepared for an early shut down. The manager and salesman stood quietly by as the coke specialists loaded the hopper with the recent arrival, no particular attention being paid to the size of the lumps that were thrown in. The travelling grates continued their regular course, automatically carrying the three inch layer of slack coal from the hopper to the fire chamber. The time soon arrived however, when the last of the slack coal reached the bottom of the hopper and in a very brief space of time the pressure gauge, which had been registering 100 lbs. per sq. in., gradually began to fall, so that in a few minutes the hand was pointing to 50, with the foremen of the machine departments inquiring as to the failure of the power.

As invariably happens, the practical man was at once approached for advice, when it was discovered that the coke had failed to find its way through the three inch opening, and the back half of the grate was bare of fuel, the cold air rushing through and cooling off the boiler shell. The coke was emptied from the hopper and spread on the concrete floor—all over the boiler room—and hammers were brought into play to reduce the lumps to a size that would pass through the openings of the mechanical stoker. In the meantime the bed of the fire was put in order and a fresh supply of slack placed in the hopper. When all was again ready, the coke demonstrator—still optimistic—took the leading role, and his assistants filled up the hopper with a supply of small coke. However, the result was little better than the preceding one; for while the coke passed through the opening and followed the bituminous and hard coal slack along the grates, it failed to ignite when reaching the fire chamber, and as soon as the air struck the thin open layer of coke, the rush of cold air prevented the back creeping of the fire that is necessary in the successful operation of this particular type of mechanical stoker. It was a very disappointed but wiser salesman that ordered the coke back to the bunkers and its subsequent removal next day.

Electricity and Hydraulics

SOME CONSIDERATIONS ON TRANSMISSION LINE CONDUCTORS

ALTHOUGH copper wire has been most commonly use for transmitting electric power on long distance transmission lines, with aluminum as an alternative choice, economic considerations have suggested the use of steel as a possible substitute. Its high tensile strength and elasticity would seem to render it eminently suitable for withstanding the heavy strains and the continual expansion and contraction to which conductors on long spans are subject and moreover permit of longer spans between towers with less sag and shorter towers than is possible in construction employing either copper or aluminum conductors.

But offsetting these advantages to be gained were the relatively more important disadvantages of low electrical conductivity and reactance of steel. In other words, for the same resistance loss in the line, the area of the steel conductors, if used, would have to be much greater than that of the equivalent copper conductors. Consequently the increased weight of metal might entail a higher initial expenditure for conductors than would be the case were pure copper used.

Skin Effect

Also the magnetic quality of iron or steel is responsible for what is known as skin effect where the current is confined to the outer circumference of the wire instead of being equally distributed over the cross section of the wire. The higher density of current thus occuring at the outer skin or surface causes heating which in turn reduces the conductivity still further. The same effect is present in non-magnetic conductors but not to such an extent as in iron or steel. But the principal factor precluding the extended use of steel for high tension transmission is the deterioration which it undergoes in service of this nature

A new type of conductor has been developed employing steel in combination with either copper or aluminum and it is quite possible that it will be used to some extent in future transmission line construction.

The Copper-Clad Conductor

In order to secure a conductor having the high tensile strength of steel and at the same time retain the high conductivity feature of copper, a compromise has been effected by manufacturing a copper-clad cable. It comprises a core of steel wire surrounded by an annular outer jacket of copper. The area of the copper is such that it will successfully carry the total current of the conductor without overheating, so that the magnetic action of the core which tends to force the current to the outer layers of the wire does not act detrimentally in this case.

The process of forming this copper to the steel is accomplished by driving a copper jacket over the steel billet while it is still in the wire bar stage and the subsequent rolling treatment serves to effectively weld the copper to the steel, virtually forming an alloy of the two metals at their junction. This method of manufacture requires that the percentage of steel to the total area of the conductor shall be large so that compared with a copper conductor of the same conductivity, it will necessarily be larger and more expensive due to the cost of steel and the extra operations involved in manufacture. The same objection of high reactance holds here as with the steel wire and, all things considered, the copper-clad cable will not supplant its prototype except in construction where long spans are imperative in which case the lesser number of towers required and the closer spacing distance allowable, since the sag is a minimum, will tend to simplify and cut down the cost of the system, and in proportion to the saving effected in this way will the objections to its use previously mentioned be minimized.

There are two grades of copper-clad steel commercially produced, the 30 per cent. and 40 per cent. depending on its conductivity relative to an annealed copper conductor of the same size. The 40 per cent. grade is usually specified for electrical work because it has a lower resistance and reactance than the 30 per cent. grade.

Aluminum-Steel Conductors

The success attained by the process for copper-clad wire led to trying aluminum in the same way but initial results were not satisfactory owing to the disparity in the melting points of the two metals. Further investigation produced a solution of the difficulty which proved even simpler than the first method. The individual aluminum wires were laid around a steel wire core in an ordinary stranding machine, the steel being double galvanized to prevent any electrolytic action between the dissimilar metals. Aluminum and zinc have about the same electro positive qualities. The stranding scheme carried out, ordinarily, makes a seven strand cable, the middle strand of steel and the outer six of aluminum. Sometimes the steel strand will consist of seven small steel wires having the same total area as would the single steel wire.

The Hemp Core Cable

Another type of composite conductor which has been the object of considerable interest and experiment, is the hemp core copper strand cable. It represents the substitution of a strand of hemp for the centre wire in a seven strand copper cable, thus leaving only six effective current carrying conductors. The physical qualities of the hemp are such as to prevent its very extended use. It lacks elasticity chiefly in respect to contracting the same amount it has elongated. The result, eventually, is a distorted cable and in time a seriously deteriorated hemp core. Such a cable would be 16 per cent. greater in cross section than the equivalent seven strand copper and the increased diameter reduces corona loss while new but the deterioration of the hemp will operate to cause increased corona. An improvement on the hemp cable is the practice of using an annealed medium drawn copper wire in place of the hemp core. Its elongating properties are such that the strain it at all times taken

STEAM FOR HEATING PRODUCED FROM ELECTRIC CURRENT*

By F. Haehn.

THE Swiss Society of Steam Boiler Owners recently conducted an interesting test for ascertaining the commercial possibilities of generating steam for heating purposes by electricity. The method investigated was to heat the water under pressure and, as required, allow it to expand to a lower pressure and so generate steam.

A small model tubular boiler 24 in. in diameter and 50 in. long containing thirty-eight 1¼-in. steel tubes was used for the test. Glass-insulated microhm heating coils having a resistance of 1.1 ohms were inserted in 34 of the tubes and so connected that the latter were divided into three groups of 18, 9 and 7 respectively, any of which could be cut out of service. Direct current at 225 volts obtained from a hydro-electric plant on the premises was applied.

The following table gives the results of two tests:

	Test No. 1	Test No. 2
Duration, hours	7.6	7.0
D.C. voltage	225.8	225.6
Average amperes	142.4	148.8
Aver. pressure, lb. per sq. in. abs.	25.0	23.4

*Translated from Schweizerische Bauzeitung.

Average kilowatts	32.2	33.6
Aver. temperature, deg. F	51.8	50.0
Total heat in one pound of steam, B.t.u.	1,160.0	1,163.4
Total evaporation, lb. per hour	85.5	89.7
Evaporation in pounds per square foot of heating surface at minimum demand	2.7	2.42
Evaporation in pounds per square foot of heating surface at maximum demand	2.85	2.68
Evaporation in pounds per square foot of heating surface at aver. demand	2.76	2.62
Total pounds steam generated per kw.-hr.	2.65	2.67
Theoretical heat in B.t.u. per kw.-hr.	3,415.0	3,415.0
Actual heat obtained in B.t.u. per kw.-hr.	3,074.0	3,106.3
Efficiency, per cent.	90.0	90.9

The efficiency of 90 per cent. might have been improved by better lagging, as most of the losses were due to radiation.

It is interesting to note that the evaporation per square foot of heating surface was greatest at minimum demand, owing to the better heat transfer to the water when the latter was not filled with steam bubbles. For practical purposes it is fair to assume a mean evaporation of 2.46 lb. per sq. ft. of heating surface.

The first requisite for steam generation by electricity is a cheap source of power. In order that such a system may compete with a coal-fired plant, with coal selling at $8.75 per ton in Switzerland and an average evaporation of 7 to 8 lb., the author computes that the cost of current cannot exceed 0.16c per kilowatt-hour.

Such low-cost current is rarely obtainable. However, cases may arise where an otherwise partly idle hydro-electric plant can be used to furnish the necessary current on nights, Sundays and holidays. If, then, sufficient heat can be stored in the water to furnish steam by regeneration for the entire week, the practical application of this method takes on an entirely different aspect.

The author derives a number of equations for computing the heating surface and the storage space required for furnishing the maximum amount of steam for heating purposes at a reduced pressure of 22 lb. absolute, with an available power supply of 883 kw. for 12 hours.

Given a feed temperature of 59 deg. F., the total steam obtained at a mean pressure of 99 lb. is shown to be 2,244 lb., which would require about 80 sq. ft. of heating surface. The total amount of water necessary amounts to 20,661 lb. and would require a storage space, making due allowance for extra steam space of some 400 cubic feet.

Placing the radiation losses at 6 per cent., the total amount of steam reduces to 2,109 pounds.

With an evaporation of 7.5 lb. and coal at $8.75 per ton, this represents an equivalent fuel cost of $1.23 per day, or $369 per year of 300 working days, an amount which the author believes sufficient to cover the interest and depreciation of the simple equipment required.

The system offers the advantage of high efficiency in transforming the surplus electrical energy into heat with only light storage losses and to give up this heat at any rate desired while requiring only nominal attention. It may also become the means for improving the load factor of the plant by cutting in the heating coils as the load decreases.

WATERS AND WATER-POWERS

THE ninth annual report of the commission of conservation contains extended references by the chairman, Sir Clifford Sifton, to numerous phases of conservation throughout 1917. Speaking of electric power plants he states that the preliminary survey of the water-powers of Canada is now practically completed. During the past year special efforts have been made to secure detailed information with regard to electric power plants and systems throughout the Dominion.

Power Progress in Ontario

The development of hydro-electric power in Canada, and especially in the provinces of Ontario and Quebec, during the last ten years has been almost incredible. At the beginning of the work of the Ontario Hydro-Electric Power Commission, the late premier, Sir James Whitney, stated that the Commission would not require so much as 10,000 h.p. At this moment, the immediate requirements of the Hydro-Electric Power Commission in Ontario may be conservatively stated at 296,000 h.p., upon which demand there is a present shortage of about 70,000 h.p. A conservative estimate of the amount of power actually in use in the city of Montreal and its environs is 225,000 h.p. The position with respect to the province of Ontario, and especially with regard to Niagara Falls, is one which should be considered with great care. At the present time, the Hydro-Electric Power Commission is about 70,000 h.p. short, and it is not too much to say that this shortage will rapidly increase. I understand that Sir Henry Drayton has reported to the Federal Government that it is not practicable to withdraw this 70,000 h.p., which is presently in demand, from the United States to which it is now being exported, for the reason that the power is necessary for the use of plants which are producing essential war material for Great Britain and her allies. The position is, therefore, that, whereas, 12 or 15 years ago, it was not thought that the Hydro-Electric Power Commission could make use of 10,000 h.p., and, accordingly permits to export were more or less freely given, there is now, in round figures, an immediate demand for 300,000 h.p., and the demand cannot be satisfied.

St. Lawrence Power Situation

A situation analagous to that in which Niagara power stood fifteen years ago now exists on the St. Lawrence river. A very large capacity for the development of power exists upon the St. Lawrence. There is a considerable development in the neighborhood of Montreal, but the greater portion of the power still remains undeveloped. Attempts are constantly being made to fataly complicate the position with respect to St. Lawrence power by securing the privilege of private development, which will be followed by contracts for the exportation of the power developed. I understand that the Cedars Rapids company exports something like 60,000 h.p. per annum. An attempt was made some years ago to secure the privilege of developing the Long Sault power, the purpose being to export the greater portion of the power in the interest of a manufacturing corporation on the United States side of the line. This project was defeated, largely through our efforts. A similar project is now being promoted, and wew are resisting it with all our energy and we trust with fair prospects of success. It is almost incredible that any responsible man should be so short-sighted as to favor this project in the face of the experience which we are now undergoing at Niagara.

International Development Proposed

Within a very few years, there will be a demand for every horse-power that can be developed on the St. Lawrence river to which Canada is entitled for use upon the Canadian side. The situation with regard to Niagara will undoubtedly be duplicated, and if we are foolish enough to allow vested interests to be created upon the other side of the line, we shall inevitably find ourselves handicapped and embarrassed as we now are with respect to Niagara power. For myself, I have no doubt at all what ought to be done with respect to the great powers dormant in the St. Lawrence river. The United States Government is not interested in the corporations that are endeavoring to get possession of the St. Lawrence powers from the other side. Neither is the Canadian Government interested in the fortunes of the gentlemen who are promoting their projects on the Canadian side. They are very few in number, and their interests are confined entirely to themselves. What the United States Government and the Canadian Government alike are interested in is that there should be a fair division of this power, that it should be developed in such a way that the neighboring and tributary population should have the use of it upon fair terms. A thorough study of the whole question inevitably leads to the conclusion that there is only one sound and satisfactory method of developing these powers, and that is by an international commission, under which the greatest and the best use of the powers will be made, the most economical development will be effected, a just and equitable division of the power will take place and the governments concerned will be able to administer the power as the Hydro-Electric Commission administers the power of Niagara for the benefit of the people who are directly concerned in its use.

Powdered rosin and gypsum are the chief ingredients of a fusible insulating and filling material for electrical purposes which has been patented.

Steam and Its Generation

MODERN PRACTICE IN APPLYING GAS FIRING TO STEAM BOILERS*—I.

By T. M. Hunter, M.A., B.Sc.

IN studying the subject of gas-firing boilers, the author has come across no books dealing with both the theoretical and the practical side of the question. This is all the more surprising, as gas-fired boilers have now been in use for a very great number of years. There are many excellent books on boiler firing, but these do not generally touch the special problems which arise when seeking for the maximum efficiency and output of a gas-fired boiler. It is little wonder that engineers in charge of gas-fired boiler plants make so little progress in the direction of improving the results at their boilers. Most of them know that these results are wretched, and most of them have attempted, with little success in most cases, to make improvements.

The theory of the combustion of gas is simple; but to know what is the best combustion arrangement for any particular set of conditions, and, when this is fitted, to be able to run it so as to get the best results, are matters requiring much study and experience. Most engineers have not access to the formulæ and tables which would enable them easily to test the results they are getting at their gas-fired boilers, so the author has included in this paper a number of tables which he hopes may be of service.

The author does not claim originality for much of this paper. It is made up from information and experience gleaned here and there in years of study of the subject. If some of the matters seem very elementary, experts will forgive it for the sake of those not so well up in the subject.

First Use of Gas

Gas as a boiler fuel was first used in connection with blast furnaces some where about the middle of last century. Boiler firing was the obvious use to which to put the gas recovered as a by-product in the manufacture of iron. Gaseous fuel is apparently the ideal fuel for boiler firing. It requires no stoking and no cleaning of fires. A whole battery of boilers can be attended to by one man, and a constant load is maintained independent of the efforts of manual labor. The main reason why blast furnace gas has not been used with greater success is that it carries huge quantities of dust. This is deposited in the boiler flues, resulting in a constant decrease of the evaporation and requiring to be cleaned out every few weeks. Under these circumstances the possibilities of the fuel were not realized. About 25 years ago gas-cleaning plants were introduced, which provided cleaned gas and did away with this disadvantage.

The introduction of regenerative coke-oven plants next provided quantities of gas, which was also used for boiler firing. On account of the higher calorific value of coke-oven gas very much smaller quantities had to be handled in order to obtain the same results from boilers. It was found that this gas could be brought into contact with the walls of boiler flues without being extinguished, and so brick-lined combustion chambers were not generally used for its combustion. It was, however, found that even with this richer gas the efficiency of gas-fired boilers was still very low.

The theory gained ground that gaseous fuel was unsuitable for boiler firing, and that it was impossible with it to obtain anything like the efficiency or the evaporation obtainable in the same boiler by coal firing. This theory is still held by many engineers. It is the more surprising that this theory should have taken such a strong hold, as at the same time the most perfect combustion arrangements were invented for small quantities of gas. We generally connect these improvements with the name of Bunsen, and the Bunsen principle is at the back of most of the work that has been done on large volumes of gas, as well as on small volumes.

About 20 years ago the Mond by-product producer, followed by other producers, provided another source of gas in large quantities, and in some cases this gas was used for boiler firing. The author thinks that in no case yet has gas firing of boilers with by-product producer gas been made a commercial success, as it has been found that steam could be raised more cheaply from the coal direct, even after allowing for all the income from the sale of by-products. He does not wish to be misunderstood in saying this, as he firmly believes that there are modern producer and boiler plants even now on the market which can make the gasification and gas-firing proposition a commercial success under suitable conditions.

Engine Developments

Many engineers came to the conclusion that they would have to give up boiler firing with by-product producer gas as commercially impracticable, and they turned their eyes to gas engines to utilize the gas economically. Gas-cleaning plants had made the use of producer and blast-furnace gas possible in gas engines. It was soon seen that gas engines would produce 1 h.p. for at most 10,000 therms in the gas. This was at a time when it was assumed that some 20 lb. of steam per horse-power were required in a good steam engine. As this represented over 19,000 therms in the steam, and as this steam had to be generated in gas-fired boilers at not more than 50 to 60 per cent. efficiency, the gas engine apparently was to be the engine of the future. Probably this would have been found true but for the adoption of steam turbines, which have reduced the steam per horse-power to about 10 lb. It was also found that the power per horse-power taken by gas engines increased rapidly as the load was reduced, whereas in turbines this was not the case. Turbines could be overloaded without danger, they could be made in units of very much larger size than the largest gas engines, and they were found, unlike gas engines, to be more economical in the larger sizes. In initial cost the turbine plant was cheaper, and in reliability and in cost of maintenance the gas engine was a very long way behind. It became evident that if gas-fired boilers could raise the steam at 75 per cent. efficiency the results from a modern turbine set would be as good as those from a gas-engine set, while as regards reliability and the skilled attendance required the steam turbine was unquestionably first.

There is no doubt that gas-fired boilers have now a greater future than ever. Probably the time is not so far distant when our present method of burning coal, together with its valuable by-products, will be considered obsolete, and possibly even illegal. It will then be replaced by some type of by-product producer or coal distillation plant yielding gas, and this gas will without doubt be largely used for boiler-firing purposes.

Calorific Value of Gas

The calorific value of a gas is expressed as the number of therms contained in 1 cubic foot, or the number of calories contained in 1 cubic metre of the gas. It is the custom to quote the calorific value of a gas at normal temperature and pressure. In this country we quote the number of therms in 1 cubic foot at 60° F. and 30 in. mercury column. On the continent normal conditions are 0° C. and 760 mm. mercury.

The calorific value of a gas is found

*A paper presented before the Institution of Electrical Engineers.

by burning the gas in a calorimeter and measuring directly the heat produced. This method reduces all the products of combustion to the temperature of the atmosphere, and thus condenses the water vapor arising from the combustion of H^2 and hydrogen compounds. The value thus obtained is called the "gross calorific value" of the gas.

In almost every case where gas is burned for practical purposes the water vapor arising from the combustion escapes to the chimney as a vapor and is not condensed. It has, therefore, become the custom to treat the latent heat lost through the non-condensation of this water vapor, not as a charge against the boiler, but as a charge against the gas itself. The "net calorific value" of a gas—which is the value generally quoted—is the gross calorific value, less the latent heat of the water vapor of combustion.

If in any special case the products of combustion are cooled down so far that some of this water vapor does condense, a calorific value more nearly approaching the gross calorific value would have to be used, otherwise the results shown would be quite deceptive.

To calculate the calorific value from the analysis of a gas we multiply the volume of each constituent by the calorific value of that constituent and add together the results. The following table shows the calorific values of the common constituents of gas; and an example is added to show the method of using the table:

	Gross calorific Values		Net Calorific Values	
	Therms per cub. ft	Calories per cub. metre	Therms per cub. ft.	Calories per cub. metre
Carbon monoxide, CO.....	344	3,062	344	3,062
Hydrogen, H_2	342	3,042	293.5	2,613
Methane, CH_4	1,063	9,460	966	8,598
Ethylene, C_2H_4	1,724	15,300	1,627	14,480
Hydrogen sulphide, H_2S	659	5,860	619	5,513

Calorific Value of a Coke-oven Gas.

Analysis, per cent.		Net Calorific Value.
H_2	49.1	$0.491 \times 2{,}613 = 1{,}282$
CH_4	32.6	$0.326 \times 8{,}598 = 2{,}800$
C_2H_4	3.1	$0.031 \times 14{,}480 = 449$
CO	8.1	$0.081 \times 3{,}062 = 248$
N_2	6.6	
O_2	0.5	4,779 calories per cub. metre
	100.0	=537 therms per cub. ft.

The question of gross or net calorific value of the gas often leads to misunderstandings. It is evident that when gas is produced from coal in a coke oven or producer plant the steam actually raised in boilers, per ton of coal put into the plant, is not affected whether we talk about the gas by its higher or lower calorific value. It is only when we investigate the efficiency of the various parts of the plant that this question arises. The maker of the producer naturally wishes to use the higher calorific value of the gas so as to show a high producer efficiency, while the makers of the boiler and combustion arrangements wish to use the lower value because the difference between the two values is a loss which is not recoverable in the boiler. It is advisable in all contracts that it should be clearly specified which value of the gas is to be used, so as to avoid any possibility of friction.

Below are indicated the losses arising from the latent heat of this water vapor in the case of several typical gases, and suggestions are made as to the possibility of reducing these losses. In all the calculations given in this paper the net calorific value of the gas is the value used.

Value of Gas

Among the by-products recovered from the distillation of coal, the manufacture of iron, the destructive distillation of coal and other processes, gas takes a very important place, and a much more important one than is generally realized by those who receive huge volumes of gas as a necessary and certainly welcome result of processes which primarily were not started for the purpose of manufacturing gas. It is common knowledge that in many modern manufacturing processes a very large proportion of the profits must of necessity be derived from by-products; it will, therefore, be worth while to consider more closely the value of gas when used under boilers.

Coke-oven Gas.—Let us assume a coke-oven plant of 50 by-product ovens which deals on an average with 100,000 tons of coal per year and yields 6,000 cub. ft. of surplus gas of 450 therms per cub. ft. per ton of coal. Let us further assume that this gas is burned with the assistance of a suitable combustion arrangement, giving an efficiency of 80 per cent. It would then be possible to generate 220,000,000 lb. of steam from and at 212° F., which corresponds to 96,500 tons of steam per year.

If the value of a ton of steam to a colliery is taken at 30c, the value of the surplus gas will be just over $30,000, and each 1 per cent. efficiency lost or gained will make a difference of $300. In other words, if the 100,000 tons of coal should produce 70,000 tons of coke, the total value of the gas will be nearly 42c per ton of coke.

Blast-furnace Gas.—The question of gas efficiency for the ironworks owner is a still more important one. It can be taken for granted that of the heat generated in a blast furnace 50 per cent. is consumed by the process of making iron, and that the other 50 per cent. is recovered in the blast-furnace gas.

If we assume one ton of coke to be used per ton of iron and the value of blast furnace coke to be $4.32 per ton, $2.16 per ton of iron is represented by the calorific value of the gas. Part of this gas must be used for heating the blast, but by far the greater part is available for the gas-fired boilers, gas engines, and the like.

If the stoves consume 30 per cent. of the surplus gas, and if 10 per cent. be allowed for losses through bell lowering, 60 per cent. is available for boiler firing, so that this portion of the gas with which we are chiefly concerned represents a value of nearly $1.32 per ton of coke.

Let us assume that a ton of coke is equivalent to 27,800,000 therms; then 13,900,000 therms per ton of coke will be available in the gas, and if 60 per cent. of that is surplus for boilers and gas engines, 8,340,000 therms can be burned under boilers.

If we again assume a boiler efficiency of 80 per cent., 8,340,000 therms would give 3.13 tons of steam from and at 100° C. per ton of coke. If the value of steam at iron-works is 48c per ton, which corresponds to a coal price of $2.88 and an evaporation of 6 lb. of steam per lb. of coal, we obtain $1.50 worth of steam per ton of coke.

In order to realize the economical importance of the whole question, let us assume the case of an ironworks with four furnaces using on an average 3,000 tons of coke per week. The value of the coke for boiler-firing purposes is in their case $243,750 per year, and each 1 per cent difference in efficiency means a difference of no less than $2,435. It is hardly credible, yet true, that scarcely any ironworks obtains a boiler efficiency of more than 50 per cent., and that many get an efficiency much lower than this, so we see that small ironworks as described above are losing 30 per cent. of $243,750, or $73,050 worth of steam a year, which could easily be recovered. The question of gas economy is thus seen to play a most important part in the financial prospects of ironworks.

Returning again to the case of the ironworks described above, the loss per ton of coke is at least 46c when assuming an efficiency of 50 per cent. As efficiencies are frequently as low as 40 per cent. the actual losses sustained are often over 62c per ton of coke.

The manufacture of pig iron in Great Britain was some 10,000,000 tons a year before the war, so that if the average loss is only 48c per ton, the formidable sum of $5,000,000 a year is sent up the stacks of the ironworks of Great Britain.

Producer gas.—Very few people at present use producer gas for boiler firing. On the other hand, at many works there are considerable amounts of waste products, like belt pickings, coke breeze, shale, etc., which are very rich in combustible matters and yet unsuitable for boiler-firing purposes. Any proposition

would be welcome which would render it possible to turn these waste products to profitable account without endangering the stability of the steam supply.

The fallacy of a producer gas proposal for boiler firing without absolute security of the results obtained in the boilers is evident if the following figures are taken into consideration. A modern producer will yield nearly 75 per cent. of the heat contained in the fuel as heat in the gas, and with the old combustion arrangements hitherto in vogue no higher efficiency than 50 per cent. can be counted on, so that only 37½ per cent. of the heat in the fuel appears as heat in the steam.

If we take a fuel containing 12,000 therms per lb., the total steam raised in a gas-fired boiler per lb. of fuel in the producer would not exceed 4½ lb. from and at 212° F. Then, again, 1½ lb. of this had to be returned to the producer in the blast, so that the net evaporation for outside purposes was only 3 lb. per lb. of fuel. Under ordinary circumstances the same fuels fired into boilers would have given 7 or 8 lb. of steam per lb. of fuel. With modern combustion arrangements an efficiency of 50 per cent. with producer gas can be raised to 75 per cent., so that fuel of 12,000 therms will give 7 lb. of steam per lb. of fuel; and as with the latest by-product recovery producers the steam necessary for producing by-products has been reduced to the amount necessary to drive the blowers, etc., the actual yield would be over 6½ lb. of steam per lb. of fuel. The result in steam for outside purposes is not materially worse than if the fuel had been burnt in the boilers, and the by-products are available to provide for depreciation, interest, and profit.

Suitability of Gas for Boiler Firing

Coke-oven gas.—Coke-oven gas gives comparatively higher efficiencies than the two other kinds of gas in gas-fired boilers owing to the greater ease with which it can be burned. The nature of the gas, however, renders it difficult to make burners which will deal with large quantities of gas. The comparatively narrow flues of Lancashire boilers offer so much resistance to a speedy expansion of the burning gas that unless we use forced draught the evaporation from coke-oven gas in Lancashire boilers is confined to 5,000 to 6,000 lb. per hour. If, therefore, new boilers are contemplated it will always be advisable, provided that the quality of the water permits it, to choose water-tube boilers. Coke-oven gas is particularly suitable for firing water-tube boilers, and with suitable combustion arrangements evaporations of 5½ lb. per sq. ft. of heating surface can easily be obtained at the highest efficiency.

Blast furnaces and producer gas.—Blast furnace and producer gas though of comparatively low calorific value, provided that they are clean and supplied under suitable pressure, will give good results, both in Lancashire boilers and in water-tube boilers. With Lancashire boilers evaporations of over 8,000 lb. per hour can be obtained, and with water-tube boilers 5 to 5½ lb. per sq. ft. of heating surface.

Blast-furnace gas we have to accept as it comes from the furnaces. It is so important that the iron made should be exactly what is required, that the kind of gas produced is never likely to be a matter of much concern to the blast furnace manager. We must accept the fact that occasionally the gas is hardly combustible at all, and we must devise means to deal with this condition.

The matter is different in dealing with producer gas. Gas is here a valuable product, though only the second product in point of value. The manager of the producer has it in his power to give us a gas which is much more or much less suitable for boiler firing. We naturally wish the richest possible gas, as it is the easiest gas to burn. At one large Mond plant the gas was found to be just under 100 therms per cub. ft., while at many plants the gas is over 150 therms per cub. ft.

WELDING AND CUTTING PROCESSES IN BOILER WORK*

By A. F. Dyer.**

At the present price of material, scarcity of labor and difficulty of obtaining steel and iron, welding and cutting by both the above processes has proved a great boon and an almost indispensable factor in railroad repair shops.

Seven years ago we employed one man as an acetylene welder and owing to failures through his lack of experience the process was nearly condemned, but as we gathered experience both gas and electric welding developed, so that now instead of one man we employ eighteen and have often to work them overtime.

Acetylene Systems

The low pressure acetylene gas system is used and the whole shops are piped for the acetylene; every other repair pit has a drop connection; in roundhouses we use dissolved acetylene in cylinders, which saves the expenses of a generator and piping where the process is only in use occasionally.

There is a great difference in opinion as to the relative merits of high or positive pressure and low pressure gas, the manufacturers of pressure outfits contending that you save oxygen by using their type of generators and claim that you can not get so near to a netural flame with the low pressure gas as you can with the high; the makers of the low pressure outfits claim that by the use of an injector embodied in the torch or welding head a neutral flame can easily be obtained; we find we can obtain a flame as nearly neutral as can be obtained with the outfit we use, although with pressure gas you can obtain a much larger flame for the same size head than with the low pressure. The principal factor, however, that made us decide on the low pressure outfit was the fact that our main supply pipes are carried overhead throughout the shops, and as nearly all, if not all, oil, steam and water pipes are overhead, we had to consider a very well known motto, viz., "Safety First," for if a man was working overhead and by mistake broke a joint of the gas pipe his torch or candle might cause an explosion, which might wreck the shop. I may say that, though we have been using the acetylene gas for eight years, we have never had an explosion of any sort yet. Our low pressure generator went through a big fire two years ago, and we were enabled to repair it and use it for several weeks till we received our new outfit.

Electric Outfits

There are many kinds of electric welding outfits on the market, and, of course, each one is claimed to be the best by its respective makers; each has its advantages, and the old prejudice very often exists among operators that the machine they are using and are familiar with is the best, and they will stick to that opinion until they become accustomed to the new machine. A new equipment using alternating currents instead of the direct current is now being put on the market, and only weighs 150 lbs., and gives from 20 to 200 amperes, and is about 50 per cent. cheaper than any D.C. machine on the market.

The electric welding outfit consists of two generators, each operating four welding circuits; the shops are wired, and at convenient places connection boxes are placed and only need a lead and ground wire connected to them and the work on which the welder is engaged.

The outfit used has panel controls, which allows each man to control his amperes independent of the other welders.

The processes have proved themselves fitly to be ranked amongst the greatest time and labor savers, and also we may safely say money-savers, introduced for a long period. For instance, in the not very distant past, a locomotive with a broken frame was due for a period of several days in the shops before they could strip down one side and remove the frame to the smith's shop, weld it, and perhaps have it machined and then replaced; now we drop the pair of wheels which may cover the break, cut out the crack with the cutting torch to the shape of a double V at an angle of 90°, clean off the oxide caused by cutting and weld up with the metal electrode, using soft steel or Swedish iron, a frame 4 in. x 5 in. being cut and welded in under 14 hours, and it can be done in less time by having two operators on the frame at once, but the men do not like facing each other's arcs, as when they are changing their filling rods their eyes get sore.

Frames, when worn by brake gear and stays, are built up and worn holes are plugged and welded instead of reaming them out to a larger size and thereby weakening the frame. In rebuilding and superheating engines the same boilers are seldom used on their original frames, and in very few cases do the various holes in angle irons, furnace bearers,

*Read before the Canadian Railway Club, Montreal, Dec. 11, 1917.

**General Foreman, Welding Dept., Grand Trunk Railway, Montreal.

etc., come into alignment with frames or boilers; these holes are welded up and redrilled.

The present price of tool steel demands that none shall be wasted; therefore, we use it down to the last inch by welding it to tire steel. Twist drills, taps and reamers when broken near the socket end are welded and put into use again; for this purpose we use either the electrode or gas, but in both cases we use vanadium steel filling rods, as we find this gives the best results. Spokes of driving wheels are welded and flat spots on tires have been successfully welded up when it was necessary to do so.

Up to now we have not had much success on cast iron with the iron electrode although with the carbon you can make a fair job, but the gas is unquestionably the best for any of this material. We have successfully welded with the gas, steam shovel engine frames, slides and cylinders by welding in patches of cast iron where worn or broken. When our contract for shells was completed and the lathes that were used for this purpose were being overhauled, it was found that most of the V slide beds were worn down by the tool carriers; these were built up with the gas, which saved machining these beds down in many cases ⅜ in.

Boiler Work

In regard to boiler work, most of the welding is done with the iron electrode, using a mild steel or Swedish iron as a filler; it is found that the electric process localizes the heat more so than the gas, though it is the writer's humble opinion that the gas makes a closer and neater weld, as all welds made by the electrode are more or less porous unless hammered up. It pays better whenever possible to do so to put quarter or half sides in order to get out of the fire line in preference to putting in a patch, for, as a rule, however well the patch is welded it generally gives out in from twelve to eighteen months' service, and the same applies to cracks, whereas the half or quarter side should last as long as the firebox.

When a nest of small cracks is found round the staybolts the bolts are removed and the holes countersunk and welded up. This method has been found to be very successful. Corner patches are welded in by running the patch into the tube or back sheets, as the case may be, at the same time removing the flanges. If it is decided to do away with a number of tubes, plugs are welded in the holes, first countersinking the holes and having the plugs punched by a countersunk die which gives the proper bevel for welding.

A great deal of trouble was experienced when welding in the superheater flues and tubes when this was first started, but after a little experience much better success was arrived at. Some operators prefer the tubes belled and others prefer them beaded; some prefer the water in the boiler and others do not.

The operators I am connected with like the belled methods best and with the water in the boiler. This keeps the tube sheet from heating, especially round the smaller tubes. Tubes are set in with copper ferrules set back 1/32 in. and the flues are belled out 3/16 in. to 7/32 in. and the small tubes 3/16 in. The sheet is roughened all round the tubes and flues, and the oil is then burnt off with the oxy-acetylene flame and tubes and flues welded in with electrode, using ⅛ in. mild steel or Swedish iron; the latter is preferred if caulking is needed.

Output Performance

A sample of an average day's work is as follows for a gang of 12 men:

14 rivet holes in smokebox and 4 peg holes in foundation ring.

10 tube holes in upper portion of firebox tube sheet.

2 air pipes which were worn through.

In the tool room:

1 ratchet for jack (2 teeth replaced).

1 gear spindle built up.

1 chuck screw key end built up.

1 boring shaft built up from 2½ in. to 2⅞ in.

2 tool holders rebuilt.

1 air hammer handle repaired.

6 teeth in lathe gear built in.

1 cone, small end filled up solid.

2 1¼-in. holes in top rail of frame filled up.

4 cracks 18 in. long in right side sheet welded.

14 bottom tube holes welded up.

2 washout plug holes built up for retapping in round head.

Cut out frame for welding and started welding same.

Welded bushes in pony truck stays.

Cut out 3 sets of boiler tubes.

Cut out 1 set of superheater flues.

Build up caulking edge of fire hole.

Heated corners of tube sheet for closing.

Welded broken superheater damper bracket.

Built up reversing lever where worn.

Built up 2 side rods where worn.

Cut out 48 flexible staybolts in firebox.

Welded 2 cracks in throat sheet.

Air Brake Department:

1 broken flange of air brake cylinder.

In addition to this list two men are engaged continuously on cutting around the shops.

For cutting steel and wrought iron the oxy-acetylene process has practically no competitor, it being impossible with the carbon point to cut as fast or as fine and neatly as the gas torch, although for scrapping fireboxes and frames, the carbon point is cheaper if time is no object and labor cheap.

The foregoing examples only enumerate a very small fraction of the uses to which the two methods of welding and cutting are being put to in locomotive repairing and machine shops, and fresh uses are being found for it every day.

Both Processes Valuable

No roundhouse should be without an oxy-acetylene outfit, both for repair work and as a part of the wrecking outfit; many days are lost by engines being tied up through parts having to be sent to the nearest big shops for repair, which could be repaired on the spot with a welding and cutting outfit. All large roundhouses should have both processes, as they would pay for themselves over and over again.

In concluding, I would state that though there are many different opinions as to which is the best process, no shop is complete unless it has both equipments, although the gas has really the widest range, but, on the other hand, a heavy piece of steel or iron needs no preheating with the electrode, but welding can be commenced as soon as your arc is drawn; 95 per cent. of the failures which occur, instead of being laid on the process, should be placed on the shoulders of the operators.

Welding should not be treated as a side line of the machinists' or boilermakers' business, but should be treated as a trade in itself, as it really is, for it needs the entire concentration of a man's mind, careful study, plenty of practice and a conscientious man to make a welder.

Wherever possible a separate building or suitable space should be provided for bench work, and should be equipped with a suitable furnace for heating and annealing castings, and also have plenty of floor room to allow of charcoal fires being built for preheating cast iron jobs for welding.

STRIVING AFTER NATURE?

CONSIDERABLE notoriety has been achieved during recent months by an individual rejoicing in the name of Giradossian, who has influenced certain members of the United States Congress sufficiently to bring before the House a scheme which he wishes to have tested by the Government. The entire proceedings have been so irregular and spectacular that more than ordinary interest has been aroused in engineering circles. Our contemporary "Power" treated the matter editorially in a recent issue, and its comments are very much to the point. Under the caption "Power from the Air," it says:

It is recorded that the Lords of the British Admiralty rejected the propeller when it was proposed by Ericsson, and Dr. Lardner demonstrated that a steam-propelled vessel could never cross the Atlantic. In the absence of a demonstration the injector might well have been regarded as a mechanical absurdity, and a proposition to converse across miles of space, without even a wire connection, would have sounded insane a half-century ago.

The open-minded attitude induced by the contemplation of such instances need not, however, lead one to take seriously a proposition to make ten pounds of sugar out of nine pounds of cane, or to take out of a train of mechanism more energy than is put into it.

Garabed T. K. Giradossian, an Armenian mechanic, claims to have invented a "free energy generator." This, he says, is not a perpetual motion, but makes available a free source of energy, by which vessels may be propelled to any distance without stopping to coal up, airplanes may fly around the world and

carry thousands of pounds, torpedoes may be projected at great speed, and the speed of steam engines doubled (although it is not apparent what we should want of the poor old steam engine any more).

We have a great admiration for Garabed T. K. Giradossian, not as an inventor, for our office is the depository of countless schemes for the multiplying of power and evading the law of the conservation of energy, but as a promoter. In "Power" for July 31 was told how he had appeared before the House Committee on Patents, which issued twenty-five pages of printed report about his invention and various subjects more or less touching on and appertaining thereto. The committee has now reported a bill which went through both Houses of Congress with a whoop, providing that the device shall be tested by a board of five scientists to be selected by Mr. Giradossian and approved by the Secretary of the Interior.

Every once in a while somebody discovers that water is a combination of oxygen and hydrogen, and declares that all that a vessel has to do to secure an unlimited supply of fuel is to decompose some of the water upon which it is floating and burn the hydrogen that is produced with the oxygen from which it has been separated. The trouble is that the water is the product of a previous combustion of hydrogen—a union of hydrogen and oxygen—and that it takes just as much energy to separate them as they generate in coming together, just as it takes as much energy to hoist a weight as it will give back in falling.

Is there any reason to hope that Mr. Giradossian's project has any firmer foundation?

It cannot be said that Mr. Giradossian's dream is impossible of realization. The process is going on continually before our eyes. Carbon, in its various forms of coal, wood, charcoal, oil and other fuels, is burned by combination with oxygen, the product of the complete combustion being carbonic-acid gas. To decompose a pound of this gas would require as much energy as would lift a ton weight over one hundred and fifty feet, but here comes in one of the most wonderful, beautiful and mysterious of nature's processes. It is a peculiar property of vegetation that under the influence of sunlight it can overcome the attraction which exists between the atoms of carbon and oxygen, appropriating the carbon to its own use, building it into its structure, and letting the oxygen go free into the atmosphere.

To separate these two elements in our laboratories, we are obliged to resort to the most powerful chemical agents and to conduct the process in vessels composed of the most refractory materials, under all the violent manifestations of light and heat; and we then succeed in liberating the carbon only by shutting up the oxygen in a still stronger prison. But under the quiet influence of the sunbeam in that most delicate of all structures, a vegetable cell, the chains which unite together the two elements fall off, and while the solid carbon is retained to build up the organic structure, the oxygen the atmosphere. To separate a pound of carbon from the oxygen with which it unites in burning would require the expenditure of an amount of energy which would raise the weight of a ton to the height of over a mile, and yet in the economy of nature this process is constantly going on, not with the noisy demonstration of prodigious effort, but quietly, in the delicate structure of a green leaf waving in the sunshine.

Has the Armenian mechanic discovered the secret of the vegetable cell?

VARIABLE SPEED TRANSMISSION DEVICES

IT is curious to note how after a century or more of intense mechanical development some of our most widely used machines and mechanical devices are of a type that appears to outrage every mechanical principle. The picking motion of the loom is one such device, the combination of motor cycles and side car is another, the sliding gear variable speed device for power driving road vehicles and other machines is a third. A study of some of these apparently barbaric suvivals leads to the conclusion that their practical advantages outweigh fundamentally their technical deficiences, and suggests that they are not likely to be superseded by more "correct" devices that will better satisfy the mechanical sense. They may be all wrong, but they give more for a dollar than any alternative arrangement. But in other cases they appear to owe their continued existence to the fact that being early established as a standard device, a hundred times more effort has been given to their improvements than to the development of any radically different and, perhaps better method, so that the competition continues to be between an actual much improved bad thing and a prospective ill-developed good thing.

Whether the sliding change speed gear now employed on the overwhelming majority of road motors belongs to the first or second of these arrangement classes it is as yet too early to say, but the arrangement is too crude to go for a long time unchallenged. R. E. Phillips in a paper on variable speed gears, read some time ago before the Institute of Mechanical Engineers, admits that although from an engineer's point of view it is theoretically an embodiment of everything that is wrong, it has been developed by the perfection to which its design has been brought, by the high standard of workmanship employed in its manufacture and by the use of the highest grade of materials into a completely satisfactory piece of mechanism. In practice it has proved to be "not so bad as it looks," and it has managed to hold its own for nearly 20 years against many other gears which theoretically should give better results. This condition of things has attributed, however, partly to the factor above mentioned, that nothing like the same attention has been devoted to other transmission devices as to this, and partly to the fact that the motors now used are of such a gen is allowed to return to its home in high horse power that at least 75 per cent. of the running is now done on the direct drive.

The amount of effort that has been given to the improvement of the side meshing type of change-speed gear is evidenced by the number of varieties that have been evolved. These have been catalogued by M. Rutishauser, an eminent French engineer, into no fewer than 9 main divisions and 20 sub-divisions. The most frequent aim of the inventor has been to prevent undue wear and tear on the teeth of the wheels due to the clash engagement, and the problem has been tackled in many ways. The side mesher action can, of course, be altogether at a price. All that is necessary is to keep the several trains of gears constantly in mesh, and bring into action the particular train required by means of some of some form of clutch. This method, though theoretically attractive, has in practice three weighty drawbacks; it increases the length and weight of the gear box; it adds greatly to the complexity and cost and it means that all the wheels are running all the time. A happy compromise is that in which the sliding wheels are mounted loosely on their shafts, and are brought into mesh with the respective corresponding wheels of their trains before they became coupled to the shaft on which they are mounted.

SUPPLIES OF GASOLINE

IN 1915, Canada consumed over 43,000,000 gallons of gasoline. Of this amount about 5 per cent. was produced from Canadian crude, while the remainder was either imported direct or produced from imported crude. This fact shows the dependence of Canada upon supplies of gasoline and petroleum from United States and strengthens the argument used in a previous issue wherein it was stated that 20 per cent. of the gasoline used in Canada was produced from Canadian crude oil.,

TENDERS WANTED

TENDER forms and specifications have been received from D. H. Ross, Canadian Trade Commissioner, Melbourne, for equipment required by the Department of the Navy, Melbourne, and the Postmaster General's Department, Brisbane, Queensland. These tender forms are open to the inspection of Canadian manufacturers at the Department of Trade and Commerce, Ottawa. (Refer File No. 1729 O.) Particulars of the requirements are briefly outlined thus: The tender addressed to the Director of Navy Contracts, Navy Office, Melbourne, is as follows:—Supply and delivery of one motor driven hydraulic pump for Garden Island, Sydney, N.S.W. Date of closing April 5. Tenders addressed to the Deputy Postmaster General, Brisbane, Queensland, are as follows:—Schedule, No. 432. Fifteen miles, 550 yards silk and cotton insulated switchboard cable, as specified; 990 yards paper-insulated, rubber covered cable, as specified; 8,880 yards lead-covered, paper-insulated telegraph cable, as specified. Date closing Feb. 27.

The MacLean Publishing Company
LIMITED
(ESTABLISHED 1888)

JOHN BAYNE MACLEAN - - - - - - - President
H. T. HUNTER - - - - - - - - - Vice-President
H. V. TYRRELL - - - - - - - - General Manager

PUBLISHERS OF

POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air, and Water Power, and to the design and operation of Refrigerating Machinery.

J. M. WILSON, Editor. Manager: B. G. NEWTON.

Associate Editors:

A. G. Webster, J. H. Rodgers W. F. Sutherland

OFFICES

CANADA—
Montreal—Southam Building, 128 Bleury St., Telephone Main 1004.
Toronto—143-153 University Ave., Telephone Main 7324.
Winnipeg—1207 Union Trust Building, Telephone Main 3449.
Eastern Representative—E. M. Pattison.
Ontario Representative—S. S. Moore.

Toronto and Hamilton Representative, J. N. Robinson.

UNITED STATES—
New York—R. B. Huestis, 111 Broadway, New York, Telephone 8971 Rector.
Chicago—A. H. Byrne, 900 Lytton Bldg., 14 E. Jackson Street. Phone Harrison 1147.
Boston—C. L. Morton, Room 733, Old South Bldg., Telephone Main 1024.

GREAT BRITAIN—
London—The MacLean Company of Great Britain, Limited, 88 Fleet Street, E.C., E. J. Dodd, Director, Telephone Central 11960. Address: Atabek, London, England.

SUBSCRIPTION RATE

Canada, $1.00; United States, $1.50; Great Britain, Australia and other colonies, 4s. d., per year; other countries, $1.50. Advertising rates on request.

Subscribers, who are not receiving their paper regularly, will confer a favor by telling us. We should be notified at once of any change in address giving both old and new.

Vol. XI. FEBRUARY, 1918 No. 2

PRINCIPAL CONTENTS

City of Peterborough Municipal Pumping Station 29-32
General 32
Report of Boiler Inspection in Ontario....Gas Supply Depleted....Canada Gets Coal Supply....The Ekenberg Peat Process....Market for Pumps in Paraguay.
The Preventable Waste of Coal in the United States 33-36
General 36
Gas Firing and Regenerative Settings....Will Wood Fuel Take Place of Coal?
Emergency Repairs on Damaged Engine Parts 37-40
General 40
Selling and Burning Fuel.
Electricity and Hydraulics 41-42
Some Considerations on Transmission Line Conductors.... Steam for Heating Produced from Electric Current.... Waters and Water Powers.
Steam and its Generation 43-45
Modern Practice in Applying Gas Firing to Steam Boilers —I....Welding and Cutting Processes in Boiler Work.
General 46-47
Striving After Nature?....Variable Speed Transmission Devices....Supplies of Gasoline....Tenders Wanted.
Editorial 48
The Eternal Question....Buying Coal on a Heat Basis.
Association and Personal 49
The Operators' Point of View 50-53
Does a Piston Stop at Reversal?....A Piston Does Stop at Reversal.... Securing Gas-tight Piston Rings.... Packing Economies....A Water Level Alarm....Readers' Queries.... Machine Oil vs. Automobile Oil....Oiling Machinery.
Operators' Instruction Course 54
Education Paper—V.
Progress in New Equipment 55
Selected Market Quotations 56
Trade Gossip, Catalogues (Advtg. Section) 46-48

THE ETERNAL QUESTION

WITHOUT artificial heat, man, as he is to-day, could not exist in the greater part of the temperate zones of the earth—that is those portions having moderate extremes of heat and cold. Without power, man, in the present condition of the world's population, could not maintain civilization in its present high degree of advancement. Light could be dispensed with to a great extent if man cared to subdue his desires for many artificial features of our existence.

Heat and power are just as essential to the continuity of life on this planet as a supply of fresh air, food and water is.

The sources of these two vital elements become increasingly valuable as time passes. Coal is simply a substance which gives forth heat under specific conditions. Its extent is limited within approximately known amounts, and, when exhausted, can not be replaced. It is not a source of heat in the same sense that a spring is the source of a river.

A real source of power is that medium or relation of natural forces whose operation is continuous in periodical regularity and will continue so, short of some cataclysmic occurrence which would completely alter climatic conditions on the earth.

The symbol of man's future existence and his natural heritage is the waterfall. Simple streams of water drawn toward the earth by gravity are, in the final analysis, mankind's salvation. Unknown discoveries may yet make available other methods of utilizing the energy of the sun for the benefit of man, but the continual, vast and unchangeable process of evaporation and condensation will for centuries to come be the source of energy wherewith man can maintain his present conditions of life.

An economic feature of hydro-electric power generation as opposed to steam electric is the absence of complexity in the apparatus. The advent of the steam turbine removed much of the complication found in reciprocating engines but the questions of fuel supply, handling and combustion remain with their respective losses due to carelessness of operation, types of equipment and inherent and unavoidable features of existing conditions. In the case of hydraulic power generation the percentage of efficiency is largely, though not all, fixed by the excellence of design in general plant layout and the maintenance of such at a high level involves less manual labor and consumption of stores as well as the absence of heavy losses which can be sustained through careless boiler house operation and lack of upkeep in steam engine efficiency.

BUYING COAL ON A HEAT BASIS

THE purchase of coal on a basis of contained heat units appeals to the engineer who is accustomed to judging the majority of materials on an efficiency basis. As a standard of value it is the only correct method of classifying fuels apart from types such as hard, soft, etc., each of which has individual characteristics rendering it more or less suited for specific purposes.

It is stated that since 1906 the $8,000,000 worth of fuel purchased annually by the United States Government has been bought on B.t.u. and chemical bases, and it is suggested that our own government might well adopt such a plan in buying over $1,000,000 worth of coal yearly. Where large amounts such as these are dealt with, the system is equitable as the producer must have a production large enough to allow inequalities of cost, etc., to balance up.

As the better grades get exhausted, they cost more to mine, and relatively may give the producer a smaller profit per ton than a lower grade easily mined coal which can be sold on the open market at ruling prices irrespective of its efficiency as a heat producer.

The root of ultimate trouble is the fact that coal is not a manufactured product and must be accepted as Nature made it. Perhaps when national fuel control is an accomplished fact, the manipulation of coal for by-products will enable a standard fuel to be made available which will possess a nearly uniform heat content and avoid many inconsistencies which would arise if the heat basis were adopted on a wide scale at present.

Association and Personal

M. J. Beatty, of Beatty Bros., Fergus, Ont., has been elected a director of the company. He succeeds the late G. P. Scholfield.

W. H. A. Fraser, of Fraser & Co., and director of the Hull Power Co., died at his home in Ottawa on Feb. 4. Mr. Fraser was born at Westmeath, Ont., in 1863.

Edward G. Mack, managing director of the Crouse-Hinds Co. of Canada, Ltd., Toronto, has been elected to the executive council of the Toronto Board of Trade for the ensuing year.

Flight Lieut. Ralph Gordon Hall, of the Royal Flying Corps, was accidentally killed whilst flying in Birmingham, England, on Jan. 22. His father is Thomas Hall, president of the Hall Engineering Works, Montreal.

William Allan Foley, who for seven years was superintendent for Goldie & McCulloch Co., Galt, Ont., died in that city on Jan. 27, in his 75th year. The deceased had lived in Galt over fifty years.

Lloyd Harris, president of the Russell Motor Co., who has been associated with the British War Mission in Washington for several months, has been appointed chairman of the Canadian War Mission in that city.

W. F. Tye, of Montreal, president of the Sterling Coal Co., Toronto, and former chief engineer of the C.P.R., has been named a member of the Commission of conservation to succeed the late Sir Sanford Fleming.

Sir John Wolfe, Barry, widely known engineer, officer of numerous engineering and allied societies, member of the army railway council and consulting engineer to many railway and public works corporations, died in London on Jan. 23. He was born in 1836.

F. F. Backus, general manager of the Toronto, Hamilton & Buffalo Railway, with headquarters at Hamilton, has been appointed railway traffic expert in charge of traffic at the Canadian terminals on the Niagara frontier. The position has been created by the Canadian Railway War Board for the purpose of supervising and expediting freight traffic from the United States.

William A. Noble, chief engineer at the Normal School, Toronto, for the past twelve years, died suddenly on Monday morning at the home of his brother, Trustee Dr. John Noble, 219 Carlton Street. A few days ago he was seized with la grippe, which resulted in complications. The late Mr. Noble, who was born in Peel County 57 years ago, had spent the last twenty years in Toronto. He was a member of the Masonic order and a member of L. O. L. No. 140. The body will be interred at Mono Centre.

C. C. Curtiss, successor to E. L. Milliken as manager of the Cape Breton Electric Co., has arrived in Sydney, N.S., and will immediately take up his new duties. Mr. Milliken leaves early next week for Houghton, Mich., where he will manage another branch of the company's system. Mr. Curtiss was recently stationed in Texas where he was engaged in a similar capacity with Stone and Webster to that which he will occupy here.

PERMISSIBLE TEMPERATURE OF COAL PILES

THE permissible temperature which a coal pile can be allowed to attain, according to the "Travelers Standard," is 150 degs. F., this having been adopted in a number of cases as a standard and no serious trouble experienced so far as is known.

It is conceivable, however, that there might be an appreciable diminution in the calorific value of the coal if it were subjected to prolonged heating at a temperature approaching 150°, even though actual ignition did not take place. It is therefore recommended that a maximum temperature of 130 degs. F. be allowed, which will probably be safe under almost all conditions.

Under certain conditions a considerable rise in temperature may take place within a short time. A rise of this kind may stop before it reaches the danger point, but, on the other hand, it may continue and result in spontaneous ignition; therefore, if such a rise is observed, steps should be taken immediately to check it. A recent case is illustrative of the conditions that may cause such a sudden rise in temperature. At a certain plant a steam pipe passed through a coal pile, but it was not expected that this pipe would cause any trouble because it was heavily insulated with a covering of 85 per cent. magnesia. Nevertheless, a rapid rise in the temperature of the coal pile was noted (the coal at this particular plant being under close observation for the purpose of detecting possible heating), and thereupon the steam was shut off before the danger point was reached.

OPERATOR ORGANIZATIONS

British Columbia Association of Stationary Engineers, Vancouver.—Subordinate Lodges at Vancouver, Victoria, New Westminster, Cumberland, Merritt, and Fernie.

North-West Association of Stationary Engineers, Edmonton, Alta.

Manitoba Association of Stationary Engineers, Winnipeg.

Canadian Association of Stationary Engineers, Hamilton, Ont.—Subordinate Lodges at Montreal, Toronto, Hamilton, Ottawa, Brantford, Guelph, Kitchener, Chatham, Ont.; St. John, N.B.; Owen Sound, London, Stratford, Belleville, Kingston, Sudbury, St. Thomas, North Bay, Port Arthur, Sarnia, and Windsor, Ont. The executive officers of the C.A.S.E. Grand Lodge are as follows:—

Past President—W. G. Forbes, Montreal, Que.
President—R. F. Gofton, Kitchener, Ont.
Vice-President—Wm. Cooke, Belleville, Ont.
Treasurer.—A. W. Heath, Hamilton, Ont.
Conductor—S. Balmfirth, Toronto, Ont.
Doorkeeper—George Moll, London, Ont.
Secretary.—John H. Hale, Hamilton, Ont.

RELATION BETWEEN INDOOR AND OUTDOOR TEMPERATURE

INVESTIGATIONS involving the making of records of indoor and outdoor temperatures at regular intervals, and also the fluctuations of the temperature of the hot water used in the heating systems showed that for each degree drop in temperature outside an increase of 2° F. in the water temperature was sufficient to keep up the room temperatures. It was also shown that the lowest water temperature recorded 100° F., and the highest 160°, proved that the boiler capacity and the amount of radiation were sufficient.

Largest Locomotive in the World.—The greatest steam locomotive in the world has been put into service by the Baldwin Locomotive Works, Philadelphia, Pa. It is so gigantic that its boilers had to be made flexible at three different joints so that the locomotive could turn around a curve. It is more than 100 feet long and weighs some 450 tons. Twenty-four driving wheels, each standing as high as an average sized man, afford its traction. The driving wheels are distributed along the length of the locomotive in sets of four pairs, the wheels of each set being coupled together and driven by two giant steam cylinders. Under full steam the locomotive can exert an 83-ton pull on cars behind it, which means that it can easily haul a freight train two miles long and 23,000 tons in weight over an ordinarily good roadbed at an average of fourteen miles an hour, and possibly more. Bad roads will retard it only slightly.

The Operators' Point of View

DOES A PISTON STOP AT REVERSAL?

I WAS quite interested in the articles by R. W. Millar and W. F. Schaphorst on the subject of whether or not a piston stops on reversal. As Mr. Millar's query brought only one reply, and as no one undertook to diagram the problem, I decided to try to put another spoke in the wheel.

Personally I never had any doubt but that the piston stopped on reversal. With Mr. Schaphorst I thought that if it did not stop how could it ever start moving in an opposite direction and all in the same straight line?. The only question in my mind was: Did it actually stand at rest for even an infinitesimal length of time? As for giving a verbal solution of the problem I do not think that any one answer would satisfy everybody. From time to time we hear quite a bit about the personal element or the human factor as a variable and uncertain, but very important, item in economics, production, etc., and I am of the opinion that this element is the chief factor in the solution of this problem. By way of explaining my meaning I will cite the following two incidents.

Once when several of us were together, A made the assertion that a perfect circle had never been made. Most of us thought that circles perfect enough for all practical purposes could readily be drawn or laid out, but we finally consented that an "absolutely" perfect circle could not be made. We were expecting to be joined by a young Englishman whom A knew to have been acquainted with the noted Druids' Circle. This Englishman soon arrived, and a few minutes later A had directed the conversation in such a way as to lead the Englishman to mention the said Druids' Circle, and he incidently remarked on the stones that were placed so as to form a perfect circle. To this remark A replied: "We had just agreed a few minutes ago that a perfect circle was an impossibility." Of course some of us felt that some one had been duped, and I still believe that A had deliberately planned the catch.

In another instance a young man went to a manufacturer and ordered a perfect straight-edge three feet long to be made of glass. The manufacturer said "We cannot make it perfect, we may get it within a fraction of a light wave, but we cannot make it perfect. The young man asked what the price would probably be and (if I remember right), was told it would probably be about forty thousand dollars. Later it became understood that the straight-edge was not wanted for optical purposes, and that for the purpose for which it was wanted a variation of one thirty-second of an inch from perfect would not materially affect its usefulness. Under these conditions the cost of the straight-edge was but a small fraction of one per cent of the first named price.

The point which I wish to emphasize is that what to one man is true, straight, or perfect, may to another be very imperfect.

Aside from this, there is a more or less true saying that "You cannot convince a man until he convinces himself," and another that "A man convinced against his will is of the same opinion still." Therefore I would advocate that each sufficiently interested operator try this thing out for himself by the making and studying of diagrams such as I am about to describe. The study of small diagrams does not bring out the actual movements nearly so clearly as will large size diagrams carefully made.

One of Mr. Millar's stipulations is the assumption that there is no lost motion in the parts. Now, supposing that we have an engine with a two-foot stroke and a connecting rod five feet long from center to center of its bearings, it is obvious that if there is no lost motion the center of the crank pin will travel in a circle having a radius of one foot, the diameter of the circle being two feet. It is also obvious that if there is no lost motion, and if the piston remains absolutely without movement, the centre of the crank end bearing of the connecting rod can only move in the arc of a circle having a five foot radius or describing a portion of a circle, which if completed would be ten feet in diameter. Now if each interested operator will, with reliable beam compasses, using a fine-pointed pencil, draw upon a sheet of plain paper firmly held on a good drawing board or other plain surface a few curves having a five-foot radius and inside of each of these, draw a curve having a one-foot radius, he will, by noting to what extent they coincide as shown in Fig. 1, be able to study for himself the amount of movement of the piston while the crank is travelling past or near the crank end dead center. Fig. 2 shows a few curves having a five-foot radius and outside of each of these draw a curve of one-foot radius (the backs of the curves toward each other). One is thus able in the same way to study the movement of the piston while the crank is travelling past or near the head end dead center. These latter curves fall apart much quicker than do the former ones which shows that if the piston actually came to rest at each end of the stroke the period of rest would be shorter on the head end of the stroke than on the crank end of the stroke. It also shows that the speed at which the piston travels when just approaching or receding from the dead center at the head end of the stroke is greater than the speed at which it travels when just approaching or receding from the crank end dead center.

FIG. 1.

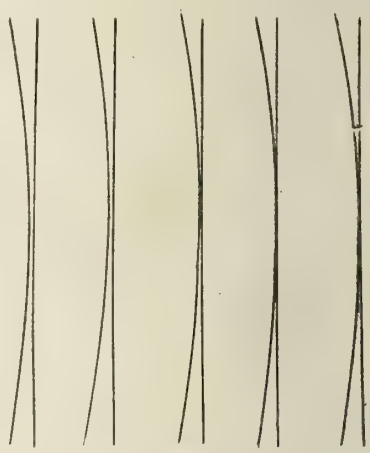


FIG. 2.

By drawing a number of curves as recommended above, one can have some

pairs made so that the two lines merge into one another at their centers, while in other pairs one can leave a small space between them which I think gives a better chance to judge of the actual amount of piston movement represented by their differences.

In the head end curves the back-to-back position will, by optical illusion, give the wider curves the appearance of having a straight portion near their centers, but by holding the paper nearly edgewise to the eye this illusion disappears and it is also then easy to see that no part of either curve forms a straight line, neither do they travel exactly parallel to each other for any distance. They merely, in a varying degree, approach to and recede from each other and can really coincide at one point only, thus indicating that the piston comes to a stop at this point but starts back again without resting. Mr. Millar would perhaps prefer not to use the term point, since according to geometry a point has no dimensions. If so, we can choose another though less convenient term approved of and used in geometry. We can speak of a degree or a fraction thereof.

We all know that there are three hundred and sixty degrees in every circle or circumference.

In the case of our two-foot circle the circumference in inches is $24 \times 3.1416 = 75.398$ ins., and one degree equals $75.398 \div 360 = .2094$ in., or just over one-fifth of an inch. There are sixty minutes in a degree and sixty seconds in a minute, so we can get down to pretty fine measurements by counting in seconds of a degree or fractions of one of the seconds, or we can speak of thousandths or other decimal parts of a degree if we prefer. It is here that the personal element or human factor feature comes into play, and I am of the opinion that the man who considers as perfect almost any circle carefully drawn with reliable compasses, or who would consider as perfect the cheaper one of those two glass straight-edges above mentioned, would also be satisfied that the piston remained at rest, while the crank was passing through an arc of one or two degrees at the crank end dead center.

On the other hand the type of man who considered that a perfect circle had never been drawn, or who required precision in a straight-edge even to a fraction of a light wave, or who delighted in extremes of micrometer precision in measurements would unhesitatingly assert that the motion of the piston was continuous, though not of uniform velocity. I also believe that so long as men differ thus widely in their ideas as to what constitutes exactness, just so long will there be a difference of opinion on this question, but I may be misjudging my fellows. At any rate this method of constructing diagrams affords to each an easy means of deciding the problem to his own satisfaction, for, given good instruments, he can bring into play all the scientific accuracy and all the hard practical common sense he considers it necessary to apply. There is also this added simplicity as compared with some other engine problems—there is no necessity for taking connecting-rod angularity into consideration. The angularity of the beam of the compasses used in describing the wider arcs sufficiently duplicates that of the connecting rod.

Perhaps after making and examining a few of the curves the following solution of the question may appeal to some. Improvise a definition something like this: The dead-center is an imaginary point, having no dimensions. Then state that the piston stops at the time when the crank is passing the dead-center. Finally claim that since the said dead-center has no dimensions, the piston does not stop long enough to have any period of rest between strokes.

Up to now I have been assuming that there is no lost motion, but of course this condition cannot be completely obtained in practice. We must have sufficient play to avoid undue friction with its attendant overheating and loss of available power for useful work. Given an engine having light reciprocating parts and a high degree of compression, the lost motion present may not really affect tse relative motion of the crank and piston to each other while passing the center since the compression forces the piston, when nearing the end of the stroke, to take up all the lost motion available. In the case of other engines, and in the case of a belted pump, for instance, the effects of lost motion are more noticeable. I believe, though, that it is needless to further dilate on this latter phase of the subject.

I would like to add, that where there is at hand a compass with a capacity of six or seven feet radius I would recommend that curves of over five feet radius be used in the diagrams. My own would not extend to six feet, therefore I used the five.

A PISTON DOES STOP AT REVERSAL

By W. Fletcher Shepherd

IN his revival of this time-honored controversy in the December 6th issue Mr. R. Hamilton attempts by an ingenious argument based on Euclid's definition of a line to prove that a piston—theoretically—does not stop at reversal. Euclid's definition of a line as having length but neither breadth nor thickness is now, however, regarded as insufficient for modern analytical mathematics. According to the modern mathematical conception a line is the trace or path of a point moving in space or in a plane and its breadth and thickness are infinitely small as compared with its length.

That this conception is based on sound reasoning a moment's consideration will show. A point on a body moving along any path or line must pass through a multitude of points so that the line itself is composed of an infinite succession of points. If then a point has no dimensions at all no progress could be made along the line since if nothing be added to nothing the sum is nothing no matter how often the process be repeated.

Now it appears to the writer that the piston problem can be very simply settled by a close observation of the pin joining the connecting rod to the crank. The path of the crank pin center is a circle and in a well balanced engine the crank pin moves around its entire circular path with practically no lost motion. Its reciprocating motion, however, in the direction parallel to the piston axis varies in acceleration and speed from a maximum at the middle of the piston stroke to zero at each end of the piston stroke. We also observe that at each end of the piston stroke the crank pin centre crosses the piston axis at right angles and can therefore at that instant have absolutely no movement in either direction along that axis. The breadth of that axis may be infinitely small and the time consumed in crossing it infinitely short but the essential fact remains that there is an instant when the crank pin has absolutely no movement in either direction along that axis and this is true irrespective of the speed of the engine.

Now since the crank pin is linked to the piston the latter also at that instant can have absolutely no movement in either direction along its axis and since these are the only directions in which it can move the piston must therefore for that instant be at rest.

SECURING GAS-TIGHT PISTON RINGS

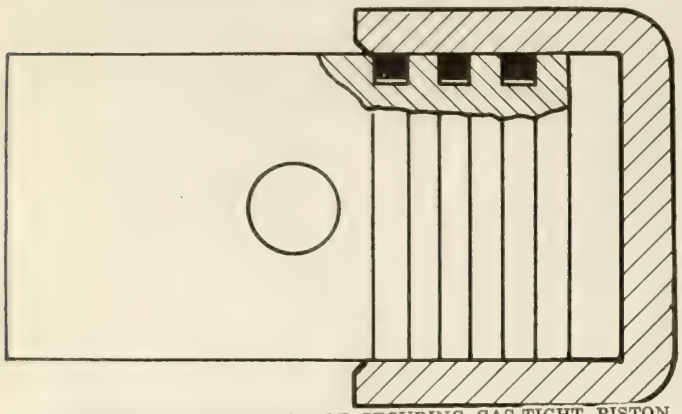
By A. L. Loy.

TROUBLE is often experienced with the leakage of compression past the piston rings in gasoline engines. This is more often true with the cheaper makes of farm engines, on many of which the standard of workmanship is low. This leakage of compression quite naturally cuts down the power which the engine will develop as well as resulting in an increased fuel consumption. Needless to say it is extremely annoying at all times.

When the piston is being pushed back into the cylinder on the compression stroke the friction between the rings and the cylinder will naturally retard their movement, and they will rest against the side of the groove toward the shaft, leaving a slight clearance on the opposite side. Now, if the side of the groove and ring as well is rough or uneven the metals will not come in contact completely around, allowing a small space through which the gases will pass. In manufacturing care is always taken to see that one side of the ring is well finished and the same is true in the piston. If these two surfaces are in contact a fairly tight joint may be obtained.

The method here described was seen by the writer in a small gas engine shop which had had trouble in securing perfect results along these lines, and it is well adapted for use in the repair shop also. A casting is bored out to just slip over the rings and piston, bevelled at the edge so the rings will enter easily. A thin mixture of emery flour and oil is

poured into the ring grooves and the casting slipped over, and, as it is pushed forward, it will carry all the rings in the same direction so they will rest against the sides of the grooves, when they may be ground to a seat the same as a valve, using a rotational movement. This method has worked out admirably, and has resulted in cutting down the rejections due to leaky rings and pistons.



ILLUSTRATING METHOD OF SECURING GAS-TIGHT PISTON RINGS.

PACKING ECONOMIES

IN the November number, J. M. talks about packing economies.

I remember a plant in which there were a great many cylinder heads to pack and as the heads had to be removed frequently, and the work was not always done carefully, the plant was a bonanza for the packing manufacturers. With a view to economy we tried asbestos yarn, but not exactly in the manner described by J. M.

We first applied shellac or varnish to the cylinder heads inside the bolt holes and then a few turns of asbestos yarn, being careful to get a turn close up to the part that projects into the cylinder in order to prevent a pocket for condensation, and having the outside turn just inside the bolt holes.

We did not wrap anything around the bolts or studs as that appears to be unnecessary. The shellac eliminated any worry as to the yarn staying in place. It stayed put.

We then painted the cylinder flange inside the studs with a mixture of plumbago and cylinder oil which enabled us to use the same joint repeatedly, saving packing and time. The pressure carried was at least 130 lbs., and asbestos is good for a considerably higher temperature than that to which it was exposed.

St. Catharines. R. McLAREN.

A WATER LEVEL ALARM

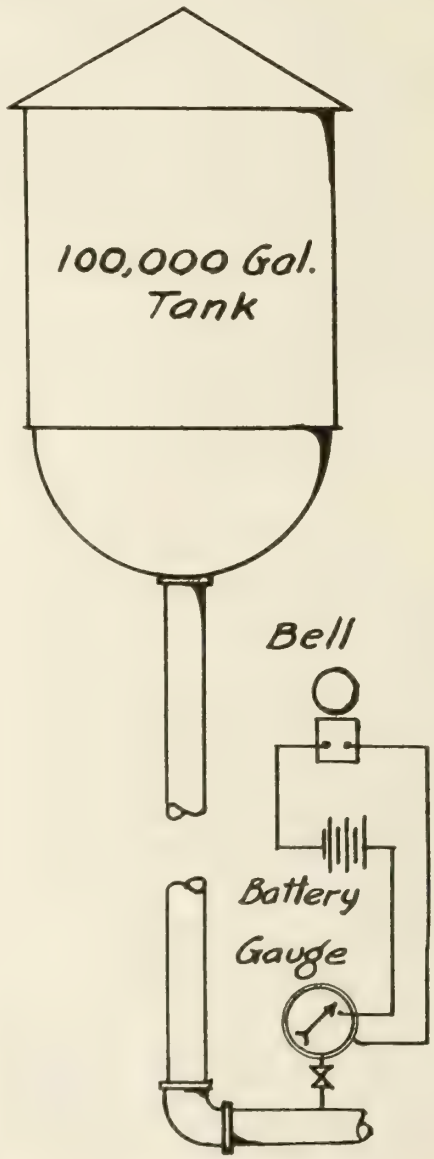
By Wm. Hall

HERE is an idea which I have tried out very successfully in connection with an overflow alarm for a water tank 175 feet high. Should this tank overflow, water would drop on a high tension line immediately below; the danger of this being apparent as the potential is 13,000 volts and the wires might easily be broken by the formation of ice.

As the pumps were in the basement an electrical alarm system was attached to the pressure gauge as shown in the accompanying illustration.

Gauge pressure corresponding to the water level in the tank is easily obtained by multiplying the height in feet by .424. This figures out at 45,-950 lbs. per square inch when the tank is full.

By the connection of an electric bell to the gauge quadrant and the arranging of same so that it rings when the pressure reaches 42 lbs. per square inch, the pump man is given due warning when the water level is about 3 feet from the top.



A WATER LEVEL ALARM.

WATER LEVEL ALARM

By James E. Noble

THE low water alarm shown by J. C. McDonnell in January POWER HOUSE reminds me of something along the same line, but simpler and more permanent in design and which obviates the disadvantage of being water soaked, even under extreme conditions, as where there is steam in the return.

Fig. 1 shows an outfit which is easily constructed and installed. A is one end of a bell and battery circuit, attached to any part of the iron tank. B is the other terminal fastened rigidly in any manner so long as it is insulated from the tank. C is a small iron counterweight and D is a copper float, these being connected by a fine wire cable E, which passes over the pulley F. This pulley is attached to the tank by the upright piece G.

When the water lowers, the weight C rises and connects with B, completing the circuit and ringing the bell. The float will not wander all over the water surface as the counter weight will keep it in its proper position at all times.

Fig. 2 shows another scheme which is very satisfactory. A 3 in. pipe is attached to the tank shown at B. A cylindrical float A has a thin wire attached to it passing through a wood or fibre guide piece C at the top of the pipe. The piece H insulates the wire from the metal bridge piece G-G. D and E are two branch wires from a lighting circuit and F is a red lamp placed in a convenient place.

When the water gets low the gap F F is closed and the red light shows.

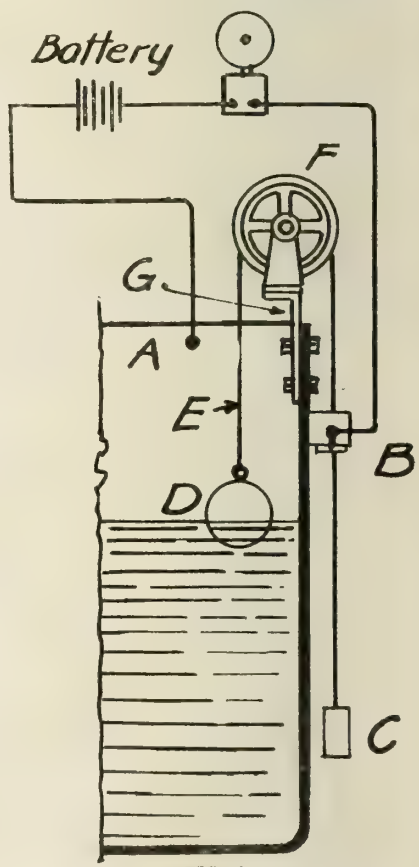


FIG. 1.

READERS' QUERIES

I HAVE a small direct current machine of about one K. W. capacity, 125 volts, and I want to use this machine for the purpose of charging 40 amp. hour. 6 volt storage batteries. Would you kindly give me a drawing showing the proper method of wiring, the position of meters, resistance, etc., and also let me know how many of the above batteries this machine would charge at one time. I can put any speed on this generator up to 1,750 r.p.m. Geo. F. Harrington.

Answer

It is assumed that the generator is shunt wound, this type in any case being the most satisfactory for the purpose and the 40 amp. hour rating of the batteries is also assumed to be at the somewhat standard rate of 5 amperes for 8 hours; 8 hours being the usual time on which discharge rate is based.

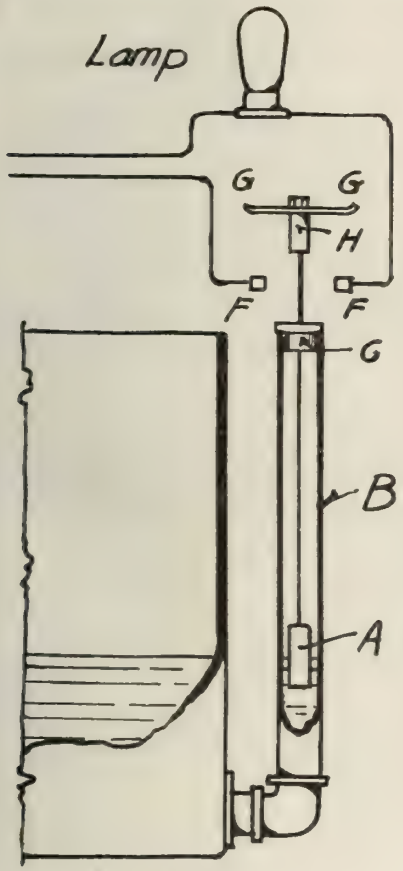


FIG. 2.

The approximate maximum charging voltage for the above batteries will be in the neighborhood of 2.5 × 3 = 7.5 volts per battery, which would give a possible number of 125 ÷ 7.5 = 16 batteries in series on one charge. Since the batteries, when on charge, will have an assumed charging current of about 5 amperes and since the generator has a capacity of 8 amps. at 125 volts it will be seen that there will be ample capacity for the purpose.

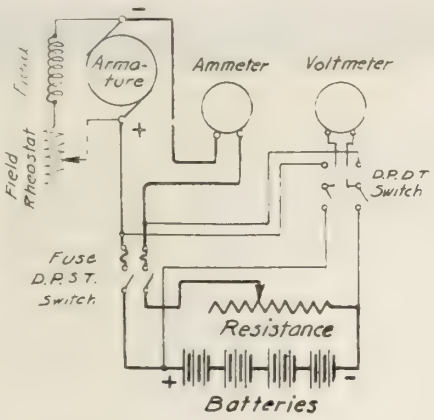
The resistance required in the rheostat in series with the cells, is given by

$$R = (E—2N) \div I.$$

Where:

I = charging current in amperes.
E = E. M. F. of generator.
R = resistance in ohms required.
N = number of cells.

Since it is supposed that it might be desired to charge one battery only at a time and since each battery will consist



of three cells, (N) will have a value of three, (I) will have a value of approximately 5 amperes and R = (125—6) ÷ 5 = 23.8 ohms. The rheostat therefore should have a continuous rated carrying capacity of at least 8 amperes, should have as a mixiumum resistance a value of 25 ohms and should have about ten to fifteen steps.

The ammeter should have a full scale reading of 10 amperes and the voltmeter should read from zero to about 150 volts.

The accompanying diagram gives connections suitable for charging any number of cells up to the maximum number allowed by the generator. It should be noted that the positive side of the generator is connected to positive side of the battery. After bringing the generator up to speed, measure the voltage of the cells and adjust the field rheostat of the generator, until the voltage of the latter is a few volts higher than that of the cells, before closing in the main switch. This precaution is of course only necessary when the number of batteries to be charged approaches the maximum number possible for the generator voltage. The resistance in the rheostat in series with the cells should be so adjusted in conjunction with that of the field rheostat as to give the proper charging current called for by the makers of the cells.

* * *

WE have a dry kiln of about 20,736 cubic feet capacity. How many lineal feet of 1 in. pipe would it require to heat the kiln up to 140 deg., using exhaust steam? Woul it be necessary to have a steam trap on this pipe, and, if so, what size? E. Towers.

Answer

THE number of lineal feet of pipe required will depend to a large extent on the shape of the dry kiln, but 6,500 lineal feet of 1¼-in. pipe, or about 8,300 lineal feet of 1-in. pipe would be about right. You would probably find the 1¼-in. pipe the more economical of the two.

The feed for the dry kiln would probably be tapped off your main exhaust line, in which case a trap would be advisable, the condensate being returned to a hot well for boiler feed if desired.

A trap capable of handling about 3,000 sq. ft. radiating surface would be right.

MACHINE OIL VS. AUTOMOBILE ENGINE OIL

By D. A. Hampson

A screw machine that had been running 1,800 R.P.M. was put on a brass job and its speed increased to 2,600 R.P.M. It gave continual trouble in the main bearings—heating up, sticking, stopping. Plenty of good "machine oil" had been used but that made no difference. When automobile engine oil was tried the the trouble stopped right away and the machine ran as well as at the lower speed.

OILING MACHINERY

INSTEAD of going over machinery with an oil can in hand it is now possible to oil it automatically. Geo M. Rogers, of Chicago, has invented an oiling apparatus which is operated by electricity and which can be put to work at any time by setting the mechanism just as one would set an alarm clock.

The oiler has a cup with an oil-feed opening in the bottom. An oilfeed pipe is connected with the cup and a plunger rod is so arranged that it gives vertical movement in the cup. A valve fitted at the lower end of the plunger fits the opening when the plunger rod is lowered. A guide pin extends downward from the valve and a gasket adapted to bear on the bottom of the cup when the plunger is lowered is arranged under the valve. The valve and plunger are operated by electricity.

If it is desired, an electric light may be included in the circuit which operates the oiler so the attendant may be able to watch the operation.

GRAPHITE REMOVES BOILER SCALE

IT IS claimed that boilers troubled with scale—especially when caused by magnesia—will not only cease to form scale, but will have gradually removed that already formed if a small amount of graphite is used with the feed water. The action on the magnesia in the water is to precipitate a mixture of magnesia and graphite in the form of a slime which may be easily washed out, while on the scale already formed the particles of graphite seem to work in between the scale and the steel, gradually loosening the scale as the treatment is kept up. In particularly bad cases the boiler should be inspected at the end of the first ten days and not less than every fifteen days thereafter for a couple of months. After this every thirty days will probably be sufficient.

Operators' Instruction Course

EDUCATION PAPER—V.

HOW many tons of work are performed by an ammonia condenser using 300 Imp. gals. of water per minute at 60° Fah., the water leaving the condenser at 90° Fah.?

Water flowing over the condenser at the above rate and under the above conditions carries $(90 - 60) \times 3{,}000 = 90{,}000$ B.t.u.'s per minute, or $90{,}000 \times 60 \times 24$ B.t.u.'s per 24 hours.

Since one ton of refrigeration necessitates the absorption of 284,400 B.t.u., the number of tons of work will be $90{,}000 \times 60 \times 24 \div 284{,}400 = 450$ tons nearly.

* * *

One hundred and sixty U. S. gals. of brine per minute are pumped through a brine cooler. The ingoing brine has a temperature of 35° Fah. and the outgoing brine 15° Fah. How many tons of work?

Taking the specific heat of brine solution as .9, the amount of heat given up by one pound of solution will be $(35 - 15) \times .9 = 18$ B.t.u. per min. The amount given up by 160 U. S. gals. will be $18 \times 160 \times 8\ 1\text{-}3 = 24{,}000$ B.t.u. per min., or $24{,}000 \times 60 \times 24$ B.t.u. per hour.

Since one ton of refrigeration necessitates the absorption of 284,400 B.t.u. the number of tons of work will be $24{,}000 \times 60 \times 24 \div 284{,}400 = 121$ tons nearly.

* * *

The temperature of liquid ammonia is 84° Fah. and the temperature of the brine in the cooler is 20° Fah. The liquid ammonia in order to evaporate must first be cooled from 84° to 80° Fah. This cooling takes place right behind the expansion valves where part of the liquid evaporates and extracts the heat from the remaining liquid. The latent heat of liquid at 82° Fah. is 502.9 B.t.u. nearly.

Assume that 100 lbs. of the ammonia has been cooled down from 84° to 80° Fah., the amount of heat absorbed by the cooling medium (evaporating ammonia) is $100 \times 1.0058 \times 4 = 402.32$ B.t.u.

This requires the evaporation of $\frac{402.32}{503.9}$ lbs. of ammonia—that is, a total of $100 + \frac{402.32}{503.9}$ lbs. of ammonia have to be passed through the system at this point to obtain 100 lbs. of the liquid ammonia. The percentage loss of liquid ammonia will be

$$\frac{402.32}{503.9} \div \left(100 + \frac{402.32}{503.9}\right) \times 100 = 0.79$$

A suction gas pipe, not insulated and passing through a room at 60° Fah., is causing a loss, as the pipe must be frosted to deliver saturated gas. How many B.t.u. are lost to condense and freeze one pound of moisture on the pipe?

To cool one pound of moisture from 60° Fah. to 32° Fah. requires approximately $60 - 32 = 28$ B.t.u.

To freeze it takes 144 B.t.u. more. Thus to place one pound of ice on the pipe will require $28 + 144 = 172$ B.t.u.

* * *

What will be the percentage of strength of a double-riveted joint of the following dimensions:—Thickness of plate, 7/16 in.; diameter of rivets, 13/16 in.; pitch of rivets, 2.708 in.?

The efficiency of a double-riveted lap joint is given by the following formulæ taken from the Ontario Steam Boiler Act:

$$Kt = (P - d) \div P$$
$$Ks = 2a \times C \div PT$$

Where $2a$ = area of two rivets in single shear.

C = a constant = Shearing strength of rivets per sq. in., divided by the tensile strength of the plate per sq. in.

C may be taken as:

.85 for iron rivets in steel plates.
.70 for steel rivets in steel plates.
.65 for iron rivets in steel plates.

Kt = efficiency of plate in joint.

Ks = efficiency of rivets in joint.

P = pitch of rivets in inches in outside row when calculating the efficiency of joints.

d = diameter of rivets after driving, equals diameter of rivet holes in joint.

T = thickness of plate in inches.

Substituting the values given in the problem or in the above formulæ, Kt is found to equal .7 and Ks is found to equal .61.

The efficiency of the joint will be governed by the lower of the above figures, and thus will be equal to 61 per cent.

* * *

A gusset stay is to support a surface 13 by 13 in.; it is ½ in. thick by 10 in. deep, and fastened to the plate with four ¾-in. bolts. What pressure will you allow on such a stay?

When gusset stays (attached to plate between two angle irons) are used their area should be 10 per cent. in excess of that required for diagonal stays, but as diagonal stays can be used in most cases where gusset stays can, they should be given the preference.

The working pressure allowed on gusset stays is calculated as follows:

$$\frac{Swt \times W \times T}{E} \times \frac{L}{H} \times .9 = B, \text{ where}$$

E = area in sq. inches of surface supported.

Swt = working tensile strength in lbs. per sq. inch.

W = width in inches of web of stay at narrowest part.

T = thickness of web in inches.

H = the length of stay.

L = the length of a line drawn at right angles from the surface to be supported to a point on this line at right angles to the end of the diagonal stay.

Substituting the values given in the above formula, and assuming that the gusset makes an angle with the shell of 30° (that is that H & L are in the ratio of 2 to 1.732, or $\frac{L}{H} = .866$), and further using for the width of the plate the net width between bolt holes, the value for B, or the working pressure, will be found to be:

$$\frac{11{,}000 \times \frac{1}{2} \times 6\frac{1}{2}}{13 \times 13} \times .866 \times .9 = 210$$

lbs. per square inch approximately.

The above shows that this gusset is amply strong in tension across the weakest part at the bolt holes, and it will be necessary to consider the value of the four ¾-in. bolts, which are assumed to be in double shear.

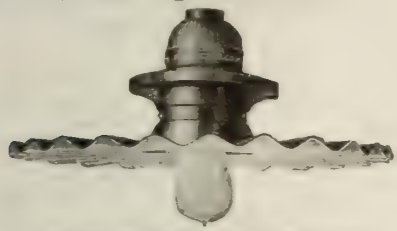
One ¾-in. bolt in double shear has a value of about 5,300 lbs., and so the total value of the four bolts will be $5{,}300 \times 4 = 21{,}200$ lbs., and the working pressure allowed from the above will be $21{,}200 \div 13^2 = 126$ lbs. per sq. in. which will govern, as it is less than the working pressure allowable for tension in the gusset plate itself.

The United States super-dread-nought Tennessee will be driven by four alternating-current motors, one to each propeller shaft, supplied by current at 3,400 volts from two 13,500 horse-power turbo-generators. The motors will be wound for both 36 poles and 24 poles, operating on the former as squirrel-cage machines and on the latter as wound-rotor machines.

Progress in New Equipment

HIGH TENSION STREET LIGHTING FIXTURES

WHEELER high tension series street lighting fixtures are designed to provide a high factor of safety with very substantial mechanical construction and convenient reflectors to properly centre the filament of the lamp so as to give the widest possible light distribution.



SHOWING COMPLETE FIXTURE

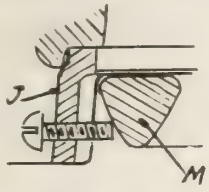
These are all built around the Wheeler high tension series porcelain receptacle head, which is a self-contained unit of high grade electrical porcelain having a spring clip series receptacle moulded in one piece with it, and so designed as to provide ample insulation with a wide margin of safety against accidental grounding on high tension circuits.

This head is supported by a cast iron canopy with three set screws in the lower edge of the skirt to firmly grip the insulator. It is threaded at the top for ¾-in. or 1¼-in. iron pipe, as may be desired, and plain or ornamental brackets of several designs are supplied, which are so constructed as to give ample support under wind stress even in exposed locations.

A cast iron skirt (J) securely bolted to the insulator has three set screws to support the different types of reflectors and globes used therewith. The reflectors

are flat and fluted to give the desired wide light distribution, and are drawn down with a deep neck to properly position the reflecting surface above the filament centre. These reflectors are attached by means of the set screws in the skirt, which pass through holes in the collar of the reflector and bear against a galvanized seating ring (M) with an inverted wedge shape cross section. The tightening of the set screws against this seating ring prevents the reflector from rattling in high winds, and thus prevents chipping of the enamel.

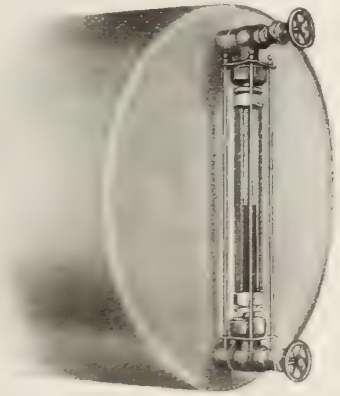
The insulator has ears on opposite sides moulded in one piece with the porcelain. These ears are pierced with holes, through which the lead wires are tied before entering the ports under-



neath the skirt of the insulator that lead to the terminals inside the head, or the wires may be brought down through the brackets directly to the terminals when the fixtures are used for concealed wiring.

SAFETY GAUGE GLASS

AN improved gauge glass is being manufactured by the Nason Manufacturing Co., 71 Fulton Street, New York, and several important advantages are apparent in its construction.



SAFETY GAUGE GLASS AND HOUSING

As will be seen from the illustration the glass is so enclosed and centered in its housing that it is immune from breakage caused by expansion and contraction, and should the glass become broken maliciously or through some unusual accident, the metal netting encasing it renders injury from flying glass fragments impossible. Each gauge-cock fitting is equipped with a ball valve which closes automatically should the gauge glass become broken. The above fitting is made in steel for ammonia refrigeration work and in bronze for steam conditions.

The safety gauge glass is sold with gauge fittings complete and is also sold separately for insertion in any standard gauge fitting at present manufactured.

LOSS OF HEAT BY RADIATION

A UNIQUE test for determining loss of heat by radiation from boiler settings and steam drums has been run by Mr. C. A. Eastwood, superintendent of Station A, Pacific Gas and Electric Company, San Francisco, Cal. For his experiment Mr. Eastwood selected a 560 h.p. B. & W. boiler, the steam drums of which were covered with one course of common brick. A rectangular can containing a measured quantity of water was placed on top of one drum and the boiler was run at its rated capacity for a period of three days. During this time the rise in temperature of the water was carefully noted, and with these data it was a comparatively simple matter to determine: (a) the amount of heat radiated per square foot of surface per hour; (b) the amount of heat radiated from the total exposed area of the drums; and (c) the quantity of fuel which was being burned to make up for this loss. Mr. Eastwood's figures showed that the loss totalled 390 barrels of oil per year.

To determine how much of this fuel-loss could be saved by the use of an effective heat insulating material, one 2½-inch course of Nonpareil Insulating Brick, manufactured by the Armstrong Cork & Insulation Company, Pittsburg, Pa., was then placed on top of the common brick covering and readings were taken as in preceding tests. The result showed that with the Nonpareil insulating brick in place the loss of heat amounted to 144 barrels of oil per year —a saving of 246 barrels, or 63 per cent. With oil costing 70 cents per barrel, the saving amounted to $172.20 per year.

In considering these figures there are two points in connection with them that might be mentioned. First, the total amount of heat lost represents that radiated from the steam drums alone; second, only 2½ inches of Nonpareil brick were used. Had the radiation from the exposed boiler walls been included as well, the total heat-loss would have been considerably increased. Furthermore, if the common brick had been removed entirely and replaced with a course of Nonpareil brick set on edge, giving 4½ inches of insulation instead of 2½ inches, a still greater saving would have been effected, since, according to tests, Nonpareil brick are said to be ten times better heat insulators than either common brick or fire brick.

SELECTED MARKET QUOTATIONS

A Record of Prices Current on Raw, Semi-finished, and Finished Materials Entering Into the Manufacture and Operation of Power Plant Equipment

BOILER TUBES

Size	Seamless	Lap-welded
1 in.	$36 00	$.....
1¼ in.	40 00	.....
1½ in.	43 00	36 00
1¾ in.	43 00	36 00
2 in.	50 00	36 00
2¼ in.	53 00	38 00
2½ in.	55 00	42 00
3 in.	64 00	50 00
3¼ in.	.....	58 00
3½ in.	77 00	60 00
4 in.	90 00	75 00

Prices per 100 feet, Montreal and Toronto.

PLATES

	Montreal	Toronto
Plates, ¼ to ½	$13 00	$12 00
Heads	13 30	12 30
Tank plates, 3-16 in.	13 65	12 10

WROUGHT PIPE

Effective Jan. 7, 1918.

Standard Buttweld.

Size.	Black Per 100 feet	Galvanized Per 100 feet
⅛ in.	$ 6 00	$ 8 00
¼ in.	5 10	7 23
⅜ in.	5 10	7 23
½ in.	6 46	8 03
¾ in.	8 17	10 29
1 in.	12 07	15 22
1¼ in.	16 33	20 59
1½ in.	19 53	24 61
2 in.	26 27	33 12
2½ in.	42 12	52 94
3 in.	55 08	69 23
3½ in.	69 92	86 94
4 in.	82 84	103 00

Standard Lapweld.

2 in.	29 43	35 71
2½ in.	43 88	54 11
3 in.	57 38	70 76
3½ in.	71 76	89 70
4 in.	85 02	106 28
4½ in.	96 52	121 29
5 in.	112 50	141 34
6 in.	145 90	183 36
7 in.	190 40	238 00
8 in.	200 00	250 00
8 in.	230 40	288 00
9 in.	276 00	345 00
10 in.	256 00	320 00
10 in.	329 60	412 00

Prices—Ontario, Quebec and Maritime Provinces

WROUGHT NIPPLES

4" and under, 45%.

4½" and larger, 40%.

4" and under, running thread, 25%.

Standard couplings, 4" and under, 35%.

4½" and larger, 15%.

IRON PIPE FITTINGS

Malleable fittings, class A, 20% on list; class B and C, net list. Cast iron fittings, 25% off list. Malleable bushings, 25 and 7½%; cast bushings, 25%; unions, 45%; plugs, 20% off list. Net prices malleable fittings: Class B black, 24½c lb.; Class C black, 15¾c lb.; galvanized, Class B, 34c lb.; Class C, 24½c lb. F.O.B. Toronto.

COLD ROLLED SHAFTING.

At mill ..... list plus 40%

At warehouse ..... list plus 50%

Discounts off new list. Warehouse price at Montreal and Toronto.

FINISHED IRON AND STEEL

Per lb. to Large Buyers	Cents
Iron bars, base, Toronto	$5 25
Steel bars, base, Toronto	5 50
Steel bars, 2" to 4" base	6 00
Iron bars, base, Montreal	5 25
Steel bars, base, Montreal	5 50
Reinforcing bars, base	5 50
Small shapes	5 75

SHEETS

	Montreal	Toronto
Sheets, Black, No. 28.	$ 8 50	$ 8 50
Sheets, Black, No. 10.	12 00	12 00
Canada plates, dull, 52 sheets	9 00	9 00
Canada plates, all bright	10 50	10 50
Apollo brand, 10¾ oz. galvanized	....	....
Queen's Head, 28 B.W.G.	....	....
Fleur-de-Lis, 28 B.W.G.		
Gorbal"s Best, No. 28.		
Colborne Crown, No. 28	....	....
Premier, No. 28 U.S.	9 45	9 45
Premier, 10¾ oz.	9 75	9 75

PROOF COIL CHAIN B

¼ in.	$12 00
5-16 in.	11 50
⅜ in.	11 15
7-16 in.	10 90
½ in.	10 70
9-16 in.	10 70
⅝ in.	10 50
¾ in.	10 40
⅞ in.	10 25
1 in.	10 10
Extra for B.B. Chain	1 20
Extra for E.B.B. Chain	1 80

ELECTRIC WELD COIL CHAIN B.B.

⅛ in.	$15 50
3-16 in.	11 70
¼ in.	8 40
5-16 in.	7 40
⅜ in.	6 35
7-16 in.	6 35
½ in.	6 35
⅝ in.	6 35
¾ in.	6 35

Prices per 100 lbs.

FILES AND RASPS

	Per Cent.
Great Western, American	50
Kearney & Foot, Arcade	50
J. Barton Smith, Eagle	50
McClelland, Globe	50
Whitman & Barnes	50
Black Diamond	37½
Delta Files	37½
Nicholson	37½
Globe	50
Vulcan	50
Disston	50
P.H. and Imperial	50

OILS AND COMPOUNDS

Castor oil, per lb.	52
Royalite, per gal., bulk	17
Palacine	20
Machine oil, per gal.	26½
Black oil, per gal.	13
Cylinder oil, Capital	45½
Cylinder oil, Acme	36½
Standard cutting compound, per lb.	06
Lard oil, per gal.	2 50
Union thread cutting oil antiseptic	88
Acme cutting oil, antiseptic	37½
Imperial quenching oil	39½
Petroleum fuel oil	13½

BELTING—No. 1 OAK TANNED.

Extra heavy, single and double	30-5%
Standard	40%
Cut leather lacing, No. 1	$1 95
Leather in sides	1 75

COAL AND COKE.

Solvay Foundry Coke	.....
Connelsville Foundry Coke	.....
Steam Lump Coal	.....
Best Slack	.....

Net ton f.o.b. Toronto.

BOLTS, NUTS AND SCREWS

	Per Cent.
Coach and lag screws	25
Stove bolts	55
Plate washers....list plus	20
Machine bolts, 7-16 and over	net
Machine bolts, ⅜ and less	10
Blank bolts	net
Bolt ends	net
Machine screws, fl. and rd. hd., steel	27½
Machine screws, o. and fil. hd., steel	10
Machine screws, fl. and rd. hd., brass ....add	20
Machine screws, o. and fil. hd., brass ....add	25
Nuts, square blank ....add	$1 50
Nuts, square, tapped....add	1 75
Nuts, hex. blank ....add	1 75
Nuts, hex. tapped ....add	2 00
Copper rivets and burrs, list plus	30
Burrs only list plus	50
Iron rivets and burrs	15
Boiler rivets, base ¾" and larger	$8 50
Structural rivets, as above	8 40
Wood screws, flat, bright	72½
Wood screws, O. & R., bright	67½
Wood screws, flat, brass	37½
Wood screws, O. & R., brass	32½
Wood screws, flat, bronze	27½
Wood screws, O. & R., bronze	25

MISCELLANEOUS.

Solder, strictly	0 39
Solder, guaranteed	0 43
Babbitt metals	18 to 70
Soldering coppers, 3 to 6 lbs.	0 64
Putty, 100-lb. drums	4 55
White lead, pure, cwt.	15 20
Red dry lead, 100-lb kegs, per cwt.	15 50
Glue, English	0 35
Gasoline, per gal., bulk	0 31½
Benzine, per gal., bulk	0 30½
Pure turpentine, single bbls., gal.	0 74
Linseed oil, raw, single bbls.	1 36
Linseed oil, boiled, single bbls.	1 39
Lead wool, per lb.	0 15
Plumbers' oakum, per cwt.	9 00
Sandpaper, B. & A....list plus	20
Emery Cloth....list plus	20
Sal Soda	0 03½
Sulphur, rolls	0 05
Sulphur, commercial	0 04½
Rosin "D," per lb.	0 03
Rosin "G," per lb.	0 03½
Borax crystal and granula	0 13
Wood alcohol, per gallon	1 80
Whiting, plain, per 100 lbs.	2 20

COPPER PRODUCTS

	Montreal	Toronto
Bars, ½ to 2 in.	$55 00	$48 00
Plain sheets, base 16 oz. and heavier	56 00	48 00
Copper sheet, tinned, 14x60 in., 14 oz.	60 00	60 00
Copper sheet, planished, base 16 oz. and heavier	64 00	49 00
Braziers' in. sheets, 6x4 base	55 00	48 00
Tubing T.P.S., base ¾ in. up to 3 in.	60 00	60 00

Above prices are full sheets and bars. Cut sheets and bars are 5c per lb. higher.

BRASS PRODUCTS.

Brass rods, base ½" to 1" rd.	$0 43
Sheets 24 oz. and heavier base	0 48
Brass tubing, seamless	0 55
Tubin, I.P.S., 1" base	0 55

POLISHED DRILL ROD.

Discount off list, Montreal and Toronto	Net

RUBBER BELTING

Standard	10%
Best grades	15%

WASTE

White.	Cents per lb.
XXX Extra	21
Peerless	21
Grand	19¾
Superior	19¾
X L C R	18½
Atlas	18½
X Empire	17¼
Ideal	17¼
X press	16
Colored.	
Lion	15
Standard	13½
No. 1	13½
Popular	12
Keen	10½
Wool Packing	
Arrow	25
Axle	20
Anvil	15
Anchor	11
Washed Wipers	
Select White	11
Mixed colored	10
Dark colored	09

This list subject to trade discount for quantity

MILLED PRODUCTS

	Per Cent.
Set screws	25
Sq. & Hex., Head Cap Screws	20
Rd. & Fil Head Cap Screws	Net
Flat & But. Hd. Cap Screws plus	Net
Fin. & Semi-fin. nuts up to 1 in.	25
Fin. and semi-fin. nuts, over 1 in., up to 1½ in.	20
Fin. and semi-fin. nuts, over 1½ in., up to 2 in., list plus	10
Studs	20
Taper pins	40
Coupling bolts, pins	10
Planer head bolts, without fillets ....list plus	10
Planer head bolts, with fillet list plus 10 and	10
Planer head bolt nuts, same as finished nuts.	
Planer bolt washers	net
Hollow set screws..list plus	20
Collar screws...list plus 30,	10
Thumb screws	20
Thumb nuts	65
Patch bolts ....add 40,	10
Cold pressed nuts to 1½ in.	add $4 50
Cold pressed nuts over 1½ in. ....add	$7 00

METALS

	Montreal	Toronto
Lake copper	$31 00	$32 00
Electro copper	31 00	32 00
Castings, copper	30 00	31 00
Tin	77 00	80 00
Spelter	10 50	10 50
Lead	9 75	9 00
Antimony	18 00	18 00
Aluminum	65 00	62 00

Prices per 100 lbs...

ROPES AND PACKING

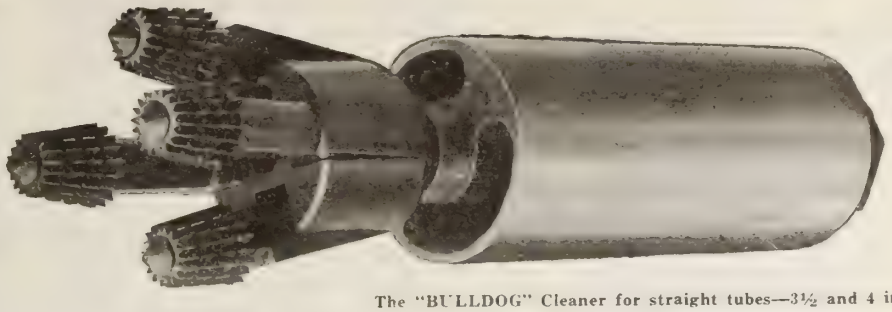
Packing, square braided	0 34
Packing, No. 1 Italian	0 40
Packing, No. 2 Italian	0 32
Pure Manila rope	0 39
Transmission rope, Manila	0 45
Drilling cables, Manila	0 41

LEAD SHEETS

	Montreal	Toronto
Sheets, 3 lbs. sq. ft. lb.	$12 00	$13 25
Sheets, 3½ lbs.	12 00	13 25
Sheets, 4 to 6 lbs.	13 00	12 50

Cut sheets, ¾c per lb. extra.

Cuts sheets to size, 1c per lb. extra.



The "BULLDOG" Cleaner for straight tubes—3½ and 4 in. sizes

Engineer Duke was so sure of his "Bulldog's" ability that—

but read this fact story yourself

Frank K. Duke is a prominent Philadelphia engineer. At a plant near his own they decided to buy a boiler tube cleaner that was not a "Bulldog."

Mr. Duke had a "Bulldog" and to him it was the *only* tube cleaner worth having.

"Hold on!" he said to his neighbor. "Try another make of cleaner if you want to but try my 'Bulldog' in comparison with it—and don't buy before you do try."

He actually sent his "Bulldog" Cleaner over to them, loaned it to them for the trial—

And as usual, the "Bulldog" Cleaner proved its superiority. It emerged from that trial indisputably the winner.

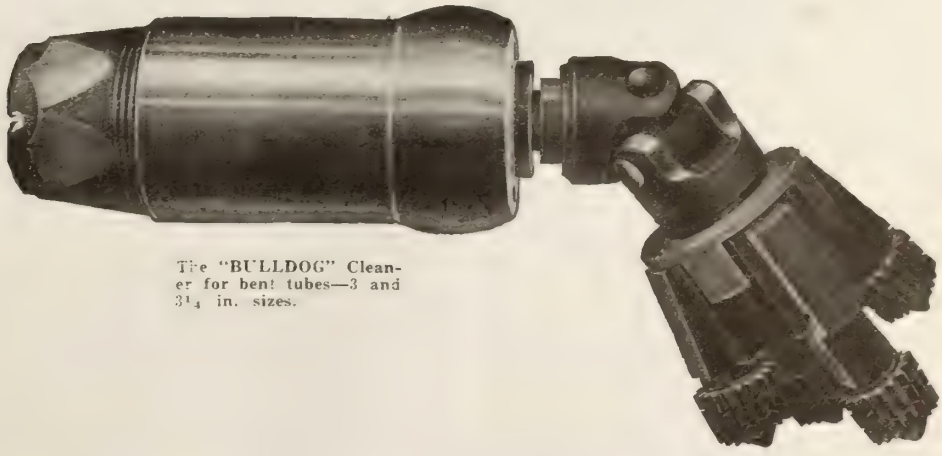
We don't know of any more convincing experience than this in proving not only that the "Bulldog" is as good a scale remover as you'll find anywhere, but also that no one appreciates that fact so well as the engineer who uses a "Bulldog." When are you going to purchase yours?

If you want some real definite information on scale fighting, send for our Catalogue "H." It describes the "Bulldog," also all types of Liberty Cleaners—a Cleaner for every purpose and every condition.

Liberty Manufacturing Company

6904 Susquehanna Street

Pittsburgh **Pennsylvania**



The "BULLDOG" Cleaner for bent tubes—3 and 3¼ in. sizes.

Trade Gossip

Mitchell, Ont.—The Town Council are contemplating installing a gasoline engine and pump.

Brandon, Man.—The City Council contemplate installing a new pumping plant at the municipal waterwarks.

Port Colborne, Ont.—Town Council contemplate the installation of a waterworks plant and pump equipment.

Port Colborne, Ont.—The Town Council contemplates the installation of a waterworks pumping plant and equipment.

Merritton, Ont.—The Riordon Pulp & Paper Co. will instal power equipment at the mill here. Head office, Montreal.

Nelson, B.C.—The Waneta Power Co. is engaged in the development of a large water power on the Pend d'Oreille River, south of Nelson.

Norwich, Ont.—Town Council propose enlarging the pump house and installing additional pump at a cost of $4,000. Engineer, F. J. Ure, C.E., Woodstock.

The Elliott Co., manufacturers of power accessories, have disposed of their office building in Pittsburg, Pa., and have taken a spacious suite of offices in the Frick Building in that city.

The Liberty Manufacturing Co., manufacturers of boiler tube cleaners, have removed their offices from Susquehanna street to the Frick Building, Pittsburg, Pa.

Airplane Engine a Success.—The first of one thousand aeroplane engines being built in Toronto was satisfactorily tested recently. The engines are being constructed at the plant operated by the Imperial Munitions Board.

Newboro, Ont.—A by-law has been passed giving the contract to J. P. Tett & Bros., for supplying electric light to the village. Power will come from Bedford Mills.

Penticton, B.C.—The City Council contemplate an expenditure of $20,000 for the construction of certain works in connection with the domestic water system and $35,000 for works in connection with the irrigation system.

Guelph, Ont.—Damage to the extent of about $3,500 was done by fire, smoke and water at the building owned by the Light and Heat Commission on Huskisson Street on Jan. 30. The loss is covered by insurance.

New Ross, N.S.—The mill and all the equipment of the Nova Scotia Manganese Co. at New Ross was completely destroyed by fire on Jan. 26. The loss cannot be replaced with less than $100,000 and there was only a few thousand dollars insurance.

Prince Rupert, B.C.—W. P. Hinton who was here recently, says that the Grand Trunk Pacific will spend $250,000 in Prince Rupert this year on a brick railway station to meet all requirements for ten years; machine shops and round house at Cameron Cove, and a 1,000-foot wharf.

Brantford, Ont.—Immediate Hydro power for Brantford Township has been promised the council of the municipality by Engineer Gaby, of the Ontario Hydro Commission.

Toronto, Ont.—The Ontario Wind Engine & Pump Co. has taken out a permit for the erection on the corner of Atlantic and Liberty Avenues of a steel and iron sila factory to cost $4,000.

Montreal, Que.—An influential deputation from Sault Ste. Marie, Ont., came to the city to interview F. W. Clergue, president of the Universal Transmissions, Ltd., regarding the construction of a shipbuilding yard and drydock at the Soo.

The Empire Waterworks Supply Co., of Winnipeg, has been awarded contracts from the Greater Winnipeg Water District for three 24-inch Rensselar gate-valves, all of the automatic air cluster valves and sluice gates, the latter being Coldwell and Wilcox.

Oxygen to Run Power Engine.—Production of motive power and light from the oxygen of the air at practically no cost except that of the original installation of the plant has been accomplished by Patrick K. Gallagher, of Nelson, B.C. For some years he has been working on his invention, and it has now reached the stage where he is developing an internal combustion engine, in which oxygen will take the place of gasoline, gas or oil.

Nelson, B.C.—The Waneta Power Co's big water-power plant on the Pend l'Orelle River, south of Nelson, is nearing completion. Preliminary construction work has been in progress for some years, though the company has but recently been incorporated, with a capital of $1,500,000. Power will be supplied to industries of both sides of the international border.

Ottawa, Ont.—The City Council has made application to the Ontario Municipal Railway Board for a hearing in connection with a by-law to raise by way of debentures $250,000 for the purpose of establishing a municipal fuel depot. The Board instructed the applicant city to first pass the by-law as proposed, when a date for the desired hearing will be fixed.

Nanaimo, B.C.—The Nanaimo Gas Co. has taken over the Nanaimo gas works, with W. W. Lewis in charge. Plans are already in hand for the improvement of the gas works on an extensive scale, which will place the works in a first-class condition. The plant that will be installed will be up-to-date in every respect and will be able to fill the wants of the city.

Vancouver, B.C.—A new and important canning industry is promised British Columbia if plans of the Dominion Canners, Ltd., of Hamilton, Ont., are consummated. Three sites here are now under consideration of the directors of the company, four of whom are now here personally looking over the ground with a view of establishing their second plant in British Columbia.

Niagara Falls, Ont.—The Hydro Commissioners of Ontario have agreed to let the City of Niagara Falls tap the new pipe which is being laid with a 24-inch main, which will give this city all the water it needs for many years to come. At the same time this will only be a temporary arrangement, as the city is negotiating with the Hydro for a permanent supply from the Power Canal being constructed.

Windsor, Ont.—It is likely that before long the Hydro Commission will purchase the Essex County Light and Power Co.'s plant and business. The plant is at present owned by the Detroit Edison Co. of which Alex Dow is president. This company supplies power to Windsor, Walkerville, Sandwich and Essex. Negotiations for the purchase have been proceeding for some months, but the deal has not been completed yet. The price will be likely around $200,000.

Niagara Falls, Ont.—Work is already well started upon the new pipe which is to supply 50,000 more horse-power for the Hydro. The pipe, which is 13½ feet in diameter, is to be run through Queen Victoria Niagara Falls Park. The work on the Chippawa-Queenston Hydro Canal is proceeding in spite of the severe weather, though it is exceedingly difficult to get men to stay on the job. As soon as weather conditions prove more favorable the Hydro engineers will put a new impetus on the job. The railway along the power canal is progressing and preparations are being made for dredging.

Hamilton, Ont.—The local Hydro Board has decided to reduce the power consumption here by the drastic method of cutting off non-essential industries one day a week. Hamilton is about 1,500 kilowatts short of its requirements, and it was thought that by cutting off certain industries rotation for one day a week this could be made up, and munitions plants and food-producing concerns could keep going without interruption. Several times of late all plants depending on Hydro have been cut off owing to this city having exceeded its limit, and it was thought this would be the most effective and most satisfactory way of meeting the situation.

Could Produce Much More Coal.—That the 10,000 miners of Nova Scotia could produce from 1,500 to 2,000 tons of coal more per day if "mechanical haulage" or more horses were used at the mines to remove the "mine boxes," was the statement of S. Barrett, President of the Amalgamated Mine Workers of Nova Scotia, who arrived in Ottawa on Monday to attend the joint conference of Canada's Labor delegates with heads of the Government. Mr. Barrett explained that he had come to Ottawa at the invitation of the Government to talk over increased coal production. He stated that it was his intention to bring to the knowledge of the Government the mode of mining coal, and he would suggest that more up-to-date methods be employed than having the men push out the mine trucks.

Brockville, Ont.—There are extensive peat fields adjacent to Brockville, which, if developed, would supply a want in the fuel shortage. Local interests have expended much in drainage and experimenting with drying processes without any material results. The Town Council is now petitioning the Ontario Government to take over the project.

Guelph, Ont.—A movement is on foot in this city to develop the unused power on the Speed River in the neighborhood of the Ontario Military Hospital. Several farmers have become interested in the scheme, with the hope that they may be able to secure power for use on their farms. It is understood that R. H. Clemens, district representative, is taking up the matter with the Hydro-Electric Power Commission, and an engineer will make an inspection soon.

Toronto, Ont.—Two whole townships, estimated to contain millions of tons of peat, have been set aside by the Ontario Government with a view to having them developed as a source of fuel for the province. The two townships are Hanna and St. John, lying on either side of the T. and N. O. railway, immediately south of Cochrane. In these townships, unsuitable for cultivation, examination has shown that the deposits of peat range in depth from six to forty or fifty feet in some places.

Chatham, Ont.—The Chatham Public Utilities Commission is considering the advisability of asking local manufacturers using Hydro power to operate their plants on night and day shifts in such a manner as to prevent any heavy peak loads at certain hours. The consumption of power in Chatham is considerably in excess of the allotment, resulting in the street lights being turned off at night and industries operating at night forced to economize. The normal consumption is 1,132 horse-power, while the city under the new orders is allotted 540 horse-power during the day and 940 at night.

Cornwall, Ont.—The St. Lawrence Power Co's. plant at the Sheiks Islands dam, which supplies electric power to several industries in Cornwall, is completely out of commission as a result of the high water. All local plants are shut down and this may last until the water recedes and repairs can be made. The water rose nine feet above the floor in the power house, putting the generators and transformers completely under its surface. Officials of the company stated that it would take at least a week to dry out their machinery and have it ready for action after the power house is cleared of water. The Stormont Electric Light & Power Co is doing all in its power to relieve the lighting situation in town by transferring their power wherever possible.

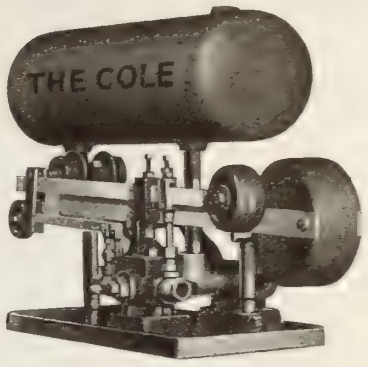
Saskatoon, Sask.—The contract has been let for the installation of the refrigeration machinery for the public co-operative cold storage system in Saskatoon being operated by the Saskatchewan Co-operative Creameries to the Canadian Ice Machine Co., of Toronto and Winnipeg. The total cost of the building and machinery will be about $125,000; of this amount the machinery alone will cost $60,000. The building has a total cold storage space of 206,000 cub feet. The machinery will comprise two 35-ton York compressors and condensers, electric motors, etc., equal to the cooling power of 70 tons of melted ice every 24 hours.

Niagara Falls, Ont.—Ice is causing considerable trouble in the power companies' plants here which has created a shortage of power for the Hydro-Electric Commission. The Hydro secures its power from the Ontario Power Co., the Canadian Niagara Co. and the Electrical Development Co. All these companies have had trouble with ice. One day recently there was a shortage of from five to ten per cent on the power from the Ontario Power Co. As the total capacity of the machines of this company is 160,000 horse-power this meant a shortage of from 8,000 to 16,000 horse-power. The amount of power that was available fluctuated throughout the day and at intervals of ten minutes there was only 50,000 horse-power available.

Gowganda, Ont.—The South Bay Power Co. will install a 500 h.p. electric unit and proceed with the diversion of the East Montreal River. The company fully expects to carry out its original plan, that is, to install a 1,500 electric horse-power plant at Hangingstone Falls, Gowganda Lake, for the purpose of supplying electric power to the mines at Gowganda. First, to install a 500-horse-power unit, part of the electric energy from same to be used to drive a tunnel to divert the East branch of the Montreal River into Hangingstone Lake, which will give water enough to develop an additional 1.000 horse-power. The Reeves-Dobie Mining Co. is assisting in the financing of the company for the purpose of securing electric power to operate their mine.

Sudbury, Ont.—The proposal of the British-America Nickel Corporation to secure Hydro power from a development plant on the French River has been definitely abandoned, owing to the prohibitive cost involved, according to a report current here. In consequence of this it is thought probable that the company will establish a refining plant in the neighborhood of Ottawa, where the Hydro-electric Commission has ample power at a low figure. Owing to the war all kinds of material have advanced in price, and it was estimated that power could not be developed on the French River under $40 or $50 per horse-power. The Hydro Commission, therefore, advised against the French River proposal and advocated the establishment of a nickel refinery in the Ottawa Valley. In the meantime, the British-America Nickel Corporation will likely install a steam plant at the Murray Mine to supply some of the power needed.

There is One Way to Save Fuel! Don't Burn It!



THERE is also another way to save it. That is by the installation of a "COLE" Return Trap System.

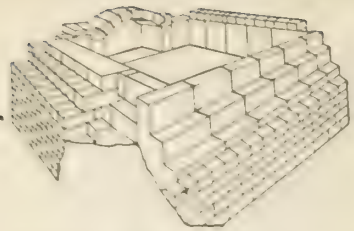
The fuel question is one of the most vital points in manufacturing to-day, and all means possible should be used to prevent its loss.

Send for a copy of our book "Steam Condensation," it may be of great help to you, and at any rate will cause no harm.

Remember! our engineering department is at your service.

Geo. W. Cole, Ltd.

2002 Dundas St. W.
TORONTO



Gates Boiler Furnace

Patented 1916

Will last three times as long as ordinary good grade Fire Brick. These blocks are inter-locking, and made so that any handy man or fireman can renew them without disturbing any of the other brick work.

WRITE FOR PARTICULARS.

John W. Gates St. James S MONT REA

CLASSIFIED ADVERTISING

RATES.

Two cents per word for first insertion. One cent per word for subsequent insertions. Count five words when box number is required. Each figure counts as one word.

CONSULTING ENGINEER

WITH 25 YEARS' EXPERIENCE IN THE following lines: Steam, mechanical, electrical, heating, ventilating and printing. Consultation, supervision and inspection. Fred J. Grant, 126 Denison Ave., Toronto. Phone College 210. p1h

SECOND-HAND ONE HUNDRED (100) horse-power locomotive boiler, and one seventy-five (75) horse-power Corliss engine. Both in first-class condition. Located at Atikokan, Ontario. Address Wm. M. O'Connell, 601 Merchants National Bank Building, St. Paul, Minnesota. (p2h)

Attention, Water Power Users

FOR SALE

Four standard 55-inch Crocker Turbine Water Wheels, fitted with graduating gates, complete with shafting, gears, etc. Wheels were manufactured by Jenckes Machine Company, and guaranteed to develop 150 H.P. when horizontal shaft is running at 150 R.P.M. when working under an effective head of four feet. Have never been used and are as good as new.

H. Corby Distillery Co., Limited

CORBYVILLE, ONTARIO (p3h)

NOW!

You've been going to and in that ad for weeks, so why not mail it now for next week's issue.

POWER HOUSE

143-153 University Ave. Toronto

The Canadian General Electric Co. has secured the contract for the entire electrical equipment of the Bennett-Martin Asbestos and Chrome Mines at Coleraine, Que. The Canadian Wire & Cable Co. of Toronto, will supply the wire for the transmission system.

Winnipeg, Man.—At the meeting of the Greater Winnipeg Water District last Thursday afternoon, on learning that C. G. Anderson, owing to the alleged delay in granting the contract for the gate house and intake at Waugh, refused to do the work, Controller Wallace, seconded by Controller Cockburn, moved that the contract be granted to the next lowest tenderer, whose price was $97,000, while Anderson had tendered for $90,000.

Joint Commission to Prepare Report.—The International Joint Commission created by Canada and United States in 1911 to consider the developing of water-power and securing adequate sanitation in rivers and streams jointly controlled by the two Governments met in New York on Feb. 4 to prepare its final report which will be submitted to the Dominion Parliament and to Congress. The text of the report, it was announced, will not be made public until it has been approved by both governments.

Hamilton, Ont.—Tenders will be received by the Board of Control, up to Monday, March 4, 1918, for supplying the city with the following materials: Castings (ordinary and special), iron pipe, hydrants, valves, extension boxes, hardware, lead pipe, pig lead, road oil, lubricating oil, flux, fuel oil, lumber, gasoline, brass work, including ordinary and special brass castings for the Water Department. Specifications and form of tender for all of the above can be obtained at the office of the City Engineer, Hamilton, Ont.

Melbourne, Australia.—Tenders for the following may be addressed to the Director of Navy Contracts, Navy Office, Melbourne: Supply, delivery and erection at Garden Island, of one (1) 200 horse-power prime mover set of either semi-Diesel type or other heavy oil engine direct coupled to 2-65 K.W. 240 volt D.C. electric generating set. All accessories, tank and fittings to be supplied by tenders as per specification. Date of closing June 7, 1918. Tender forms are open for inspection at the Department of Trade and Commerce, Ottawa. File No. 20117.

The Canadian Crocker-Wheeler Co. of St. Catharines, Ont., whose fiscal year ended Dec. 31 last, reports a favorable condition of affairs in 1917 in comparison with the 1916 period. A new machine shop and power house were completed during the year and R. A. Stinson, the vice-president of the company, announces that the outlook for business in 1918 is most encouraging. They have recently completed the equipment and re-tooling of their ordnance department for the manufacture of 75 mm. French shells for the American Government. The contract for these shells will keep this department busy at least eight months.

CATALOGUES

What It Means To You is the title of a bulletin being distributed to the trade by the Dodge Manufacturing Co., Toronto. The bulletin deals with the principal features of the Dodge standard wood split-pulleys and contains an illustration showing their construction. The bulletin contains a list of firms in Ontario who stock the Dodge transmission equipment.

Pumps for Any Service is the title of an 84 page catalogue just issued by Darling Brothers Ltd., engineers and steam specialists, 120 Prince street, Montreal. It describes in detail, both in illustrations and text, the many and varied lines of pumps and compressors manufactured by this firm. It also contains several pages dealing with important information for the benefit of intending purchasers of pumps. The book is well gotten up and is a credit to Darling Bros.

New Catalog of "Beaver" Tools.—The Borden Co., Warren, Ohio, has just issued its 1918 catalog of "Beaver" easy working die stocks and square-end pipe cutters. This catalog is said to be the finest tool catalog ever issued, and its attractive appearance indicates that no expense has been spared in securing the services of the best artists and printers. This book is printed in two colors, on high grade paper, and illustrates in a complete and artistic manner the complete line of the "Beaver" product. Several new "Beaver" tools are shown for the first time in this catalog—one of the most popular of these being the new No. 3 "Beaver" Junior ratchet die stock, which is built on the unit plan to thread pipe from ⅛ in. to 1 in. inclusive. While this expensive catalog is not intended for general distribution, the Borden Co. will undoubtedly send a copy to any of our readers who will write a letter or card stating that they are interested in "Beaver" tools.

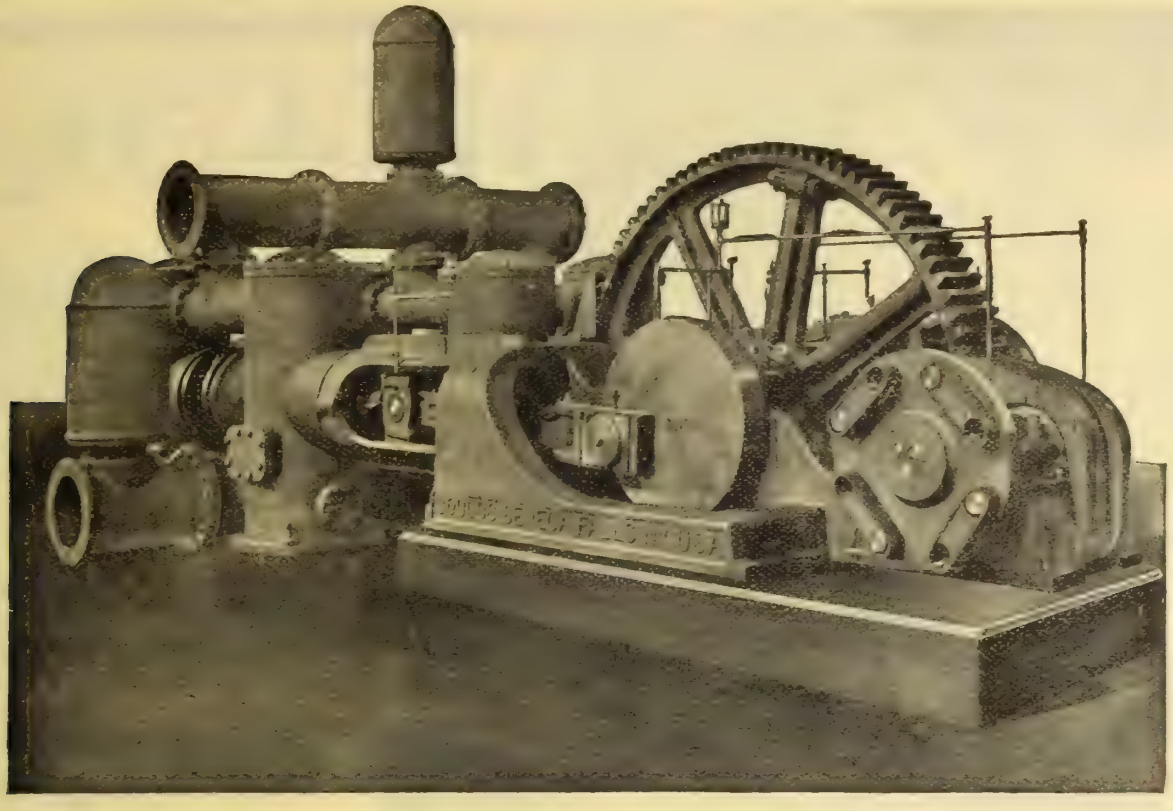
MONCRIEFF'S "UNIFIC" WATER GAUGE GLASSES

Stand in a Class by Themselves for Quality, Efficiency and Economy
A trial will convince you. Write for Catalog

W. J. WALL, 134-136 BLEURY ST., MONTREAL
(Canadian Representative)

THE CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED.

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS



Fairbanks-Morse Pumps
Goulds Pumps

Pipe
Valves
Fittings
Gaskets
Reducing Valves
Governors
Strainers
Bolts and Nuts
Belting
Pulleys
Shafting
Hangers
Motors
Engines
Tanks
Float Valves
Pump Valves
Unions
Lubricators
Packing
Regulators
Reseaters
Hose
Nozzles
Relief Valves

Isolated auomatic pumps, each driven by a 1/6 horse-power electric motor.

Portable forest fire gasoline engine pumping plants, each weighing 120 pounds complete and having a capacity of 20 gallons per minute, maximum pressure 120 pounds. Designed to be packed anywhere by man, horse or canoe.

Complete city water supply systems.

These outfits furnished by us, are all operating successfully. They are an incication of the rance of our line of pumps.

We supply pumps for any service.

"Canada's Departmental House for Mechanical Goods"

THE CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED.

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

St. John Quebec Montreal Ottawa Toronto Hamilton
Windsor Winnipeg Saskatoon Calgary Vancouver Victoria

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

DURABLA

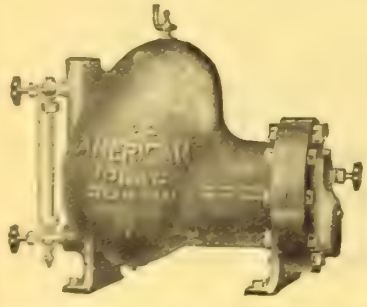
No defects in manufacture pass these men, who inspect every sheet.

The Durabla sheet is a quality sheet, and we guarantee every gasket cut from it to make a permanently tight joint.

Only quality promotes Efficiency. Only standardizing on the best proves true economy.

Durabla Mfg. Co.
NEW YORK
Distributors for Canada:
The Canadian Fairbanks-Morse Co., Limited

American Efficiency Demands That Fuel Be Saved



THE AMERICAN IDEAL STEAM TRAP will keep steam lines free from condensation.

Let us help you select the proper size for your particular needs.

Agents for Canada: CANADIAN FAIRBANKS-MORSE CO., Limited
Montreal Toronto Quebec

AMERICAN STEAM GAUGE & VALVE MFG. COMPANY
New York Chicago BOSTON Atlanta Pittsburgh

Penflex

FOR Steam or Air Drill, Pneumatic Tools, Boiler Flue Cleaning, Syphon Connections, Suction Lines.
For all kinds of Oil, Gasoline, Paints, Hydraulics, Gas.

"PENFLEX" METAL HOSE

INTERLOCKING

An all Metal Flexible Hose. Manufactured in Bronze or Galvanized Steel. Will withstand highest pressures. Is unsurpassed for durability and pressure resisting qualities.

Large Stock Carried in Canada

Pennsylvania Flexible Metallic Tubing Company - - Philadelphia, Pa.

Canadian Agents: The Canadian Fairbanks-Morse Co., Ltd., St. John, Quebec, Montreal, Ottawa, Toronto, Hamilton, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria.

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

In These Days of War Conditions

there may be plenty of coal at the mines, but it's the small amount of coal in your engine room and its high cost that makes it necessary that you should see that there is no loss of power by reason of steam leaking through poor packing in the stuffing box.

Then why not use "Palmetto," the packing that has behind it years of sustained reputation for long service under hard conditions.

You can test working samples of "Palmetto" under your own conditions at our expense.

May we send them?

Representatives in Canada:
The Canadian Fairbanks-Morse Co., Limited
St. John, Toronto, Quebec, Hamilton, Montreal, Ottawa, Vancouver, Victoria

Greene, Tweed & Co.

Sole Manufacturers
109 Duane Street
New York

TRADE MARK
"PALMETTO" PACKING

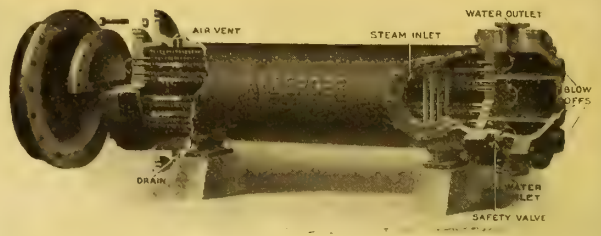
never fails to give long, satisfactory service, because it's made of those materials designed for extreme conditions.

THE CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED.

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

For these reasons

the Alberger



is *without* usual heater troubles

1. Alberger "floating" heads into which the tubes expand at one end of heater prevent all expansion strain.

2. Alberger tubes are of pure copper. Brass, although a good conductor of heat, is subject to segregation of materials, with a consequent result of splitting under temperature changes when drawn into tubes. Copper, free from this objection because a homogenous material, will last indefinitely.

3. All water and steam connections are on the body of our special grade cast iron shell and these connections need not be broken to secure access to the heating surface.

4. Alberger tubes are small and corrugated: *Small* because usage shows that small tubes transmit a much greater quantity of heat per square foot of heating surface than large tubes; *Corrugated* because usage shows that corrugated tubes transmit over 50% more heat than plain tubes of the same size.

Read with Profit Bulletin 201.

ALBERGER HEATER COMPANY, BUFFALO, N.Y.

GENERAL SALES AGENTS:
CANADIAN FAIRBANKS-MORSE COMPANY, Limited

St. John Montreal Ottawa Toronto Hamilton Quebec Calgary
Edmonton Vancouver Winnipeg Victoria

PRATT & CADY

VALVES
and
Asbestos Packed Cocks

PRATT & CADY Valves and Cocks have proven highly successful under conditions where other cocks and valves have failed. Put them to the test where the service is most severe.

Pratt & Cady Co., Inc.
Hartford, Conn.

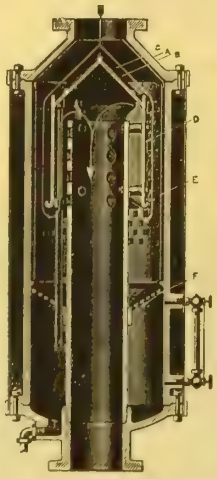
P&C Co

P&C Co

General Sales Agents
The Canadian Fairbanks-Morse Co., Ltd.
St. John, Quebec, Montreal, Ottawa, Toronto, Hamilton, Winnipeg, Saskatoon, Calgary, Windsor, Vancouver, Victoria.

III IMPORTANT THINGS

TO CONSIDER ABOUT A SEPARATOR.



I. **THE PLAN**—Is it sensible, will it work, no matter how large the Separator or how well made?

II. **THE SIZE**—Is it big enough regardless of plan, will it hold a good dose of water?

III. **THE CONSTRUCTION**—Is it strong enough, are flanges heavy, how will it look by the side of a nicely finished engine? Send for catalog and note these points in

Sweet's Separators

DIRECT SEPARATOR COMPANY
820 Geddes Street - SYRACUSE, N.Y.

General Sales Agents:
Canadian Fairbanks Morse Company, Limited
St. John, Montreal, Quebec, Ottawa, Toronto, Hamilton, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

GRATON & KNIGHT
Standardized Series
LEATHER BELTING

Tanned by us for belting use

GRATON AND KNIGHT

Coal---Power---Belts---Production

YOU invest your money in coal to get power—POWER—the basis of production. If power leaks out in transmission, it **never** becomes production.

That is why selection of the belting that will transmit the greatest amount of power is a vital matter. It does not receive the careful study which it demands.

First: Use **leather** belting—the material that guarantees least power leakage; that is standard for main drives; that stands the mauling of shifters; that can be easily spliced and repaired; that when partly worn can be cut down for narrower pulleys; that has greatest elasticity and pulley-grip.

Second: Don't select belting on specification. Select it on scientific adaptation to the **work to be done.** Right here is the reason for the superiority of Graton & Knight Standardized Series Leather Belting.

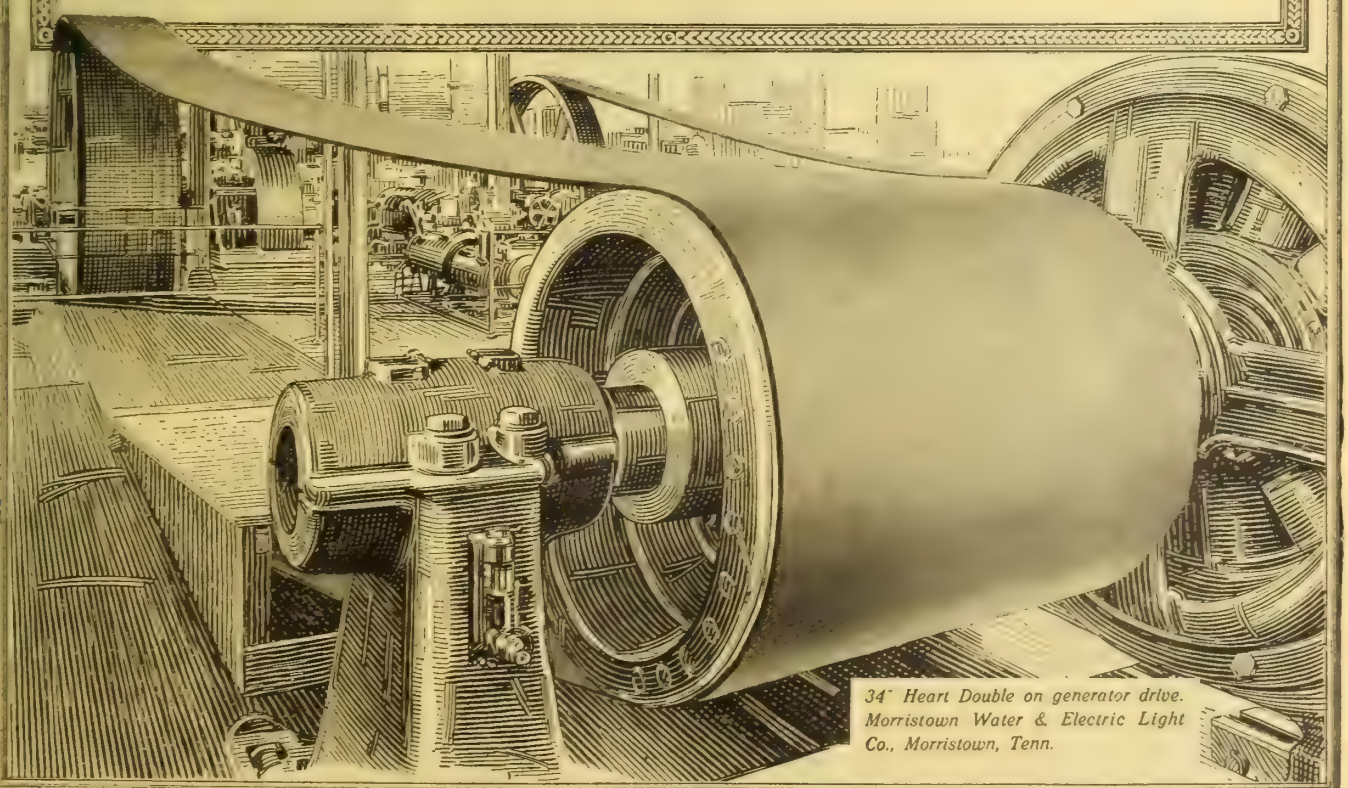
Twenty mills with practically identical needs often specify twenty varied types of belting. And yet the requirements of power transmission fall into a relatively small number of classifications. For each of those classes there is a Graton & Knight Standardized Belt. Long study and experience fixed that standard and we keep it there—rigidly.

It will work an economy for you if you will let us specify the grade of belt for each pulley in your plant. Then, when you buy belting, call for "Graton & Knight———Brand or equal." This doesn't commit you to buying our belting. It puts your buying squarely and permanently on the only sound basis—the **work to be done.**

The Graton & Knight Manufacturing Company

WORCESTER, MASSACHUSETTS, U.S.A.

Canadian Representatives: The Canadian Fairbanks-Morse Co., Limited, St. John, Montreal, Ottawa, Toronto Hamilton, Quebec, Calgary, Saskatoon, Vancouver, Windsor, Winnipeg, Victoria.



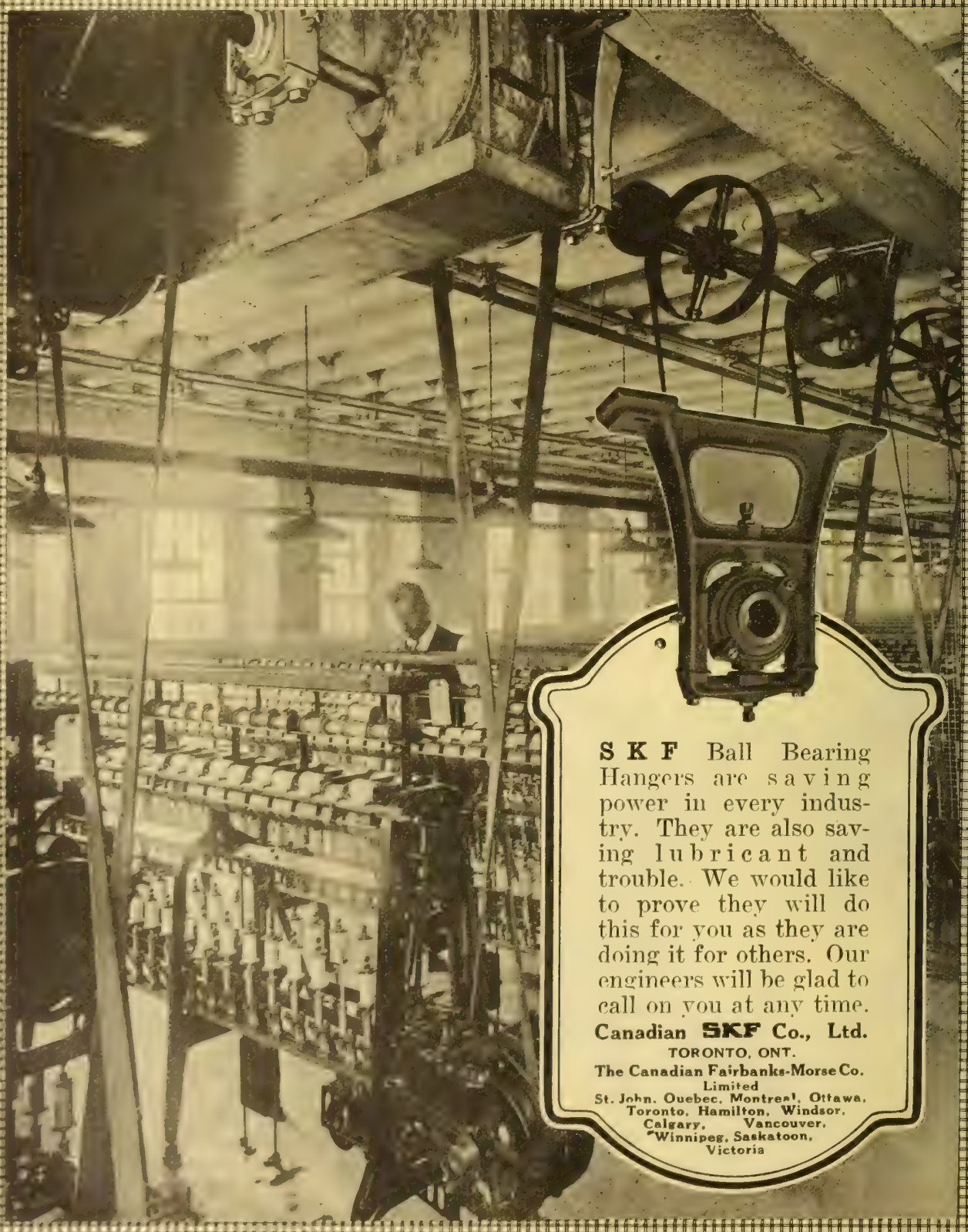
34" Heart Double on generator drive. Morristown Water & Electric Light Co., Morristown, Tenn.

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

SKF

BALL BEARING HANGERS



S K F Ball Bearing Hangers are saving power in every industry. They are also saving lubricant and trouble. We would like to prove they will do this for you as they are doing it for others. Our engineers will be glad to call on you at any time.

Canadian SKF Co., Ltd.
TORONTO, ONT.

The Canadian Fairbanks-Morse Co. Limited
St. John, Quebec, Montreal, Ottawa, Toronto, Hamilton, Windsor, Calgary, Vancouver, Winnipeg, Saskatoon, Victoria

The function of lubricating oil is to give the greatest ease of motion to all parts of the engine, so that every possible atom of power may be transmitted to the machines. An oil that will do this will have effect on other divisions. Ease of operation would mean elimination of friction, no wear on the bearings, less oiling. Pure oil would be a decided labor-saving, cost-reducing, efficiency-promoting factor in the engine room. A great many Canadian manufacturers have pronounced our "Non-Corrosive Cylinder Oil" pure. We, who know its construction, pronounce it pure. Get in touch with us.

NON-CORROSIVE
CYLINDER OIL
MANUFACTURED ONLY BY
E. H. KELLOGG & CO.
NOS. 242 & 244 SOUTH ST. NEW YORK, U.S.A.

WALTER J. FRANCIS, C.E. M. Can. Soc. C.E. M. Am. Soc. C.E. M. Inst. C.E.
FREDERICK B. BROWN, M.Sc. M. Can. Soc. C.E. Mem. Am. Soc. M.E. Mem. A.I.E.E.

WALTER J. FRANCIS & COMPANY
CONSULTING ENGINEERS
Head Office, 232 St. James St., Montreal
Cable Address, "Walfran, Montreal"—W.U. Code.
Long Distance Telephone, Main 5643.

MacKinnon, Holmes & Co., Ltd.

MacKinnon Steel Co.
Limited
Sherbrooke,
Quebec

Builders of

Coal Bunkers, Oil Tanks, Water Tanks and Receivers

We specialize in Bridges, Buildings, Towers, Tanks, Penstocks, Roof Trusses, Columns, Smoke Flues and Stacks, Coal Bins, Ore Bins, Buckets, Refuse Burners, Stills, Air Receivers, etc.

Write for Prices

"Clean All" Feed Water Treatment

Your Boiler Troubles are Solved and the Solution is Genuine.

We guarantee that "Clean All" if used according to directions:

To remove (not dissolve) scale already formed, and to stop further formation.

To stop pitting, corrosion and minor leaks.

To be absolutely harmless to metals, packings and fittings.

To remove oil and grease, and increase efficiency of boilers 100%.

Submit samples of water used and all particulars of conditions of boilers, etc., and let boiler specialists diagnose your case.

SOLD IN 30 or 50 GALLON LOTS UNDER 60-DAY TRIAL.

William C. Wilson & Co.
AGENTS
21 Camden St. TORONTO

CYLINDER LUBRICATION

A powerful microscope will disclose hundreds of irregularities on a bearing surface, no matter how smooth it may appear to the naked eye.

DIXON'S Ticonderoga Flake Graphite

will fill up these minute irregularities and form a smooth, durable veneer of graphite that is practically frictionless.

It will give better lubrication, cut the oil bills in half and eliminate wear and tear.

Send for Booklet No. 222-C telling more about this lubricant and method of successfully feeding dry graphite into cylinders

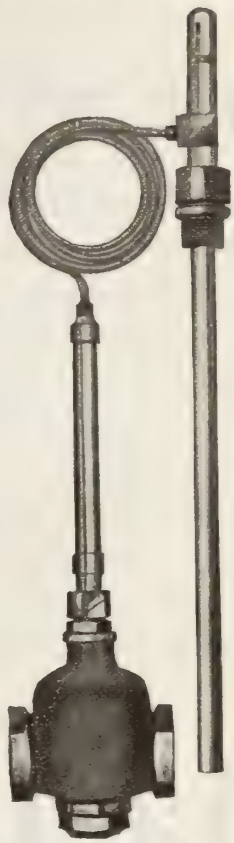
Made in Jersey City, N.J., by the

JOSEPH DIXON CRUCIBLE COMPANY

ESTABLISHED 1827

Sole Canadian Representative:
CANADIAN ASBESTOS CO.
Montreal, Que.

TEMPERATURE CONTROL



Vital as this may be to the final result in your manufacturing process-yet it is equally as important in the matter of fuel saving. Saving steam means fuel economy.

Why tolerate overheating when it represents fuel consumed and money lost with no direct benefit to your product?

Fuel economy is today recognized as an absolute necessity, and with the present high cost of steam many manufacturers and owners save the entire cost of installing SARCO TEMPERATURE REGULATORS within the first week or two. After that, this saving represents additional profit, and production is better.

The Sarco is small, simple in construction and automatically operated by its own hydraulic power.

Stop wasting steam—fuel and money. Get accurate temperature control and better your production.

A free trial will convince you of the merits of this simple and substantial Sarco Temperature Regulator.

SARCO COMPANY, Inc.
Woolworth Building, New York City
Drexel Building, Philadelphia
New Telegraph Building, Detroit
Monadnock Block, Chicago
Cleveland, Ohio
Canada: Peacock Brothers, Montreal

We Are Losing The War!

OUR war aims have fallen from their original elevation. You may say they were too high at the beginning—when first formulated. Perhaps they were, but the real reason for their toning down, as Colonel John Bayne Maclean sees it, is because we have lost many things to Germany which can never be recovered—and lost them by the bungling of incompetent Cabinet Ministers. He instances the failure to make contraband cotton in 1914, when, had this war material been made contraband, the war might have ended in the year in which it was begun. He instances the Dardanelles fiasco which almost drove Australia out of the war. Colonel Maclean shows how Russia might have been saved as an aggressive ally, and how Bulgaria might have been made an ally at the cost of a million dollars. It is startling material which Colonel Maclean provides, and will cause world-wide discussion. We are losing the war, he affirms, but he does not say we have lost it. How it can be won he tells also. Read what he has written in

MacLean's Magazine

for FEBRUARY

In this issue are short and long stories by Alan Sullivan, E. Phillips Oppenheim, Archie P. McKishnie and Ethel Watts Mumford. There is a war poem by Alfred Gordon. The special Business articles which are a feature of every issue of MACLEAN'S MAGAZINE, and the department of Women and their Work, are present.

The Review of Reviews Department contains satisfying presentations of literary and descriptive articles taken from the leading magazines of the world. The story of Hon. Henri Beland, Canadian prisoner of war in Belgium, is told in this number of MACLEAN'S MAGAZINE. There are biographical sketches of Thomas Findley, President of Massey-Harris Company, and of George J. Desbarats, C.M.G., who has done so much for Canada's development of her Naval service.

On Sale at all News Dealers - 20 Cents

MUELLER

Globe and Angle Valves

BUILT from actual, practical experience. Made of the famous *MUELLER* steam metal and fully guaranteed against all defect in design and construction. Not a Valve, but *the* Valve.

¶ *MUELLER* globe and angle Valves can be repacked under pressure. The disc is so designed as to adjust itself to any position and still receive the thrust of the spindle on the center line; thus preventing any distortion to the seat or diaphragm. The pipe threads are full length, and are tapered to conform to I. P. Threads, insuring perfect joints.

¶ Full sized and unobstructed passages guarantee full service. The large Hexagons allow an excellent wrench grip and our design puts the strain where it belongs, so that there is no danger of distorting either the body or the bonnet. Furnished with enameled, Malleable iron wheel handles. Every *MUELLER* Valve tested to beyond unusual service conditions. Write for prices.

MUELLER **gate and check valves, steam cocks, etc. rank highest in every branch of exacting service.**

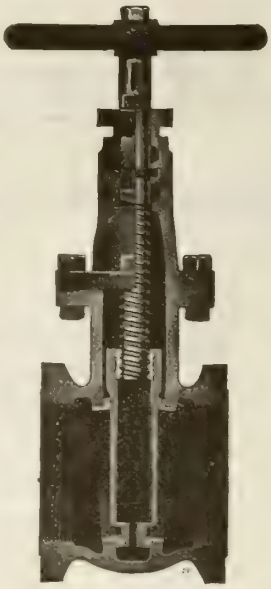
H. Mueller Mfg. Co., Limited

SARNIA, CANADA

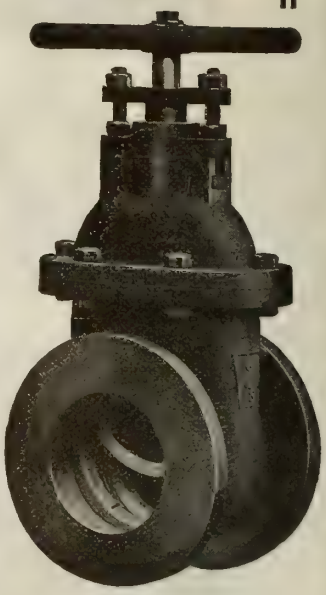
KERR

("New KEYSTONE" Pattern) GATE VALVES

If you have not used any of these New Pattern Valves, specify "KERR" in your next order. We want you to get acquainted with the most reliable valve on the market.



If you have been using them, we are confident that our satisfaction will bring us your repeat orders. These valves will never cause you or your customer the slightest trouble. Their high quality is consistent.

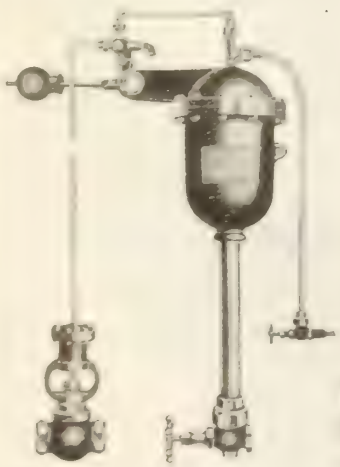


When you buy a "KERR" Valve you get a guaranteed article that is backed by a reliable firm. Many of the largest distributers of valves in Canada have sold "KERR" Valves for over 25 years, and are still recommending them as the "Best Valve." Write us for particulars.

Kerr Engine Co., Ltd., Valve Specialists **Walkerville, Ont.**

Vigilant

Automatic Feed Water Regulator



You see here No. 3-A—our latest improved Vigilant. It is used in the power plants of nearly all the iron and steel producers in the States.

For feeding water to boilers automatically and keeping the level constantly at the desired point, regardless of the load or firing, this No. 3-A Vigilant is by the test of use quite superior to any other device.

It is perfectly automatic and requires absolutely no attention.

Write for Illustrated Catalog.

The Chaplin-Fulton Manufacturing Co.
28 Penn Ave., Pittsburgh, Pa.

Wherever there's an out-of-the-way valve—

there is a place for a

Babbitt
—Adjustable—
SPROCKET RIM

Makes inaccessible valves easy to operate—increases convenience—eliminates serious accidents due to ladders slipping—can be attached to any valve in a few minutes—a wrench is the only tool needed.

Ask your dealer about them or let us send a descriptive pamphlet giving full information.

BABBITT
STEAM SPECIALTY CO.
NEW BEDFORD, MASS.

93-1

JENKINS·BROS·VALVES·

TRADE JENKINS MARK

Jenkins Bros.

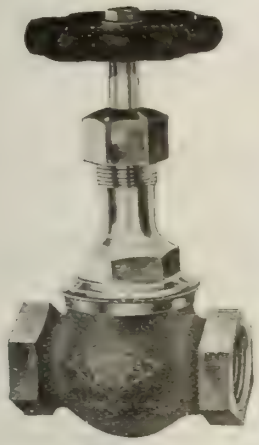


FIG. 106

FIG. 108

Why Jenkins Bros.' Valves are Superior

THEY are the original renewable Disc Valves. They have more imitators than all other makes of valves combined. They have kept pace with increasing steam pressures and severe working conditions. They are of the simplest design, and can be easily repaired by any man of ordinary intelligence. They are made interchangeable in every part, and any part can be duplicated promptly and inexpensively either by the dealer or through the nearest Jenkins Bros.' branch, where large stocks of duplicate parts are constantly kept. In the majority of cases they can be repaired by merely changing the disc without the laborious task of regrinding.

They are recognized as the Standard Steam Valves in all parts of the World, and wherever there are supply houses—Jenkins Bros.' Valves will be found. The Standard of quality never changes except to improve, and while to-day there are hundreds of imitators, the sales of genuine Jenkins Bros.' Valves are constantly increasing.

Jenkins Bros.' Valves are approved for use in Ontario and the Western Provinces by the Depts. of Public Works. Stocked by first-class dealers everywhere.

CATALOGUE No. 8 SENT FREE ON REQUEST

HEAD OFFICE AND WORKS:
103 St. Remi Street
MONTREAL, CAN.

JENKINS BROS.

LIMITED

AGENCIES IN ALL THE PRINCIPAL COUNTRIES OF THE WORLD

EUROPEAN BRANCH:
95 Queen Victoria Street
LONDON, E.C. 4, ENG.

Becoming a Bigger Man

WHAT is the difference between some men you know and others known to you? Why are some men earning $3,000 a year and some $30,000? You can't put it down to heredity or better early opportunities, or even better education. What, then, is the explanation of the stagnation of some men and the elevation and progress of others?

We are reminded of a story. A railroad man, born in Canada, was revisiting his home town on the St. Lawrence River. He wandered up to a group of old-timers who sat in the sun basking in blissful idleness. "Charlie," said one of the old men, "they tell me you are getting $20,000 a year." "Something like that," said Charlie. "Well, all I've got to say, Charlie, is that you're not worth it."

A salary of $20,000 a year to these do-nothing men was incredible. Not one of the group had ever made as much as $2,000 a year, and each man in the company felt that he was a mighty good man.

Charlie had left the old home town when he was a lad. He had got into the mill of bigger things. He developed to be a good man, a better man, the best man for certain work. His specialized education, joined to his own energy and labor sent him up, up, up. To put it in another way: Charlie had always more to sell, and the world wanted his merchandise—brain, skill and ability. Having more to sell all the time, he got more pay all the time.

Charlie could have stayed in the old home town; could have stagnated like others; could have been content with common wages. In short, Charlie could have stayed with the common crowd at the foot of the ladder. But Charlie improved himself and pushed himself, and this type of man the Goddess of Fortune likes to take by the hand and lead onward and upward.

Almost any man can climb higher if he really wants to try. None but himself will hold him back. As a matter of fact, the world applauds and helps those who try to climb the ladder that reaches towards the stars.

The bank manager in an obscure branch in a village can get out of that bank surely and swiftly, if he makes it clear to his superiors that he is ready for larger service and a larger sphere. The humble retailer can burst the walls of his small store, just as Timothy Eaton did, if he gets the right idea and follows it. It is not a matter of brain or education so much as of purpose joined to energy and labor. The salesman or manager or bookkeeper or secretary can lift himself to a higher plane of service and rewards if he prepares himself diligently for larger work and pay. The small manufacturer, the company director, the broker—all can become enlarged in the nature of their enterprise and in the amount of their income,—by resolutely setting themselves about the task of growing to be bigger-minded men.

Specialized information is the great idea. This is what the world pays handsomely for. And to acquire specialized information is really a simple matter, calling for the purposeful and faithful use of time. This chiefly.

One does not have to stop his ordinary work, or go to a university, or to any school. One can acquire the specialized information in the margin of time which is his own—in the after-hours of business. Which means: If a man will read the right kind of books or publications, and make himself a serious student at home, in his hours—the evening hours or the early morning hours—he can climb to heights of position and pay that will dazzle the inert comrades of his youth or day's work.

IF business—BUSINESS—is your chosen field of work, we counsel you to read each week THE FINANCIAL POST. It will stimulate you mentally. It will challenge you to further studious effort. It will give you glimpses into the world of endeavor occupied by the captains of industry and finance. With the guidance of the POST, and with its wealth of specialized information, you, a purposeful man, aiming to go higher in life and pay, will find yourself becoming enlarged in knowledge and ambition, and will be acquiring the bases and facts of knowledge which become the rungs of the ladder you climb by.

It is the first step which costs. But this cost is trivial—a single dollar. We offer you the POST for four months for a dollar. Surely it is worth a dollar to discover how right we are in our argument. If you have the will to go higher in position and pay, sign the coupon below.

THE MACLEAN PUBLISHING COMPANY, LIMITED,
143-153 University Avenue, Toronto.

Send me us THE FINANCIAL POST for four months for one dollar.

Money to be enclosed remitted.

Signed .....

.....

After the Stone Age, Before the Iron Was the Age of BRONZE

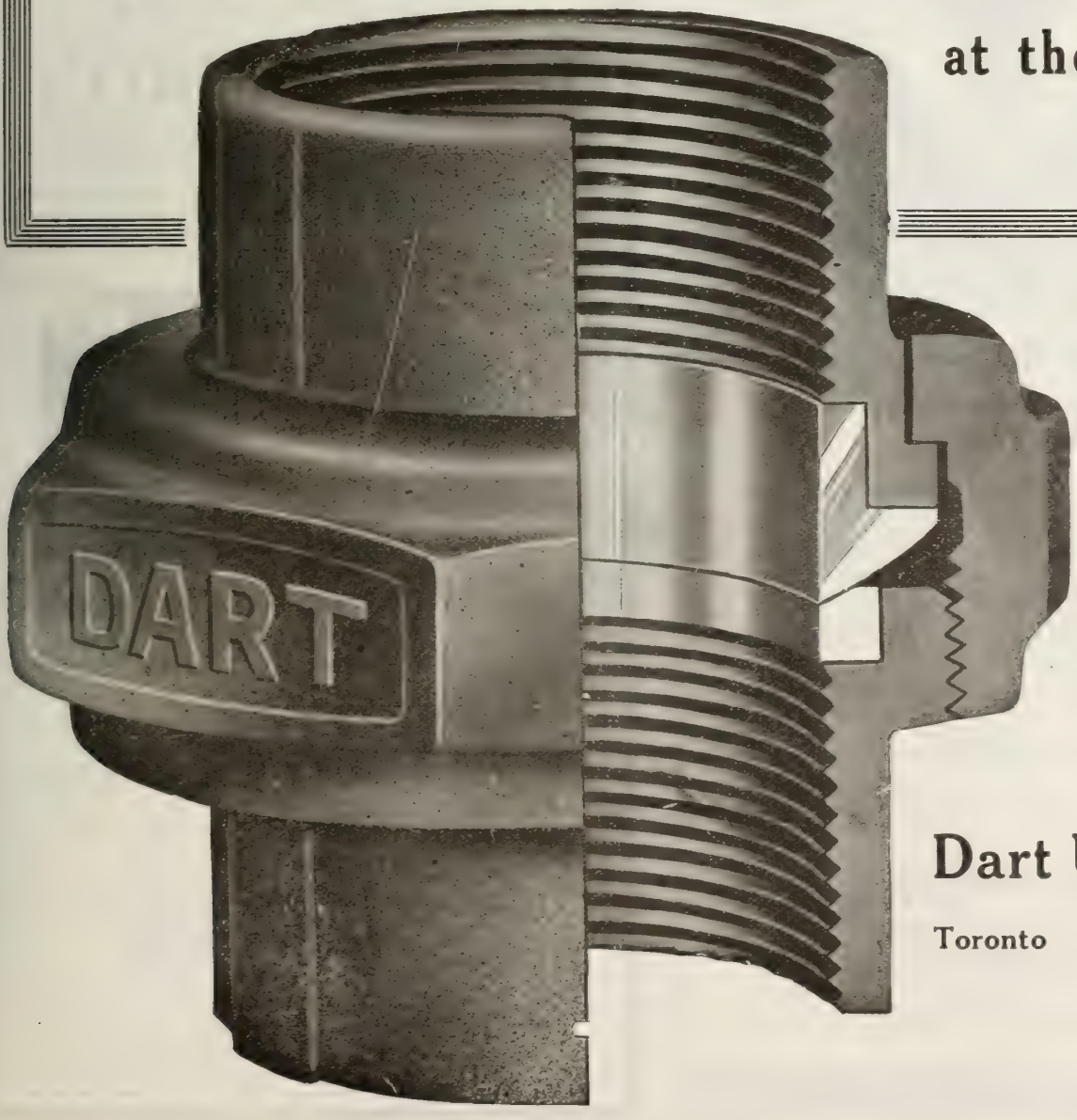
The poet wrote "eternal bronze" and in eternal bronze his likeness is preserved for us and future generations.

In parks and city squares the statues that stand uncovered in all weathers—proof against heat and cold and rain and snow, against time itself—are Bronze.

Bronze never rusts, never corrodes. Therefore Dart Unions are created

BRONZE TO BRONZE

at the Joint

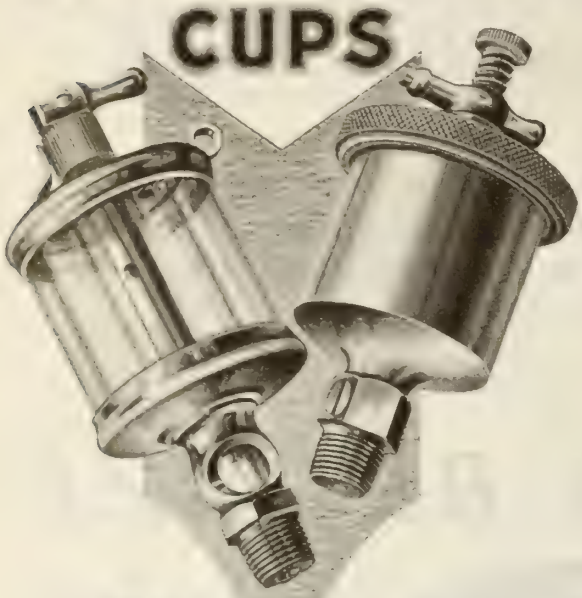


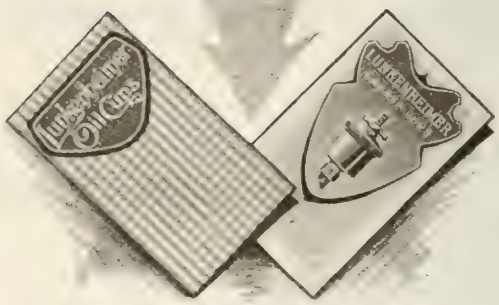
Dart Union Co.

Limited

Toronto Canada

LUNKENHEIMER
OIL AND GREASE CUPS





For Engine AND Transmission Bearings

By their unfailing reliability have won the reputation they enjoy. The engineer specifying "Lunkenheimer" **knows** that bearings thus equipped will get the amount of lubricant for which the feed is set—**uniformly**, until cups are empty, and that no further attention is necessary other than filling.

They are practical and durable; the feed regulation is simple and easily adjusted, and there is no danger of unsetting the feed when refilling.

The variety of types made embraces **Oil Cups** with Glass or Bronze Body, with or without Sight-feed; and **Grease Cups** of Bronze, Iron and Steel, with Screw or Spring Compression Feed—a type for every service requirement.

"Write [illegible] equipped" in your engine and transmission specifications, and insist on having the genuine. Descriptive Booklets Nos. 523 and 524-DC will assist you in [illegible] the proper type. Write for copies.

THE LUNKENHEIMER CO.

"QUALITY"

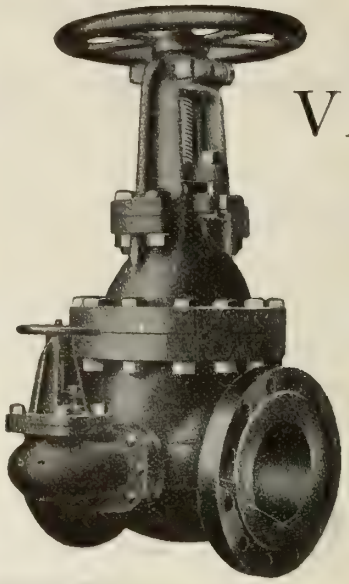
Largest Manufacturers of High Grade Engineering Specialties in the World

CINCINNATI, U.S.A.

New York Chicago Boston London

23-13-43

"McAVITY"



VALVES

GLOBE
ANGLE
CHECK
GATE

WITH or WITHOUT YOKE OR BY-PASS

BRASS OR IRON
Screwed or Flanged

SIZES ¼" to 12"
PRESSURES 125 to 500 lbs.

FITTINGS

STRAIGHT AND REDUCING FLANGES
BLANK, DRILLED OR SPOT FACED

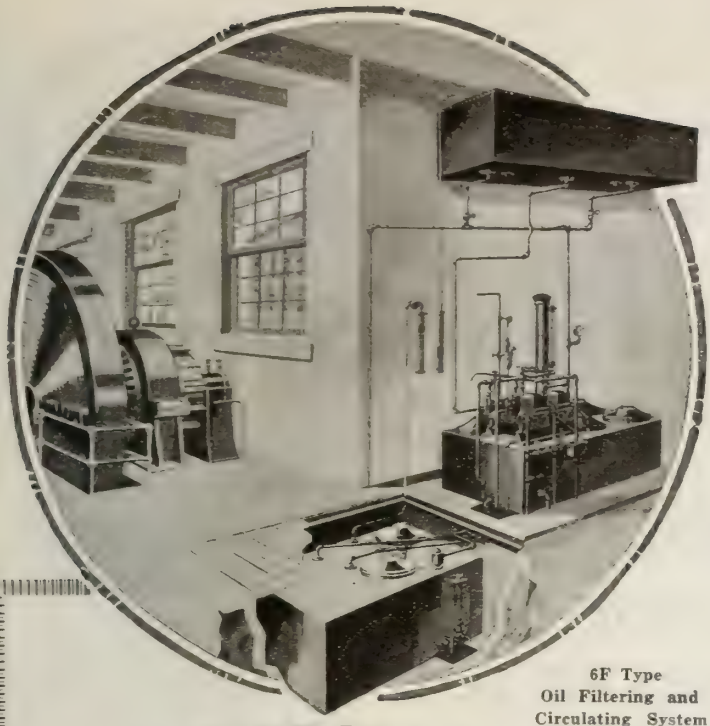
SPECIAL VALVES AND FITTINGS TO ORDER AT PROMPT NOTICE

T. McAVITY & SONS
Limited

BRASS and IRON FOUNDERS
WHOLESALE and RETAIL HARDWARE

St. John, N. B.
CANADA

MONTREAL TORONTO WINNIPEG VANCOUVER
LONDON, England DURBAN, South Africa



6F Type
Oil Filtering and
Circulating System

Results that Count

The Bowser System makes good results a sure thing.

Wherever it is installed there is more uniform lubrication of machines, without loss of oil; less depreciation of equipment; fewer repair bills; a better spirit among employees, and—increased profits, all of which are good, strong reasons why the Bowser should be in your plant.

The Bowser stores and supplies new oil—collects dirty oil—purifies it, makes it good as new—returns the proper supply to points of use wherever located. Its simplicity, durability, and ease of operation are reasons for its popularity in all well regulated plants.

"Results that Count" always follow its use—we'll be glad to tell you more about it if you drop us a line.

BOWSER
ESTABLISHED 1885

Oil Circulating
and Filtering Systems

S. F. Bowser & Co., Inc.
TORONTO, ONTARIO

Sales Offices in All Centres

Representatives Everywhere

BOWSER SERVICE

LIKE IMMORTAL JANUS
Double Faced

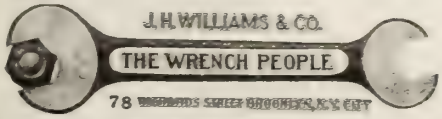
See their teeth fore and aft, and remember

THEIR JAWS REVERSE

Hand made machine tested chains insure safety in operation.

The Improved
"VULCAN"
Chain Pipe Wrench

Your dealer carries them in various sizes



WESTERN OFFICE AND WAREHOUSE: 40 SOUTH CLINTON STREET
CHICAGO, ILLINOIS
A. G. Low Co., Ltd., Saskatoon, Sask., agents for Manitoba, Saskatchewan, Alberta and British Columbia

Use only the Genuine

Daniel's P. P. P.

Ebonite Sheet

Ebonite Stop Valve Packing

We can supply you promptly.

Thomson-Gordon Limited
HAMILTON, ONTARIO

Packings, Belting, Asbestos Goods

If any advertisement interests you, tear it out now and place with letters to be answered

Six

Years of History and Service

In November, 1911, Canuck Supply Co., Limited, was organized with nothing but Anchor Steam and Hydraulic Packings to sell. Our record of service and our reputation for quality have been slowly building up a business with the strength of Gibraltar—built to last. Here are some of our present lines:

MECHANICAL DEVICES

Baker Locomotive Valve Gear

American Security Arch

O'Malley-Beare Multiplate Valves

Hunt-Spiller Gun Iron

King Metallic Packing

Henry Grease Cup

SUPPLIES

Forster Locomotive Cement

Simplex Car Cleaner

Anchor Packings

Canuck Front End Paint

Brubaker Taps and Reamers

Glidden Finishing Materials

HOUGHTON LINES

Vim Belting and Packings

Oils, Greases and Case Hardeners

Canuck Supply Co., Limited

Toronto Montreal Winnipeg

All Down the Line—

You'll find sizes and types of

Jefferson Unions

for every union need—why not standardize them and put an end to pipe line troubles throughout your plant?

The Jefferson feature of forcing the brass seat ring into a recess just back from the runway and contents of the pipe makes it corrosion-proof and at the same time much more durable than a bronze or brass seated union handled in any other way. Then the weight of a Jefferson is greater than any other union of similar class—another logical "reason why" they are most successful.

If your jobber can't supply Jeffersons, a line direct to us will bring you the name of our nearest dealer and the Jefferson Book "Unions"—a treatise on pipe line connections which you'll enjoy reading.

Jefferson Union Features

Ground ball brass-to-iron or iron-to-iron joint, ground with mate and never separated.

Sloping shoulder and large play in the ball end, which is of assistance in connecting piping out of line.

Standard pipe threads tapered to fit the pipe. Coarse nut threads for quick adjustment.

Heaviest of its class made and sold at reasonable prices.

The Jefferson Union Company

Lexington, Mass. U.S.A.

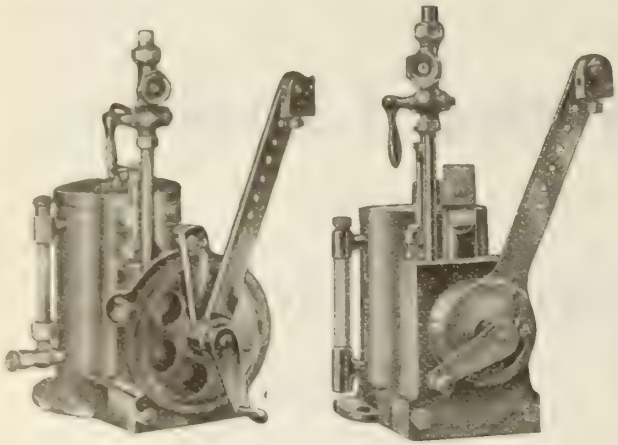
MAIL THIS HANDY COUPON FOR THE JEFFERSON BOOK "UNIONS"

Jefferson Union Co.,
Lexington, Mass.
Please send me a copy of your New Catalog.

Name.....
Firm Name.....
Address.....

If any advertisement interests you, tear it out now and place with letters to be answered

The Rochester Automatic Force Feed Lubricators



Ratchet Drive Pattern Clutch Drive Pattern

Force feed lubrication is acknowledged to be the only correct method for lubricating the cylinders of all types of engines, pumps and air compressors, so that there is no need for any argument in its favor.

We recently received an unsolicited testimonial from the Chief Engineer of an Ontario Municipal plant in regard to a Rochester Lubricator. This is extremely unusual—if we were manufacturing patent medicines, unsolicited testimonials would be expected, but seeing that we are engineers, whose business it is to manufacture Pumps, Elevators, and Steam Appliances generally, why, a testimonial, especially one like this is something to be proud of.

This Engineer goes on to say:

. . . . . "I admire the Rochester Lubricator from the standpoint of simplicity, reliability, excellence of workmanship, and good materials. . . . suffice it to say, I know a good thing when I see it, hence I would not have ordered ANOTHER Rochester had it not been a satisfactory lubricator."

Note he says "another," and he tells us that this "other" has been in use for **twelve years and still going strong.**

It's too bad that we are unable to print this engineer's name and official capacity—he objects to publicity. We have it on file at our head office for reference, if necessary.

After all this is only another proof of the excellence of our products.

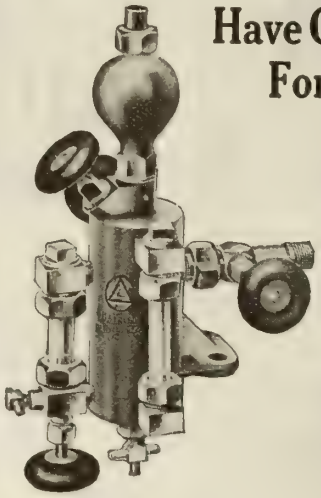
Darling Brothers, Limited

120 Prince Street

TORONTO MONTREAL WINNIPEG

Detroit Lubricators

Have Given Satisfaction For Forty Years.



Built in a sufficient variety of styles to lubricate properly every type of steam engine, pump, gas engine, air compressor, etc.

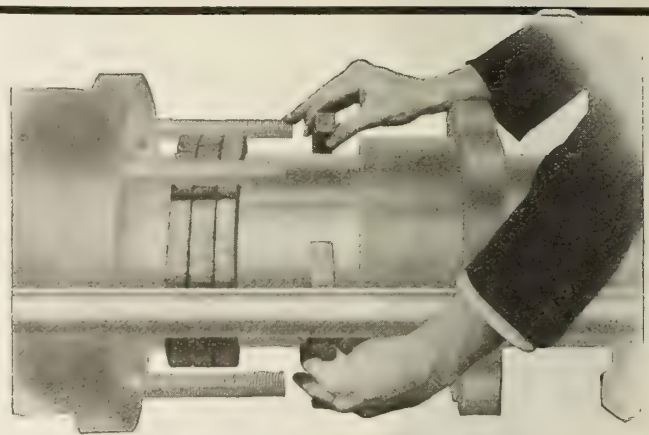
Send to-day for catalog L 1. The information on lubricating devices contained in it will be valuable to you.

THEIR efficiency holds over half the world's trade.

Makers of Stewart Carburetors.

CANADIAN DETROIT LUBRICATOR COMPANY, LTD.

WALKERVILLE, ONT.



WHY YOU SHOULD USE "JOHN CRANE"

FLEXIBLE METALLIC PACKING

1—**SERVICE:** Packing steam, air, water, oil, ammonia, gas, etc., right from same coil. Think of it!

2—**STOCK:** A coil of 1/8, 1/4, 3/8, 1/2 and 5/8 absolutely protects you against shut-down. Any coil can be formed 1/16 smaller or larger with ease.

3—**TEMPERATURE:** Heat kills fabric packing, but has no effect on metal. Hence "John Crane" permanency.

4—**PRESSURE:** These flat metal sheets are ideal barriers for pressures. Resists up to 5000 pounds.

5—**FLEXIBLE:** All metallic, yet bends easily, taking any form or shape under pressure.

6—**NO SCORING:** It is a well-known fact that a good, well babbitted bearing will never score a shaft, neither will a good babbitted packing—in other words "John Crane" packing.

7—**PERMANENCY:** Five years on outside packed plungers, accumulators, presses, rods, shafts and stems justifies its general adoption.

8—**EASILY ORDERED:** If you want to pack, you do not want to order THIS KIND FOR THIS KIND OF SERVICE and THAT KIND FOR THAT KIND OF SERVICE. All you need to do is to order "John Crane" for everything.

Put your packing troubles up to us. This metallic Packing is not only DIFFERENT, but FAR BETTER. Get our Bulletin No. 1 for special services.

Crane Packing Company - Box 241, Windsor, Ont.

General Office and Factory, Chicago, Ill.

JOHNS-MANVILLE
Service to Power Plants

Increasing Power Output—by Reducing Friction

TO the engineer the very names "packing" and "stuffing-box" tell an interesting story. The sole function of rod packing is to prevent leakage. Until recently this has been accomplished, for a time at least, by filling the stuffing-box solidly with packing, screwing up the gland or allowing the packing to expand until its pressure on the rod was sufficient to hold back the steam or liquid attempting to escape.

This prevented leakage—but it cost money in three directions: heavy wear on packings, wear of the rod, and loss of power through friction. And the last is especially important if you consider that every foot-pound of energy consumed in plant operation directly reduces the surplus of power available for sale or for factory use.

So we set out to reduce friction and wear of rods and packings at no sacrifice of steam-tightness—and by solving the problem we have inaugurated a new era in "Stuffing-Box Engineering."

Johns-Manville Sea Rings are automatic and active, instead of inert. The pressure of the fluid against the packing holds the lip of the ring tight against the rod—and when pressure falls off or is on the opposite side of the piston, the packing relaxes and permits the rod to move freely. So friction is saved, and power—and the wear on packing and rod is less.

And Sea Rings are but one item in the standardized list of Johns-Manville Packings—a packing for every requirement. Each Johns-Manville Packing is different—with a sound engineering reason for the difference. They're designed to *wear*, and to save money and power—and we back each one to the limit.

You can prove it for yourself by investigation, almost anywhere, or by test—and we'll be glad to help you.

THE CANADIAN H. W. JOHNS-MANVILLE COMPANY, LIMITED

MONTREAL TORONTO VANCOUVER WINNIPEG
LONDON HAMILTON OTTAWA

Canadian Association of Stationary Engineers

Incorporated May, 1887 — Incorporated at Ottawa, June, 1917

An organization having as its aims and objects:—

To promote the knowledge of its members in the art and science of Steam Engineering.

The dissemination of information beneficial to the members of the association in the discharge of their calling.

To further and protect the interests of competent engineers, and receive such as members of this organization.

To secure, through proper legislation, the greatest security in operation of steam plants.

To assist unemployed members to secure positions.

To maintain freedom of action between employer and employee.

The members of the Association subscribe to the above in the full belief that ability and knowledge of one's profession are necessary to insure the highest degree of success.

Labor Study Energy

These three essentials have been responsible for the success of the world's greatest men. They are no less essential for yours. We cannot all become great, but this fact does not lessen the necessity for the exercise of these essentials in our individual occupations. Cool, calm, calculating judgment characterizes the successful power house operator of to-day. The demands on the engineer of to-day are many, and the obstacles in his path are great. To assist in the overcoming of these and help the accomplishment of great works, material, moral and educational, is the desire of all our members.

The benefits accruing from association with members of his fraternity, the opportunity to benefit by their experience, and the inspiration to greater effort by reason of their success render membership in this association indispensable to all progressive engineers.

If you are interested in such an organization and live where less than fifteen engineers are located, send for a copy of our constitution and application blanks for admission to nearest branch lodge. If there are more than fifteen engineers in your community, get together and send for particulars regarding formation of a branch lodge.

J. H. HALE, General Secretary, C.A.S.E.

230 Caroline Street — Hamilton, Ont.

D. K. McLaren's

Belting shows what a farce is the common theory that only by extraordinary tension can a belt get adequate pulley grip. It stands to reason that extraordinary tension **plays particular havoc** with belting. It strains shaftings and wears out bearings. Nothing so well supports our contention as actual comparison of the service and length of service life of other belting with that of D. K. McLaren's

Genuine British Oak-Tanned
Leather Belting

D. K. McLaren's Belting—amply flexible and really nearer to stretchless than any other belting made—hugs the pulley with a grip that never slips. It renders the service **you ought to demand.**

Everywhere in Canada are enthusiastic users of D. K. McLaren's Belting. Let us put you in touch with several in your own town. Write to-day.

D·K·McLAREN
LIMITED

Head Office and Factory
351 St. James St., Montreal, P.Q.

TORONTO, ONT.
194 King St., West

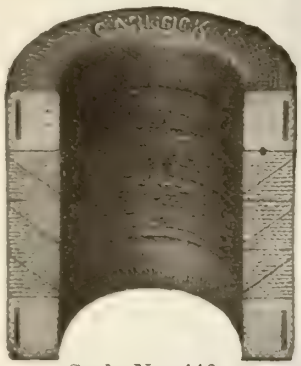
VANCOUVER, B.C.
849 Beatty St.

ST. JOHN, N.B.
90 Germain St.

GARLOCK PACKINGS

Style No. 200

High Pressure Packing will give reliable and efficient service without injury to piston rods, because it is thoroughly lubricated throughout every fibre, and the material, design and workmanship are unequalled.



Style No. 446

Medium Pressure Duo is a combination of high pressure and diagonal rings put up in sets to exactly fill stuffing box. The diagonal rings adapt themselves automatically to rods not running true, while the high pressure rings bear the brunt of the pressure and heat at bottom of stuffing box.

Style No. 950

Style No. 950 Gaskets are cut from Superheat Sheet Packing, which is made of the best quality of long fibre asbestos, built up under tremendous pressure, thus securing great tensile strength. They are not affected by extremely high temperatures, and being of a tough, non - vulcanizing material, do not need following up after being applied.

For Packing

High Pressure Steam Rods
Use Garlock Style Number 200

Medium Pressure Steam Rods
Use Garlock Style Number 446

Low Pressure Steam Rods
Use Garlock Style Number 333

Worm or Scored Piston Rods
Use Garlock Style Number 336

Cold Water Piston Rods
Use Garlock Style Number 99

Inside Packed Plungers
Use Garlock Style Number 260

Outside Packed Plungers
High Pressure Cold Water
Use Garlock Style Number 960

Outside Packed Plungers
High Pressure Hot Water
Use Garlock Style Number 1907

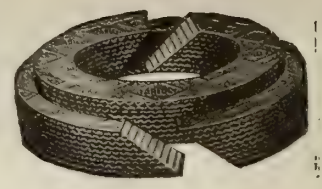
These Packings are guaranteed to give satisfactory service under the above conditions.

The Garlock Packing Co.

HAMILTON, ONTARIO

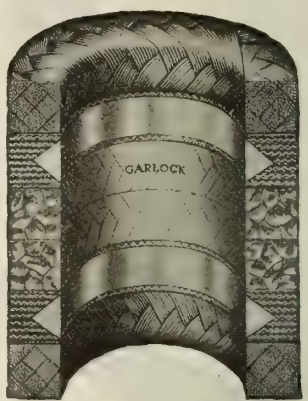
BRANCHES:

MONTREAL - - -	409 Shaughnessy Building
TORONTO - - -	404 Continental Life Building
WINNIPEG - - - - - - -	Galt Building



Style No. 336

Extra Sectional Ring while designed principally for worn or scored rods will give excellent service on any medium or low pressure steam rod when used alternately with solid Extra Rings, Style No. 333.



Style No. 960

Duo Hydraulic is composed of braided copper, metal wedge and waterproof hydraulic rings, and is best adapted to meet the varying conditions and temperatures to which hydraulic packing is subjected. This combination will hold a pressure of three thousand pounds.

Style No. 260

Special Hydraulic Solid Rings for plungers of inside packed pumps are unexcelled for durability and satisfactory service. They are also used in combination with our other packings for outside packed plungers working either in hot or cold water.

Albany Grease

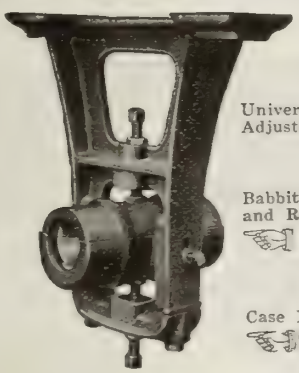
has just rounded out a half century of usefulness. Its incomparable record of lubrication service during the past 50 years stamps it as a most efficient and economical lubricant. For

50 YEARS

Albany Grease has been used by engineers on the bearings of engines, motors, pumps, compressors, line shafting and all their other equipment. If you are not using Albany Grease send for samples and try it.

ALBANY LUBRICATING COMPANY
708-10 Washington Street
NEW YORK, U.S.A.
Established 1868

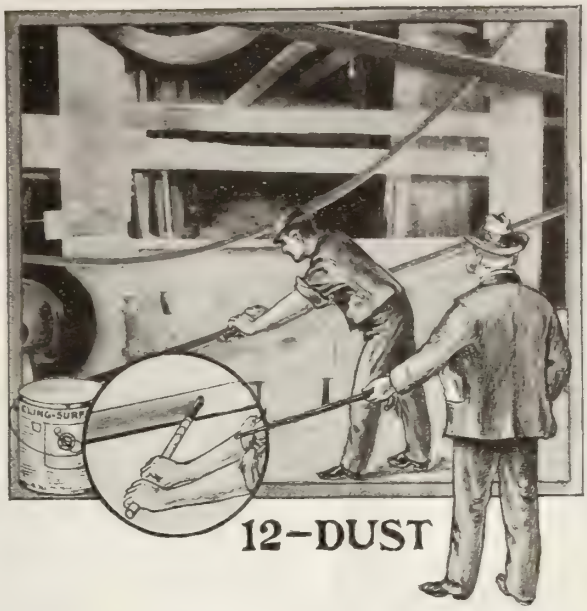
Bond Hangers are the Best



Anyone that has used them will tell you that. They cut the danger of hot bearings to a minimum because they are equipped with an up-to-date and efficient ring oiling device that keeps the bearings constantly oiled, without wasting oil. The reservoir once filled requires no attention for at least six months. Any misalignment in the shaft line is easily corrected by the universal adjustment.

Our catalog on Power Appliances is full of pointers. Send for it today.

CANADIAN BOND HANGER & COUPLING CO.
Limited
ALEXANDRIA ONTARIO



Dont Claim Exemption

—because the air is filled with dust,
—because this dust settles on the belts,
—because it makes a belt dressing "ball up"
are no reasons at all why your belts can't have the benefit of

CLING-SURFACE Belt Preservative

Just wipe the dust off first.

Then with the swab (as shown) treat the face of the belts **a little at a time.**

Your belts will absorb CLING-SURFACE very quickly, leaving a clean, **not sticky,** surface.

It will be smooth, velvety, and will not slip.

Nor will it hold the dust.

Your drives will last longer, do more work, cause no trouble, and can be run easy or slack under full loads.

They will never again have static electricity.

* * *

Results like these PAY.

Are you willing to try this treatment if such trial **costs you nothing?**

Then write to-day for the 25-pound can we have waiting for you.

Use it sixty days.

If you're satisfied, pay us for it. If not, we will take back what you have left, charge you nothing for what you've used, and pay the freight both ways.

ALL CHEERFULLY—no hard feelings!

Remember, use CLING-SURFACE and you won't need belt dressings.

Cling-Surface Co
1057 Niagara Street
Buffalo New York
U S A

If any advertisement interests you, tear it out now and place with letters to be answered

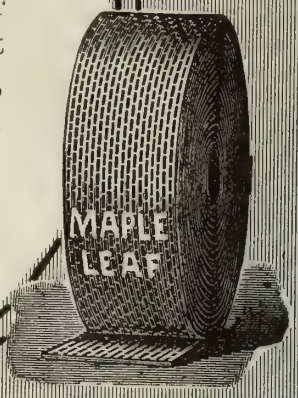
"Maple Leaf" Brand

Stitched Cotton Duck Belting

THE BEST FOR ALL KINDS OF BELTS

Is strong, durable, economical and true running. Being thoroughly waterproof, it is equally good for running in wet or dry places. As a main drive belt "MAPLE LEAF" cannot be excelled, and for conveyors is in great demand. A trial belt will convince you.

Write for prices and samples.



Dominion Belting Co., Ltd.,

HAMILTON, CANADA

BEST BY TEST

GRAND TRUNK PACIFIC ELEVATOR CO., LTD.

Fort William, Ontario, Can., 2/8/17

Magnolia Metal Co.

Gentlemen:

I have made comparative tests with Magnolia and other so-called better grades or higher priced metals, and after the severest tests I was able to subject them to, I am able and pleased to say that Magnolia gave the best results

These tests were of several years' duration and our electrician and millwrights took particular pains to make notes on these tests as well as myself. We use both oil and grease and have equally good results with both.

Our motors vary from 6 H.P. to 100 H.P., and in speed from 415 to 1,200 R.P.M. My experience with Magnolia Metal extends over a period of 25 years and might be termed a hide-bound Magnolia Metal user, and am ready to plead guilty.

I do not hesitate in stating that for reducing friction, obtaining long life, and securing an easy mind for the engineer, electrician and millwright, I have not found a metal equal to your Magnolia Metal.

Yours truly,
M. F. BUYER, Supt.

PRACTICAL ENGINEER POCKET BOOK:

Over 600 pages. A valuable reference work imported from England and sold as an advertising medium at the low price of 40c post paid.

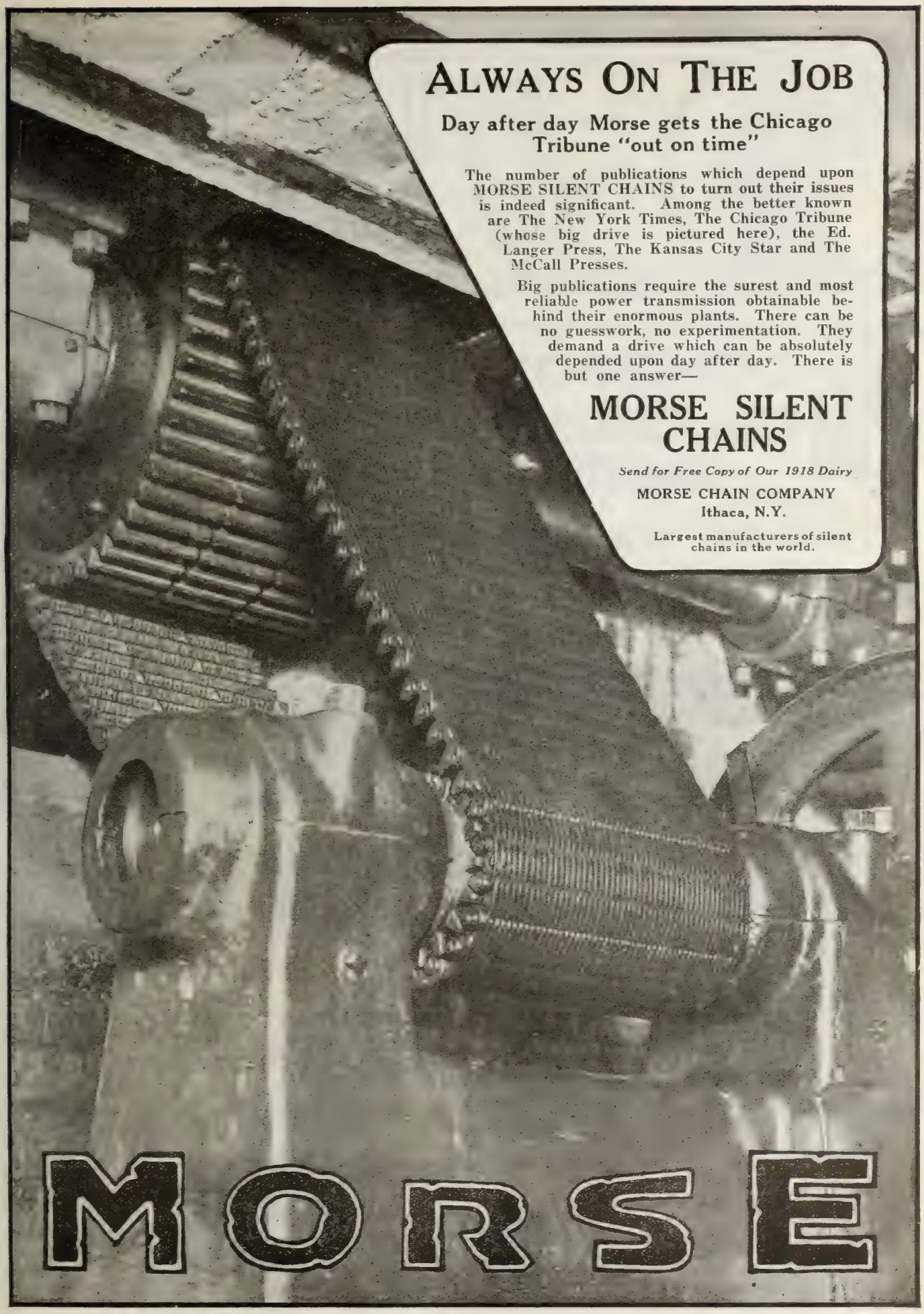
Address Montreal Office.

SOLD BY LEADING DEALERS EVERYWHERE OR BY

MAGNOLIA METAL CO.

OFFICE AND FACTORY:

225 St. Ambroise St. MONTREAL



ALWAYS ON THE JOB

Day after day Morse gets the Chicago Tribune "out on time"

The number of publications which depend upon MORSE SILENT CHAINS to turn out their issues is indeed significant. Among the better known are The New York Times, The Chicago Tribune (whose big drive is pictured here), the Ed. Langer Press, The Kansas City Star and The McCall Presses.

Big publications require the surest and most reliable power transmission obtainable behind their enormous plants. There can be no guesswork, no experimentation. They demand a drive which can be absolutely depended upon day after day. There is but one answer—

MORSE SILENT CHAINS

Send for Free Copy of Our 1918 Dairy

MORSE CHAIN COMPANY
Ithaca, N.Y.

Largest manufacturers of silent chains in the world.

MORSE

HINTS TO BUYERS

DOMINION COAL COMPANY LIMITED

"Dominion" and "Springhill" BITUMINOUS STEAM and GAS COALS

GENERAL SALES OFFICE

112 St. James St. Montreal

NOTICE

TO

Stationary and Hoisting Engineers

Everyone operating a STATIONARY steam plant of 50 h.p. or over in the Province of Ontario must hold a Stationary Engineer's Certificate from the Board of Stationary and Hoisting Engineers. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary and Hoisting Engineers' Act.

Everyone operating a HOISTING steam plant working at a pressure of 20 pounds or over, irrespective of horse power, and used for hoisting in structural operations or excavating purposes, in the Province of Ontario, must hold a Hoisting Engineer's Certificate from the Board of Stationary and Hoisting Engineers. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary and Hoisting Engineers' Act.

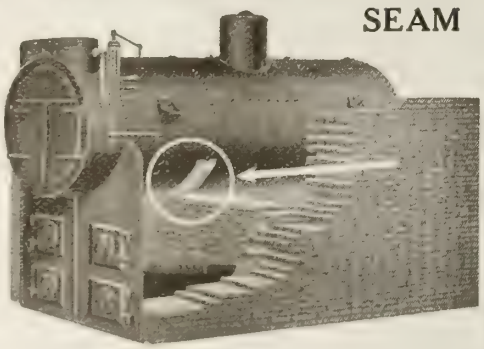
Application forms for obtaining STATIONARY or HOISTING Engineers' Certificates, may be had upon applying to the Chairman.

HON. F. G. MACDIARMID, Minister of Public Works and Highways. W. C. McGHIE, Chairman of Board.
W. A. RIDDELL, M. A. PH. D., Superintendent, Trades & Labour Branch.

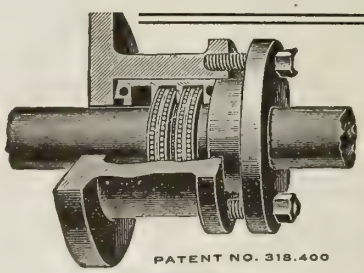
PROTECT YOUR BOILER AT THE SEAM

Don't let fire-cracks, mud-cracks and blisters shorten its life and lower its efficiency.

In 30 minutes your fireman can attach the NATIONAL BOILER GIRTH SEAM PROTECTOR. It both prevents and cures permanently. Write



National Boiler Seam Protector Co. of Canada
568 Manning Ave., Toronto 920 New Birks Bldg., Montreal



PATENT NO. 318,400

PAT. NO.	500,899	PAT. NO.	829,116
" "	534,104	" "	850,530
" "	602,328	" "	856,103
" "	654,541	" "	878,238
" "	654,542	" "	894,537
" "	725,368	" "	895,791
" "	774,490	" "	898,066
" "	775,193	" "	905,103
" "	775,194	" "	934,629
" "	791,300	" "	979,206
" "	805,669	" "	1000,75

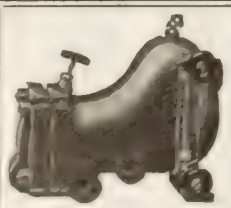
Why not Buy the Best, when in market for Packing?

HOLMES' Metallic Packing

Is Guaranteed 3 Years

Lasts many times longer. 30 days' trial. Less oil. No cutting. Easily applied to any Steam Engine, Air Compressor or Gas Engine. Satisfaction or no pay. Write us.

HOLMES METALLIC PACKING CO.,
Wilkes-Barre, Pa.
Incorporated 1897



McDANIEL IMPROVED **STEAM TRAP**

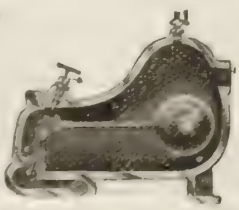
FOR HIGH OR LOW PRESSURE.

Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

MAY WE SEND ONE FOR TRIAL?

Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators.

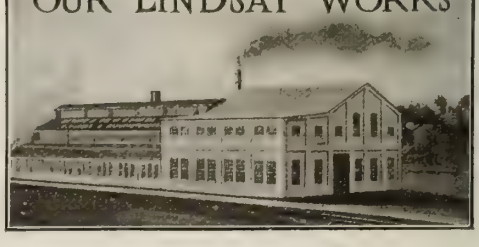
SEND FOR CATALOGUE.



THE GARTH COMPANY
26 Craig Street MONTREAL, CAN.
WATSON & McDANIEL CO.
No. 146 N. 7th Street. PHILADELPHIA, Pa.

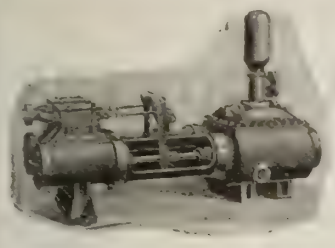
Water Turbines, Hydraulic Governors, Centrifugal Pumps

OUR LINDSAY WORKS



Boving Hydraulic & Engineering Co., Limited
LINDSAY, ONTARIO

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

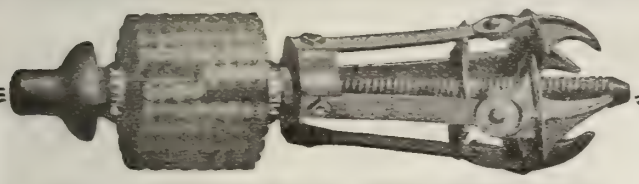


PUMPS

Modern in Design
Rugged in Construction
Reliable in Use

May we quote on your next specification ?

The Smart-Turner Machine Co., Limited
HAMILTON CANADA



Looks like a good tool and it's just a little better than it looks.
Adopted as standard by thousands of engineers who know from experience that it always gets results.

Pilleys Combination Flue Brush and Scraper

is adjustable to the tube—scrapes and brushes thoroughly in one operation. Guaranteed against defective materials and that wires will not pull out or lay over. For sale by leading Canadian jobbers.

Eastern Office: 71 Fulton St., New York.

PILLEY PACKING & FLUE BRUSH MFG. CO.
623 South Third Street ST. LOUIS, MO.

BOILER INSPECTION

The Steam Boiler Act, Chapter 252 R.S.O., 1914 With Amendments Chapter 58—6, George V.

STEAM BOILERS.

All Steam boilers constructed for use in Ontario must be built from designs which have been approved and allotted a registration number by the Steam Boiler Branch.

Used boilers, boilers sold or exchanged, and unregistered boilers brought into the Province must be inspected prior to being put into operation.

Notice of repairs to steam boilers, stating the nature and extent of same, must be sent to the Steam Boiler Branch, and should such repairs be considered extensive by the Chief Boiler Inspector, the boilers will require to be inspected.

In each and every case the inspections must be made by Inspectors authorized to inspect boilers under the Steam Boilers Act, who are employed only by the Steam Boiler Branch of the Department of Public Works. Official certificates with the maximum working pressure stated thereon are issued to the owners of the boilers so inspected.

STEAM PIPING.

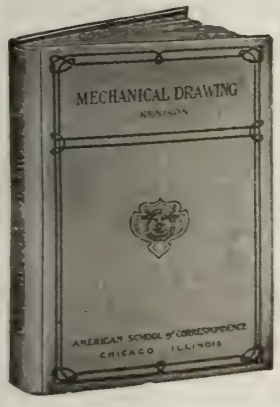
Drawings and Specifications of all high pressure steam piping must be approved and registered by the Steam Boiler Branch before any work of installation is commenced. The drawings submitted should show clearly the dimensions and layout of the main steam lines. Full particulars should be given as to the material used in the construction of the piping, and all valves and other fittings used in connection therewith must be of approved make.

Any deviation from the above requirements shall be deemed a violation of the Steam Boilers Act.

All communications in this respect should be addressed to the Steam Boiler Branch, Department of Public Works, Parliament Buildings, Toronto.

HON. F. G MACDIARMID, Minister of Public Works and Highways
W. A. RIDDELL, M.A. Ph.D., Supt. Trades & Labour Branch

D. M. MEDCALF,
Chief Inspector of Steam Boilers.



Mechanical Drawing

By Ervin Kenison, S.B.

Instructor in Mechanical Drawing, Massachusetts Institute of Technology

176 pp., 140 illus. Cloth binding. Gives a course of practical instruction in the art of Mechanical Drawing, based on methods that have stood the test of years of experience. Includes orthographic, isometric and oblique projections, shade lines, intersections and developments, lettering, etc., with abundant exercises and plates.

Price, $1.00

MacLean Publishing Co.
Technical Book Dept.
143-153 University Ave., Toronto

THE LADD VERTICAL WATER TUBE BOILER

The Goldie-McCulloch Co., Ltd.
Galt, Ontario

Canadian licencees under patents 162401 and 162402 dated May 4, 1915.

The George T. Ladd Company,
Pittsburgh, Pa.

Owners and manufacturers for the United States.

Write for new Catalogue No. 17.

LAPIDOLITH
TRADE MARK

The oldest and most reliable Concrete Hardener obtainable.
Will make your concrete floors dustproof and wearproof.
Your walls and tanks waterproof.
PLIBRICO JOINTLESS FIRE-BRICK AND PLIBRICO BONDS will make your furnaces and smelters one-piece, gasproof, and airproof.

SALES AGENTS:

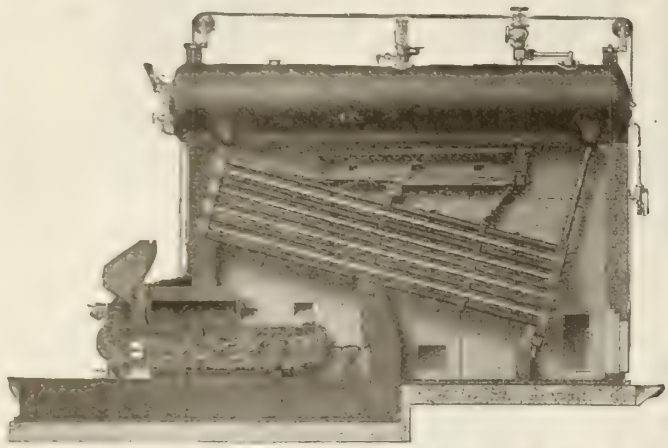
BEVERIDGE PAPER COMPANY, LIMITED, MONTREAL

N. J. Dinnen Co., Ltd., Winnipeg
Maritime Branch: 82-84 Water St., St. John, N.B.

"ALL BRITISH"

"B.&W." PATENT WATER TUBE STEAM BOILERS

HIGHEST ECONOMY, SAFETY, DURABILITY. OVER 17,000,000 H.P. IN USE.



Babcock & Wilcox Patent Water Tube Steam Boiler, Superheater and Mechanical Stoker.

ALSO

Steam Superheaters
Mechanical Stokers
Coal-Handling Machinery
Piping, Feed Water Heaters
Water Softeners and Purifiers
and **ELECTRIC CRANES**

BABCOCK & WILCOX, Limited

HEAD OFFICE FOR CANADA - COLLEGE ST. (ST. HENRY), MONTREAL
TORONTO OFFICE, TRADERS BANK BUILDING

Every Engineer Should Have a Good Kit of Tools
STARRETT TOOLS
Perhaps you men in the power plant don't need measuring instruments often, but when you do want a rule, or a square, or a micrometer, you'll want it badly. Then you will wish you had in your kit a few
Starrett Tools
be needed frequently, but we want you to get acquainted with our other tools as well. You will find them all at your hardware store or by sending for a free copy of catalog No. 21CD, describing 2100 styles and sizes.
The L. S. Starrett Co.
The World's Greatest Toolmakers
Athol, Mass., U.S.A.

The Wrench of 25% Greater Efficiency

TRIMO PIPE WRENCH

Two new features have been recently added to the Trimo Pipe Wrench, namely Nut-Guards, in all sizes, and unbreakable steel frames, in leading sizes.

The Nut-Guards prevent the accidental rotation of the nut while in use.

These improvements add 25% to the usefulness of the tool.

The Trimo Pipe Wrench is made with wood handles in 4 sizes, 6-in., 8-in., 10-in., 14-in. and in steel handles in all sizes, 6-in. to 48-in. inclusive.

All Trimo Pipe Wrench parts are interchangeable.

The inserted jaw in the handle can be readily replaced when worn, thus adding to the life of the tool.

Nut with Nut-Guards

Inquiries from Importers and Dealers Solicited. Send for Catalogue No. 55.

TRIMONT MANUFACTURING CO.

Cable Address: Triwrench
Code: Western Union

Roxbury (Boston) Mass., U.S.A.

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

POWER HOUSE BUYERS' DIRECTORY

If what you want is not listed here write us, and we will tell you where to get it. Let us suggest that you consult also the advertisers' index facing the inside back cover, after having secured advertisers' names from this directory. The information you desire may be found in the advertising pages This department is maintained for the benefit and convenience of our readers. The insertion of our advertisers names under proper headings is gladly undertaken, but does not become part of an advertising contract.

AIR COCKS
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

AIR VALVES
Mueller Mfg. Co., H., Sarnia, Ont.

AMMETERS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. H. W. Johns-Manville Co., Toronto, Ont.

AMMONIA VALVES AND FITTINGS
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Frick Co., Waynesboro, Franklin Co., Pa.
Homestead Valve Mfg. Co., Pittsburgh, Pa.
York Mfg. Co., York, Pa.

AMMONIA PURIFIERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Mfg. Co., York, Pa.

AMMONIA TANKS
Waterous Engine Works Co., Brantford, Ont.

ARCHES, COMBUSTION CHAMBER
Canadian Fairbanks-Morse Co., Ltd. Montreal.

ASH CARRYING SYSTEMS
Babcock & Wilcox, Ltd. Montreal.
Waterous Engine Works Co., Brantford, Ont.

ASBESTOS SPECIALTIES
Durabla Mfg. Co., New York, N.Y.
Garlock Packing Co., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

AUTOMATIC ICE RECORDING DOORS AND CHUTES
Jamison Cold Storage Door Co., Hagerstown, Md.

BABBITT AND ANTI-FRICTION METAL
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Hoyt Metal Co., Toronto.
Magnolia Metal Co. Montreal.
Wm. C. Wilson & Co., Toronto.

BALL BEARINGS
Can. S K F Co., Toronto, Ont.

BALLCOCKS
D'Este Co., Julian, Boston, Mass.

BATTERIES AND ACCESSORIES
Can. H. W. Johns-Manville Co., Toronto, Ont.

BELT CEMENT
Graton & Knight Mfg. Co., Montreal.

BELT DRESSING
Cling Surface Co., Buffalo.
Jos. Dixon Crucible Co., Jersey City.
Dominion Belting Co., Hamilton, Ont.
Graton & Knight Mfg. Co., Montreal.

BELT LACING, LEATHER
Graton & Knight Mfg. Co., Montreal.

BELT TIGHTENERS
Waterous Engine Works Co., Brantford, Ont.

BELT PULLEYS
American Pulley Co., Philadelphia, Pa.
Waterous Engine Works Co., Brantford, Ont.

BELTING, BALATA
Federal Engineering Co., Toronto, Ont.

BELTING, LINK
Graton & Knight Mfg. Co., Montreal.
Waterous Engine Works Co., Brantford, Ont.

BELTING, STITCHED COTTON DUCK
Dominion Belting Co., Hamilton, Ont.

BELTING, LEATHER
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Garlock Packing Co., Hamilton, Ont.
Goodyear Tire & Rubber Co., Toronto.
Graton & Knight Mfg. Co., Montreal.
D. K. McLaren Ltd., Montreal.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

BELTING, RUBBER
Can. H. W. Johns-Manville Co., Toronto, Ont.
Goodyear Tire & Rubber Co., Toronto.
Jeffrey Manufacturing Co., Montreal.
Peerless Mfg. Co., New York, N.Y.
Thomson-Gordon, Ltd., Hamilton, Ont.

BELTING, WOVEN COTTON
Federal Engineering Co., Toronto, Ont.

BINS, COAL, COKE AND ORE
Jeffrey Manufacturing Co., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford, Ont.

BLOWERS
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd. Montreal
Can. Sirocco Co., Windsor, Ont.
C. T. Coe Co., 10 Johnston St., Newark, N.J
Coppus Eng. & Equip. Co., Worcester, Mass.
Sturtevant Co. of Canada, Ltd., B. F., Galt, Ont.

BOILER COMPOUNDS
Beveridge Paper Co., Ltd., Montreal, Que.
Can. Economic Lubricant Co., Montreal, Que.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Wm. C. Wilson & Co., Toronto.

BOILER COMPOUND FEEDERS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Morehead Mfg. Co., Woodstock.
Lunkenheimer Co., Cincinnati, O.

BOILER FEED PUMPS
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Allis Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Ltd., Montreal, Que.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Laurie & Lamb, Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

BOILER FEED REGULATORS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Mason Regulator & Engineering Co., Montreal.

BOILER GRAPHITE
Joseph Dixon Crucible Co., Jersey City, N.J.

BOILER MOUNTINGS
Babcock & Wilcox, Ltd. Montreal.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Ltd., Montreal, Que.
Inglis Co., The John, Toronto, Ont.
Lunkenheimer Co., Cincinnati, O.
Mason Regulator & Engineering Co., Montreal.

BOILER HOUSE ACCESSORIES
Babcock & Wilcox, Ltd. Montreal.
Canadian Griscom-Russell Co., Ltd., Montreal.
Cole, Ltd., Geo. W., Toronto.
Mason Regulator & Engineering Co., Montreal.

BOILER SEAM PROTECTOR
National Boiler Seam Protector Co., Montreal.

BOILER SETTINGS
Beveridge Paper Co., Montreal.
Gates, John W., St. James St., Montreal.

BOILER TUBE CLEANERS
Babcock & Wilcox, Ltd. Montreal.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Cole, Ltd., Geo. W., Toronto.
Garlock Packing Co., Hamilton, Ont.
Liberty Mfg. Co., Pittsburg.
Laurie & Lamb, Montreal.
Pilley Packing and Flue Brush Mfg. Co., St. Louis, Mo.

BOILERS, HORIZONTAL, RETURN, TUBULAR AND WATERTUBE
Babcock & Wilcox, Ltd. Montreal.
Cole, Ltd., Geo. W., Toronto.
Goldie & McCulloch Co., Galt.
Frick Co., Waynesboro, Franklin Co., Pa.
Inglis Co., The John, Toronto, Ont.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Jones Underfeed Stoker Co., Toronto.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Ladd, The Geo. T., Co., Pittsburgh, Pa.
McAvity, T., & Sons, Ltd., St. John, N.B.
Waterous Engine Works Co., Brantford, Ont.

BOILERS, MARINE, LOCOMOTIVE AND VERTICAL
Babcock & Wilcox, Ltd. Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Goldie & McCulloch Co., Galt.
Inglis Co., The John, Toronto, Ont.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
John McDougall Caledonian Iron Works, Montreal.
Waterous Engine Works Co., Brantford, Ont.

BOOKS
Audel & Co., Theo, New York, N.Y.
MacLean Publishing Co., Toronto.

BRASS FOUNDERS
McAvity, T., & Sons, Ltd., St. John, N.B.
D'Este Co., Julian, Boston, Mass.
Mueller Mfg. Co., H., Sarnia, Ont.

BRINE COOLERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

BRINE TANKS
Frick Co., Waynesboro, Franklin Co., Pa.
Waterous Engine Works Co., Brantford, Ont.
York Manufacturing Co., York, Pa.

BUSHINGS
Steel Mill Packing Co., Windsor, Ont.

CABLE
Wm. C. Wilson & Co., Toronto.

CALORIMETERS
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Taylor Instrument Co., Rochester, N.Y.

CANS, OILY WASTE
Jas. Morrison Brass Mfg. Co., Toronto.

CAST IRON FITTINGS
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.

CASTINGS, BRASS AND IRON
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Lunkenheimer Co., Cincinnati, O.
John McDougall Caledonian Iron Works Co., Ltd., Montreal.
McAvity, T., & Sons, Ltd., St. John, N.B.
Mueller Mfg. Co., H., Sarnia, Ont.
Waterous Engine Works Co., Brantford, Ont.

CELLAR DRAINERS
Mueller Mfg. Co., H., Sarnia, Ont.

CEMENT, HIGH TEMPERATURE
Beveridge Paper Co., Montreal.
Gates, John W., St. James St., Montreal.

CEMENT, PIPE JOINT
Wm. C. Wilson & Co., Toronto.

CEMENT MACHINERY
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Waterous Engine Works Co., Brantford, Ont.

CHAIN DRIVES
Morse Chain Co., Ithaca, N.Y.

CHAIN WHEELS
Babbitt Steam Specialty Co., New Bedford, Mass.

CHIMNEYS, STEEL
Babcock & Wilcox, Ltd. Montreal

CHUTES, COAL
Can. Allis-Chalmers, Ltd., Toronto, Ont.

CLOCKS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Foxboro Co., The, Foxboro, Mass.

CLOSETS
Mueller Mfg. Co., H., Sarnia, Ont.

CLUTCHES
Waterous Engine Works Co., Brantford, Ont.

COAL
Dom. Coal Co., Montreal.

COAL AND ASH CONVEYORS
Babcock & Wilcox, Ltd. Montreal.
Jeffrey Manufacturing Co., Montreal.
Waterous Engine Works Co., Brantford, Ont.

COAL HANDLING MACHINERY
Babcock & Wilcox, Ltd. Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Jeffrey Manufacturing Co., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford, Ont.

COAL HOLE COVERS
Can. Allis-Chalmers, Ltd., Toronto, Ont.

COILS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

COLD STORAGE INSULATION
Armstrong Cork & Insulation Co., Montreal, Que.
Beveridge Paper Co., Ltd., Montreal, Que.

COMMUTATOR TRUING DEVICES
Jordan Bros., Inc., New York, N.Y.

CONDENSERS
Alberger Heater Co., Buffalo, N.Y.
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Toronto.
Belliss & Morcom, Birmingham, Eng.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Darling Bros., Ltd., Montreal, Que.
Goldie & McCulloch Co., Galt.
Laurie & Lamb, Montreal.
John McDougall Caledonian Iron Wks., Montreal.
Waterous Engine Works Co., Brantford.

CONDENSERS, AMMONIA AND STEAM
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

COLLECTORS, PNEUMATIC
Sturtevant Co. of Canada, B. F., Galt, Ont.

CONSULTING ENGINEERS
Walter J. Francis, Montreal.
Laurie & Lamb, Montreal.

COLD STORAGE DOORS AND WINDOWS
Jamison Cold Storage Door Co., Hagerstown, Md.

COMPRESSORS, AIR
American Steam Pump Co., Battle Creek, Mich.
Belliss & Morcom, Birmingham, Eng.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Darling Bros., Ltd., Montreal, Que.
Inglis Co., The John, Toronto, Ont.
Laurie & Lamb, Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Smart-Turner Machine Co., Ltd., Hamilton.
Taylor Instrument Co., Rochester, N.Y.

COMPRESSORS, GAS
Can. Allis-Chalmers, Ltd., Toronto, Ont.

CONDUITS
Can. H. W. Johns-Manville Co., Toronto, Ont.

CONDENSATION RECEIVER
Cole, Ltd., Geo. W., Toronto.
G. M. Davis Regulator Co., Chicago.

CONNECTIONS, FLANGED
Jefferson Union Co., Lexington, Mass.
Dart Union Co., Ltd., Toronto, Ont.

CONCRETE HARDENER
Beveridge Paper Co., Montreal.

CONTRACTORS' STRUCTURAL STEEL
Canadian Fairbanks-Morse Co., Ltd. Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.

CONVEYOR MACHINERY
Babcock & Wilcox, Ltd. Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Jeffrey Manufacturing Co., Montreal.
Waterous Engine Works Co., Brantford.

COOLER, DOORS
Jamison Cold Storage Door Co., Hagerstown, Md.

CORK INSULATION
Armstrong Cork & Insulation Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.

COTTON HOSE
Garlock Packing Co., Hamilton Ont.
COUNTERS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Foxboro Co., The, Foxboro, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
COUNTERSHAFTS
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
COUPLINGS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Jeffrey Manufacturing Co., Montreal.
McAvity & Sons, T., St. John, N.B.
COUPLINGS, BOILER, FLANGED PIPE, JOINT PIPE, UNION, STEAM PIPE
Jefferson Union Co., Lexington, Mass.
Dart Union Co., Ltd., Toronto, Ont.
COUPLINGS, SHAFT
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
CRANES, ALL KINDS
Babcock & Wilcox, Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
CRANES, ELECTRIC
Babcock & Wilcox, Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
CRANES, HAND POWER
Babcock & Wilcox, Ltd., Montreal.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Smart-Turner Machine Co., Ltd., Hamilton.
CRANES, OVERHEAD TRAVELLING
Babcock & Wilcox, Ltd., Montreal.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Smart-Turner Machine Co., Ltd., Hamilton.
CRANES, POST JIB
Babcock & Wilcox, Ltd., Montreal.
CRANES, SWING JIB
Babcock & Wilcox, Ltd., Montreal.
CRANES, WALL
Babcock & Wilcox, Ltd., Montreal.
CRANK AND CROSSHEAD PIN OILERS
Lunkenheimer Co., Cincinnati, O.
CRIMPS, LEATHER
Graton & Knight Mfg. Co., Montreal.
CRUSHING MACHINERY
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Jeffrey Mfg. Co., Columbus, Ohio.
CYLINDER OIL
E. H. Kellogg & Co., New York.
DAMPER REGULATORS
Babcock & Wilcox, Ltd., Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Darling Bros., Ltd., Montreal, Que.
G. M. Davis Regulator Co., Chicago.
D'Este Co., Julian, Boston, Mass.
Elliott Co., Pittsburgh, Pa.
Mason Regulator Co., Boston, Mass.
Jas. Morrison Brass Mfg. Co., Toronto.
DISCS, FIBRE
Beveridge Paper Co., Ltd., Montreal, Que.
DISCS, LEATHER
Graton & Knight Mfg. Co., Montreal.
DISTILLING APPARATUS
Canadian Griscom-Russell Co., Ltd., Montreal.
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.
DOORS, COLD STORAGE AND FREEZER
Jamison Cold Storage Door Co., Hagerstown, Md.
DOUBLE PIPE CONDENSERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.
DRYING MACHINERY
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Sirocco Co., Windsor, Ont.
DUST SEPARATORS
Sturtevant Co. of Canada, B. F., Galt, Ont.
DYNAMOS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Sturtevant Co. of Canada, B. F., Galt, Ont.
ECONOMIZERS
Babcock & Wilcox, Ltd., Montreal.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Green Fuel Economizer Co., New York, N.Y.
EJECTORS
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.
Smart-Turner Machine Co., Ltd., Hamilton.
ELECTRICAL ACCESSORIES AND MACHINERY
Can. H. W. Johns-Manville Co., Toronto, Ont.
Beveridge Paper Co., Ltd., Montreal, Que.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Electric Prod. & Mfg. Co., Montreal, Que.
Manufacturers & Contractors, New York.
ELECTRICAL SUPPLIES
Can. General Electric Co., Toronto, Ont.
Can. H. W. Johns-Manville Co., Toronto, Ont.
ELEVATORS
MacKinnon, Holmes & Co., Sherbrooke Ont.
John MacDougall Caledonian Iron Works, Montreal
ELEVATING MACHINERY
Canadian Fairbanks-Morse Co., Ltd., Montreal
Goldie & McCulloch Co., Galt.
Jeffrey Manufacturing Co., Montreal
Waterous Engine Works Co., Brantford
ENAMELWARE
Hamilton Mfg. Co., Toronto, Ont.
ENGINEERS' SUPPLIES
Beveridge Paper Co., Ltd., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Cole, Ltd., Geo. W., Toronto.
Dominion Rubber Co., Ltd., Montreal, Que.
Jenkins Bros., Ltd., Montreal, Que.
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.
Jas. Morrison Brass Mfg. Co., Toronto.
ENGINES, AUTOMATIC AND DROP VALVE
Frick Co., Waynesboro, Franklin Co., Pa.
Waterous Engine Works Co., Brantford

ENGINES, CORLISS AND ROCKING VALVE
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Waterous Engine Works Co., Brantford.
ENGINES, DIESEL
Can. Allis-Chalmers, Ltd., Toronto, Ont.
ENGINES, GAS AND GASOLINE
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Laurie & Lamb, Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
ENGINES, STEAM
Belliss & Morcom, Birmingham, Eng.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Can. Sirocco Co., Windsor, Ont.
Goldie & McCulloch Co., Galt.
Inglis Co., The John, Toronto, Ont.
Laurie & Lamb, Montreal.
John MacDougall Caledonian Iron Works, Montreal.
Waterous Engine Works Co., Brantford.
ENGINES, HOISTING, LOGGING, CABLEWAY
Can. Allis-Chalmers, Ltd., Toronto, Ont.
ENGINES, MARINE
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
ENGINES, SAW MILL
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Laurie & Lamb, Montreal.
Waterous Engine Works Co., Brantford.
ENGINES, SINGLE COMPOUND AND TRIPLE EXPANSION
Canadian Griscom-Russell Co., Ltd., Montreal.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Laurie & Lamb, Montreal.
John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Kerr Engine Co., Walkerville.
Waterous Engine Works Co., Brantford.
ENGINES, VERTICAL
Laurie & Lamb, Montreal.
ENGINEERING BOOKS
MacLean Publishing Co., Toronto.
EXHAUST HEADS
Can. Sirocco Co., Windsor, Ont.
Darling Bros., Ltd., Montreal, Que.
Direct Separator Co., Syracuse, N.Y.
Elliott Co., Pittsburgh, Pa.
Jas. Morrison Brass Mfg. Co., Toronto.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Watson & McDaniel Co., Philadelphia.
EXPANSION JOINTS
Alberger Heater Co., Buffalo, N.Y.
Direct Separator Co., Syracuse, N.Y.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
FANS, VENTILATING
Can. Sirocco Co., Windsor, Ont.
C. T. Coe Co., 10 Johnson St., Newark, N.J.
Coppus Engr. & Equip. Co., Worcester, Mass.
Green Fuel Economizer Co., New York, N.Y.
Sturtevant Co. of Canada, B. F., Galt, Ont.
FEED WATER HEATERS
Alberger Heater Co., Buffalo, N.Y.
Babcock & Wilcox, Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Stewart Heater Co., Buffalo, N.Y.
Waterous Engine Works Co., Brantford.
FEED WATER PURIFIERS
Stewart Heater Co., Buffalo, N.Y.
FEED WATER REGULATORS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Chaplin, Fulton Mfg. Co., Pittsburg, Pa.
Elliott Co., Pittsburgh, Pa.
Laurie & Lamb, Montreal.
FILTERS
Bowser & Co., Inc., S. F., Toronto, Ont.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
FILTERS, WATER
Canadian Griscom-Russell Co., Ltd., Montreal.
Darling Bros., Ltd., Montreal, Que.
Frick Co., Waynesboro, Franklin Co., Pa.
Scaife & Sons, Wm. B., Pittsburgh, Pa.
York Manufacturing Co., York, Pa.
FIRE BRICK, PLASTIC
Beveridge Paper Co., Montreal.
Gates, John W., St. James St., Montreal.
FIREPROOF COLD STORAGE DOORS AND WINDOWS
Jamison Cold Storage Door Co., Hagerstown, Md.
FITTINGS, AIR, AUTOMOBILE, GAS, HYDRAULIC, PIPE, PIPE FLANGED, SCREWED PIPE, STEAM
Jefferson Union Co., Lexington, Mass.
Dart Union Co., Ltd., Toronto, Ont.
H. Mueller Mfg. Co., Sarnia, Ont.
FLANGED STEAM FITTINGS
Direct Separator Co., Syracuse, N.Y.
McAvity, T., & Sons, Ltd., St. John, N.B.
FLANGES
Dart Union Co., Ltd., Toronto, Ont.
Jefferson Union Co., Lexington, Mass.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
FLOORING COMPOSITION
Armstrong Cork & Insulation Co., Montreal, Que.
FLUE CLEANERS
Babcock & Wilcox, Montreal.
Liberty Mfg. Co., Pittsburg, Pa.
Pilley Packing and Flue Brush Mfg. Co., St. Louis, Mo.
William B. Pierce Co., Buffalo, N.Y.
Wm. C. Wilson & Co., Toronto.
FLUE GAS ANALYSIS INSTRUMENTS
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Uehling Instrument Co., New York.
Precision Instrument Co., Detroit, Mich.
Penberthy Injector Co., Windsor, Ont.
FLUMES, STEEL
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
FREEZER DOORS
Jamison Cold Storage Door Co., Hagerstown, Md.
FRICTION LEATHERS
Graton & Knight Mfg. Co., Montreal.
FURNACES, BOILER
Gates, J. W., Montreal, P.Q.
FURNACES, SMOKELESS
Babcock & Wilcox, Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Detroit, Mich.
FUSES
Can. H. W. Johns-Manville Co., Toronto, Ont.
Economy Fuse & Mfg. Co. of Canada, Montreal.
GAS ANALYSIS INSTRUMENTS, ETC.
Penberthy Injector Co., Windsor, Ont.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Uehling Instrument Co., New York, N.Y.
GASKETS, RUBBER, ASBESTOS, LEAD, COPPER AND LEATHER
Can. H. W. Johns-Manville Co., Toronto, Ont.
Durabla Mfg. Co., New York, N.Y.
Frick Co., Waynesboro, Franklin Co., Pa.
Garlock Packing Co., Hamilton, Ont.
Graton & Knight Mfg. Co., Montreal.
Peerless Rubber Mfg. Co., New York, N.Y.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.
GAS COLLECTORS
Precision Instrument Co., Detroit, Mich.
GAS PRODUCER PLANTS
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Laurie & Lamb, Montreal.
GAUGE COCKS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Garlock Packing Co., Hamilton, Ont.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.
W. J. Wall, Montreal.
GAUGE GLASSES
Wm. C. Wilson & Co., Toronto.
GAUGES, AMMONIA, OIL, GAS, AIR
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
GAUGES, PRESSURE, VACUUM, DRAFT AND RECORDING, AND MICROMETER
Babcock & Wilcox, Montreal.
Foxboro Company, Foxboro, Mass.
Lunkenheimer Co., Cincinnati, O.
Precision Instrument Co., Detroit, Mich.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.
GAUGES, WATER
Babcock & Wilcox, Montreal.
Jenkins Bros., Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
Penberthy Injector Co., Windsor, Ont.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
GEARS, FIBRE CUT
Beveridge Paper Co., Ltd., Montreal, Que.
GEARS, CUT, WORM, MORTISE
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
GENERATORS, STEAM TURBO
Can. General Electric Co., Toronto, Ont.
Laurie & Lamb, Montreal.
GENERATORS AND CONVERTORS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. General Electric Co., Toronto, Ont.
GOVERNORS, ENGINE
Escher Wyss & Co., Montreal, Que.
McAvity, T., & Sons, Ltd., St. John, N.B.
Waterous Engine Works Co., Brantford.
GRAPHITE, BOILER
Jos. Dixon Crucible Co., Jersey City.
Wm. C. Wilson & Co., Toronto.
GRATES, DUMPING, ROCKING, STATIONARY
Babcock & Wilcox, Montreal.
Boiler Repair & Grate Bar Co., Toronto, Ont.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
C. T. Coe Co., 10 Johnson St., Newark, N.J.
Galt Foundry Co., Galt, Ont.
Mason Regulator & Engineering Co., Montreal.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Waterous Engine Works Co., Brantford.
GREASE CUPS
Albany Lubricating Co., New York City.
Detroit Lubricator Co., Walkerville.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.
GREASE AND OIL EXTRACTORS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Canadian Griscom-Russell Co., Ltd., Montreal.
Elliott Co., Pittsburgh, Pa.
Laurie & Lamb, Montreal.

Use Much Less Fuel

You can save yourself and Canada 8 to 20% of the fuel you use to-day. You can make your steam heated equipment produce up to 50% greater volume.

This Morehead Back-to-Boiler System takes the condensation from steam lines and returns it to the boilers as pure HOT feed water.

Would not economies achieved interest you? Write.

Canadian Morehead Mfg. Co.
Dept. A
Woodstock, Ontario

Morehead
Back to Boiler
SYSTEM

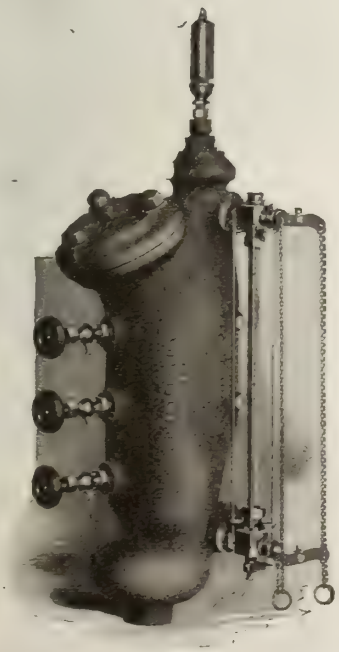
SCANDINAVIA
FEDERAL ENGINEERING & SUPPLIES LTD.
TORONTO
BELTING

Original Solid Woven Cotton Belt

SCANDINAVIA BELTS can be used in most places where leather can be used; on all direct drives, whether straight or crossed, on shifters; in hot places; in oily places; in dusty places.

FEDERAL ENGINEERING CO., LIMITED
172 John St., Toronto

Water Neared the Danger Zone



The engineer was oiling. No one was near the register. The water dropped lower.....lower. Trouble seemed inevitable. Then—*in time*—

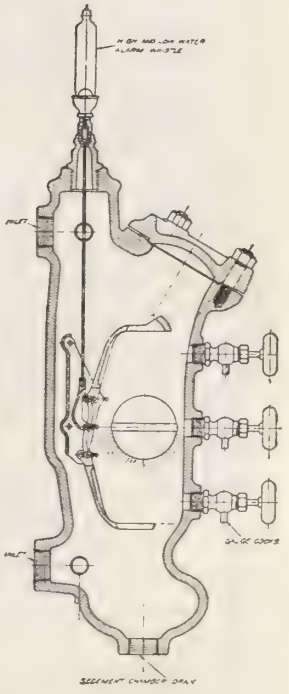
Anderson Water Column

Sounded the Alarm

The engineer, before the alarm sounded, never gave a thought to whether the boiler water was rising above or falling below danger level. His whole attention was given to the work of the moment—*as it ought to be.*

It is this feeling of security, this subconscious awareness of perfect protection, that moves users of the Anderson Water Column to speak enthusiastically of it.

Write us for full details and names of users.



The V. D. Anderson Company

1935 West 96th St., Cleveland, Ohio

If any advertisement interests you, tear it out now and place with letters to be answered

GREASES
Albany Lubricating Co., New York City.
Can. Economic Lubricant Co., Montreal, Que.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Jos. Dixon Crucible Co., Jersey City.
Wm. C. Wilson & Co., Toronto.

HAND LEATHERS OR PADS
Graton & Knight Mfg. Co., Montreal.

HANGERS
Can. General Electric Co., Toronto, Ont.
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Can. S K F Co., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Goldie & McCulloch Co., Galt.
Waterous Engine Works Co., Brantford.

HEATERS
Alberger Heater Co., Buffalo, N.Y.
Babcock & Wilcox, Ltd., Montreal.
Can. Sirocco Co., Windsor, Ont.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
Laurie & Lamb, Montreal.
McAvity & Sons, T., St. John, N.B.
Scaife & Sons, Wm. B., Pittsburgh, Pa.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Waterous Engine Works Co., Brantford.

HEATERS, EXHAUST STEAM
Can. Allis-Chalmers, Ltd., Toronto, Ont.

HEATERS, METERING
Can. Allis-Chalmers, Ltd., Toronto, Ont.

HEATING SYSTEMS, FANS
Can. Sirocco Co., Windsor, Ont.

HOISTS, GRIP
Jordan Bros., Inc., New York, N.Y.

HOISTING AND CONVEYING MACHINERY
Babcock & Wilcox, Ltd., Montreal.
Waterous Engine Works Co., Brantford.

HOSE, METALLIC
Pennsylvania Flexible Metallic Tubing Co., Boston, Mass.

HOSE, STEAM, SUCTION AND WATER
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Asbestos Co., Montreal.
Garlock Packing Co., Hamilton, Ont.
Goodyear Tire & Rubber Co., Toronto.
Peerless Rubber Mfg. Co., New York, N.Y.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

HYDRAULIC ACCUMULATORS
Smart-Turner Machine Co., Ltd., Hamilton.

HYDRAULIC MACHINERY
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
John McDougall Caledonian Iron Wks., Montreal.

HYDRAULIC PRESSES
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

ICE MAKING MACHINERY
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Griscom-Russell Co., Ltd., Montreal.
Frick Co., Waynesboro, Franklin Co.
Linde Canadian Refrigeration Co., Montreal.
York Mfg. Co., York, Pa.

INDICATORS, ELECTRIC—ALL TYPES
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Uehling Instrument Co., New York, N.Y.

INDICATORS, STEAM AND GAS ENGINE
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Canadian Fairbanks-Morse Co., Montreal.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Uehling Instrument Co., New York, N.Y.

INDICATORS—AMMONIA, HYDRAULIC
Can. Detroit Lubricator Co., Walkerville, Ont.

INDICATORS, SPEED
L. S. Starrett Co., Athol, Mass.

INJECTORS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

INSULATING BRICK
Armstrong Cork & Insulation Co., Montreal, Que.
Beveridge Paper Co., Ltd., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.

INSULATORS
Ed. Bennis & Co., Little Fulton, Bolton, Eng.
Beveridge Paper Co., Ltd., Montreal, Que.

IRON FILLER
Can. H. W. Johns-Manville Co., Toronto, Ont.

LACE LEATHERS
Graton & Knight Mfg. Co., Montreal.
Wm. C. Wilson & Co., Toronto.

LAMPS, ARC
Canadian Fairbanks-Morse Co., Montreal.
Can. General Electric Co., Toronto, Ont.
Can. H. W. Johns-Manville Co., Toronto, Ont.

LAMPS, ELECTRIC
Wm. C. Wilson & Co., Toronto.

LAMPS, INCANDESCENT
Canadian Fairbanks-Morse Co., Montreal.
Can. General Electric Co., Toronto, Ont.
Can. H. W. Johns-Manville Co., Toronto, Ont
Can. Laco-Philips Co., Ltd., Toronto, Ont.

LAMPS, NITRO
Can. Laco-Philips Co., Ltd., Toronto, Ont.

LAMPS, TUNGSTEN AND NITRO
Can. General Electric Co., Toronto, Ont.
Can. Laco-Philips Co., Ltd., Toronto, Ont.

LEATHER STRAPPING
Graton & Knight Mfg. Co., Montreal

LUBRICANTS
Albany Lubricating Co., New York City.
Canadian Economic Lubricant Co., Montreal.
Jos. Dixon Crucible Co., Jersey City.

LUBRICATORS CYLINDER
Albany Lubricating Co., New York City.
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

LUBRICATORS, FORCE FEED
Can. Detroit Lubricator Co., Walkerville, Ont.
Darling Bros., Montreal.
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

LUBRICATORS, PLAIN
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

MACHINERY INSULATION
Armstrong Cork & Insulation Co., Montreal, Que.
Beveridge Paper Co., Ltd., Montreal, Que.

MANGENESITE PASTE
Wm. C. Wilson & Co., Toronto.

MECHANICAL STOKERS
Babcock & Wilcox, Ltd., Montreal.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Dertoit, Mich.

METERS, ELECTRIC
Can. H. W. Johns-Manville Co., Toronto, Ont.

METERS, STEAM
Can. Allis-Chalmers, Ltd., Toronto, Ont.

METERS, WATER
Allen General Supplies, Toronto, Ont.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Foxboro Company, Foxboro, Mass.
McAvity & Sons, T., St. John, N.B.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Precision Instrument Co., Detroit, Mich.

MIXING VALVES
Mueller Mfg. Co., H., Sarnia, Ont.

MILL AND MINING MACHINERY
Canadian Fairbanks-Morse Co., Montreal.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Goldie & McCulloch Co., Galt.
Waterous Engine Works Co., Brantford.

METER TESTERS
Mueller Mfg. Co., H., Sarnia, Ont.

MOTORS
Canadian Fairbanks-Morse Co., Montreal.
Can. General Electric Co., Toronto, Ont.

OAKUM
Wm. C. Wilson & Co., Toronto.

OFFICE RAILINGS
Jas. Morrison Brass Mfg. Co., Toronto.

OIL CUPS
Albany Lubricating Co., New York City.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

OILER, COMPOUND FEEDERS
Lunkenheimer Co., Cincinnati, O.

OILERS, GAUGE
Lunkenheimer Co., Cincinnati, O.

OILERS, MULTIPLE
Can. Detroit Lubricator Co., Walkerville, Ont.
Lunkenheimer Co., Cincinnati, O.

OIL FILTERS AND CIRCULATING SYSTEMS
Bowser & Co., Inc., S. F., Toronto, Ont.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
Jas. Morrison Brass Mfg. Co., Toronto.

OIL SEPARATORS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
Direct Separator Co., Syracuse, N.Y.
Elliott Co., Pittsburgh, Pa.
Leitch Co., Arthur S., Toronto, Ont.
Liberty Mfg. Co., Pittsburgh.
Jas. Morrison Brass Mfg. Co., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.

OILING SYSTEMS
Albany Lubricating Co., New York City.
Bowser & Co., Inc., S. F., Toronto, Ont.
Lunkenheimer Co., Cincinnati, O.

OILS, LUBRICATING
Albany Lubricating Co., New York City.
Can. Economic Lubricant Co., Montreal, Que.
Kellogg & Co., E. H., New York, N.Y.
Wm. C. Wilson & Co., Toronto.

PACKING ENGINE
Can. Asbestos Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Can. B. K. Morton Co., Toronto, Montreal.
Canuck Supply Co., Ltd., Montreal, Que.
Crane Packing Co., Chicago, Ill.
Garlock Packing Co., Hamilton, Ont.
Peerless Rubber Mfg. Co., New York, N.Y.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING FIBRE
Beveridge Paper Co., Ltd., Montreal, Que.
Can. B. K. Morton Co., Montreal, Que.
Wm. C. Wilson & Co., Toronto.

PACKING, HYDRAULIC
Can. Asbestos Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Can. B. K. Morton Co., Toronto, Montreal.
Crane Packing Co., Chicago, Ill.
Durabla Manufacturing Co., New York.
Garlock Packing Co., Hamilton, Ont.
Goodyear Tire & Rubber Co., Toronto.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, METALLIC
Can. B. K. Morton Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Crane Packing Co., Chicago, Ill.
Greene, Tweed & Co., New York.
Holmes Metallic Packing Co., Wilkesbarre, Pa.
Steel Mill Packing Co., Windsor, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, ROD
Can. Asbestos Co., Montreal, Que.
Can. B. K. Morton Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Crane Packing Co., Chicago, Ill.
Garlock Packing Co., Hamilton, Ont.
Canuck Supply Co., Ltd., Montreal, Que.
Steel Mill Packing Co., Windsor, Ont.
Peerless Rubber Mfg. Co., New York, N.Y.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, SHEET
Can. Asbestos Co., Montreal, Que.
Can. B. K. Morton Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Canuck Supply Co., Ltd., Montreal, Que.
Durabla Manufacturing Co., New York.
Garlock Packing Co., Hamilton, Ont.
Jenkins Bros., Ltd., Montreal.
Peerless Rubber Mfg. Co., New York, N.Y.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, AMMONIA, STEAM AND WATER
Can. Asbestos Co., Montreal, Que.
Can. B. K. Morton Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Canuck Supply Co., Ltd., Montreal, Que.
Crane Packing Co., Chicago, Ill.
Garlock Packing Co., Hamilton, Ont.
Greene, Tweed & Co., New York.
Goodyear Tire & Rubber Co., Toronto.
Steel Mill Packing Co., Windsor, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, LEATHER
Can. B. K. Morton Co., Toronto, Montreal.
Canuck Supply Co., Ltd., Montreal, Que.
Garlock Packing Co., Hamilton, Ont.
Graton & Knight Mfg. Co., Montreal.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING PISTON
Crane Packing Co., Chicago, Ill.

PACKING, VALVE STEM
Crane Packing Co., Chicago, Ill.

PAINTS
Wm. C. Wilson & Co., Toronto.

PAINT, DAMP RESISTING
Toch Bros., Toronto, Ont.

PENSTOCKS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.

PILLOW BLOCKS
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Waterous Engine Works Co., Brantford.

PIPE COILS
York Mfg. Co., York, Pa.

PIPE COVERINGS, STEAM, BRINE, AMMONIA AND ICE WATER
Armstrong Cork & Insulation Co., Montreal, Que.

PIPE STEEL
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

PIPE VISES AND CUTTERS
Armstrong Mfg. Co., Bridgeport, Conn.

PIPE, GAS
Can. Allis-Chalmers, Ltd., Toronto, Ont.

PIPES, WATER
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

PIPING AND FITTINGS
Frick Co., Waynesboro, Franklin Co., Pa.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
York Mfg. Co., York, Pa.

PIPING, STEAM
Babcock & Wilcox, Ltd., Montreal.

PLATE WORK
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

PLUG COCKS
Homestead Valve Mfg. Co., Pittsburgh, Pa.

PLUMBING SUPPLIES
Mueller Mfg. Co., H., Sarnia, Ont.
Wm. C. Wilson & Co., Toronto.

POWER PUMPS
American Steam Pump Co., Battle Creek, Mich
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
Waterous Engine Works Co., Brantford.
Garlock Packing Co., Hamilton, Ont.
Laurie & Lamb, Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.

POWER, TRANSMISSION MACHINERY
American Pulley Co., Philadelphia, Pa.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Goldie & McCulloch Co., Galt.
Jeffrey Manufacturing Co., Montreal.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
MacGovern & Co., New York.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Morse Chain Co., Ithaca, N.Y.
Waterous Engine Works Co., Brantford.

PRESSES
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

PRESSURE, BLOWERS, CENTRIFUGAL
Can. Sirocco Co., Windsor, Ont.

PULLEYS
American Pulley Co., Philadelphia, Pa.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Wm. Hamilton Co., Ltd., Peterboro.
Jeffrey Manufacturing Co., Montreal.
Waterous Engine Works Co., Brantford.

Wanted—

Engineers to contribute to Power House

THIS is a practical paper for practical engineers. It is an educational medium and out to help its readers. It is a technical school and a social meeting place combined. It is first, last and all the time an engineer's paper.

If you should meet two or three or a dozen of your brother engineers you would swap ideas—you'd tell of some idea you had worked out in your plant. Others would describe some pet schemes they had devised. And so you would be mutually benefited.

Why not make Power House your monthly meeting place? Why not describe in this paper some kink or scheme you have worked out and found successful? We will pay you for it and you, in turn, will be multiplying the usefulness of your idea five thousand fold!

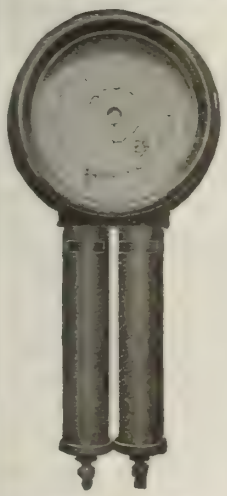
Never mind polishing up your letters—just give us the idea; that's the main thing. Never mind how crude your pencil sketch may be. We have draughtsmen who will finish up your drawings so they may be reproduced.
Try this idea a time or two and see how much satisfaction you'll get out of it. Start the ball a-rolling and thus help other engineers, yourself and your paper.

POWER HOUSE, 143-153 University Avenue, Toronto

UEHLING WASTE METER

COMBINED

CO_2 AND TEMPERATURE RECORDER



Record of CO2 and stack temperature on one chart.

Does your fireman know how much fuel he is wasting? Do you know?

The Uehling CO_2 Recorder makes a complete 24 hr. record of your combustion efficiency and the CO2 indicator at the Boiler Front holds the fireman responsible.

Get more Steam per pound of Coal and reduce your annual fuel consumption.

Let us know the number and size of your boilers and coal consumed per year, upon receipt of which information we will be glad to send you full particulars.

CO2 Indicator for Boiler Front

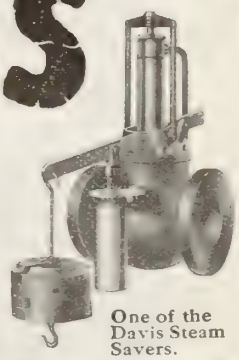
Let us hear from you. We are pioneers in the manufacture of Indicators and Recorders for Power Plant purposes.

Send for our Bulletin No. 110.

Uehling Instrument Company

2008 Empire Building New York City

DAVIS



One of the Davis Steam Savers.

PRESSURE REGULATOR

Correct Pressure and Uniform Pressure Insure Efficient Operation—

And that means the Davis.

It is built like a pair of balance scales. The steam pressure inside is balanced by weights on the outside—the action is just as visible and accurate as the action of a pair of balance scales.

No spring pressure to vary, no packing to interfere with proper action, no delicate parts needing attention and adjustment.

Simple and positive in action as the law of gravity—because it is controlled by gravity.

G. M. DAVIS REGULATOR Co

434 MILWAUKEE AVE., CHICAGO

If any advertisement interests you, tear it out now and place with letters to be answered

PULP MILL MACHINERY
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Jeffrey Manufacturing Co., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

PUMPING MACHINERY
American Steam Pump Co., Battle Creek, Mich.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Bawden Machine Co., Toronto.
Laurie & Lamb, Montreal.
McAvity & Sons, T., St. John, N.B.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.
Waterous Engine Works Co., Brantford.

PUMPING MACHINERY, ELECTRICAL
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Jeffrey Manufacturing Co., Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.

PUMPS, AIR
American Steam Pump Co., Battle Creek, Mich
Bawden Machine Co., Ltd., Toronto.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Montreal.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co. Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, CONTRACTORS'
Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
McAvity & Sons, T., St. John, N.B.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, ELECTRICAL
American Steam Pump Co., Battle Creek, Mich

PUMPS, FEED WATER
Can. Allis-Chalmers, Ltd., Toronto, Ont.

PUMP GOVERNORS AND REGULATORS
Bawden Machine Co., Ltd., Toronto.
Darling Bros., Montreal.
G. M. Davis Regulator Co., Chicago.
D'Este Co., Julian, Boston, Mass.
Elliott Co., Pittsburgh, Pa.
Mason Regulator Co., Boston, Mass.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.
Watson & McDaniel Co., Philadelphia.

PUMP STRAINERS
Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Darling Bros., Ltd., Montreal.
Liberty Mfg. Co., Pittsburgh, Pa.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, HAND AND POWER
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Darling Bros., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto

PUMPS, CENTRIFUGAL
American Steam Pump Co., Battle Creek, Mich.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Darling Bros., Montreal.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Pulsometer Engineering Co., Ltd., London, Eng.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Waterous Engine Works Co., Brantford.

PUMPS, DUPLEX
Can. Allis-Chalmers, Ltd., Toronto, Ont

PUMPS, GEARED, COMPOUND
American Steam Pump Co., Battle Creek, Mich
Bawden Machine Co., Ltd., Toronto.
Canadian Fairbanks-Morse Co., Ltd., Montreal
Darling Bros., Montreal.
Inglis Co., The John, Toronto, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, HYDRAULIC, PRESSURE
American Steam Pump Co., Battle Creek, Mich
Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Darling Bros., Montreal.
Goldie & McCulloch Co., Ltd., Toronto, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.

PUMP LEATHERS
Beveridge Paper Co., Ltd., Montreal, Que.
Can. B. F. Morton Co., Toronto, Montreal.
Graton & Knight Mfg. Co., Montreal.

PUMPS, OIL
American Steam Pump Co., Battle Creek, Mich
Bawden Machine Co., Ltd., Toronto.
Bowser & Co., Inc., S. F., Toronto, Ont.
Can. Detroit Lubricator Co., Walkerville, Ont.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, STEAM TURBO
Goldie & McCulloch Co., Ltd., Toronto, Ont
Jeffrey Manufacturing Co., Montreal
MacKinnon, Holmes & Co., Montreal, Que.
Pulsometer Engineering Co., Ltd., London, Eng.

PUMP TANK, RECEIVER
American Steam Pump Co., Battle Creek, Mich
Smart-Turner Machine Co., Hamilton, Ont.

PUMPS, STEAM
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Ltd., Toronto.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
Inglis Co., The John, Toronto, Ont.
Laurie & Lamb, Montreal.
Leitch Co., Arthur S., Toronto, Ont.
McAvity & Sons, T., St. John, N.B.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, TRIPLEX
Smart-Turner Machine Co., Hamilton, Ont.

PUMPS, VACUUM
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Ltd., Toronto.
Laurie & Lamb, Montreal.
Leitch Co., Arthur S., Toronto, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PYROMETERS
Foxboro Co., The, Foxboro, Mass.
Jas. Morrison Brass Mfg. Co., Toronto.
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.

RADIATOR TRAPS
Sarco Co., Inc., New York, N.Y.

RADIATOR AIR VENTS
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

RAGS
Wm. C. Wilson & Co., Toronto.

REBOILERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

RECEIVERS, AIR
Can. Allis-Chalmers, Ltd., Toronto, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.

RECORDING INSTRUMENTS
Can. H. W. Johns-Manville Co., Toronto, Ont.
Foxboro Co., The, Foxboro, Mass.
Precision Instrument Co., Detroit, Mich.
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.

REFRIGERATOR DOORS, WINDOWS, ETC.
Jamison Cold Storage Door Co., Hagerstown, Md.

REFRIGERATING MACHINERY
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Griscom-Russell Co., Ltd., Montreal.
Frick Co., Waynesboro, Franklin Co., Pa.
Linde Canadian Refrigeration Co., Montreal.
Vilter Mfg. Co., Milwaukee, Wis.
York Mfg. Co., York, Pa.

REFUSE DESTRUCTOR
Canadian Griscom-Russell Co., Ltd., Montreal.
Laurie & Lamb, Montreal.

REGULATORS, PRESSURE
Chaplin-Fulton Mfg. Co., Pittsburgh, Pa.
D'Este Co., Julian, Boston, Mass.
Jas. Morrison Brass Mfg. Co., Toronto.
Taylor Instrument Co., Rochester, N.Y.

REGULATORS, TEMPERATURE
Sarco Co., Inc., New York, N.Y.
Taylor Instrument Co., Rochester, N.Y.

RETORTS
MacKinnon, Holmes & Co., Sherbrooke, Que.

REVOVLING DOORS FOR HARDENING ROOMS
Jamison Cold Storage Door Co., Hagerstown, Md.

ROOFING
Wm. C. Wilson & Co., Toronto.

ROPE
Wm. C. Wilson & Co., Toronto.

ROPE PRESERVATIVE
Cling Surface Co., Buffalo.

ROTARY CONVERTERS
Canadian Fairbanks-Morse Co., Montreal.

RUBBER HOSE
Can. H. W. Johns-Manville Co., Toronto, Ont.
Garlock Packing Co., Hamilton, Ont.
Liberty Mfg. Co., Pittsburg, Pa.
Thomson-Gordon, Ltd., Hamilton, Ont.

RUBBER MOLDS
Bawden Machine Co., Ltd., Toronto.

SAFES
Canadian Fairbanks-Morse Co., Montreal.
Goldie & McCulloch Co., Galt.

SCALE REMOVERS
Babcock & Wilcox, Ltd., Montreal.
Beveridge Paper Co., Ltd., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
William B. Pierce Co., Buffalo, N.Y.

SEAM PROTECTORS, GIRTH
National Boiler Protector Co. of Canada, Montreal, Que.

SHAFTING
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Waterous Engine Works Co., Brantford.

SHAKING AND DUMPING GRATES
Babcock & Wilcox, Ltd., Montreal.
Galt Foundry Co., Galt, Ont.
Waterous Engine Works Co., Brantford.

SMOKE BOXES, STACKS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

SMOOTH-ON
Wm. C. Wilson & Co., Toronto.

SPECIAL MACHINERY
Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Waterous Engine Works Co., Brantford.

SPEED INDICATORS
Foxboro Co., The, Foxboro, Mass.
Schaeffer & Budenburg Mfg. Co., Brooklyn, N.Y.
L. S. Starrett Co., Athol, Mass.

SPLICE PROTECTORS
Jordan Bros., Inc., New York, N.Y.

SPROCKET CHAIN ATTACHMENTS
Waterous Engine Works Co., Brantford.

SPROCKET RIMS
Babbitt Steam Specialty Co., New Bedford, Mass.

SPUR WHEELS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Waterous Engine Works Co., Brantford.

STACKS, STEEL
Babcock & Wilcox, Ltd., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.

STAND PIPES, STEEL
MacKinnon, Holmes & Co., Sherbrooke, Que.

STAYBOLTS, FLEXIBLE
Can. Allis-Chalmers, Ltd., Toronto, Ont.

STEAM SEPARATORS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Darling Bros., Montreal.
Direct Separator Co., Syracuse, N.Y.
D'Este Co., Julian, Boston, Mass.
Elliott Co., Pittsburgh, Pa.
Leitch Co., Arthur S., Toronto, Ont.
Penberthy Injector Co., Windsor, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Watson & McDaniel Co., Philadelphia.

STEAM SPECIALTIES
Alberger Heater Co., Buffalo, N.Y.
Canadian Fairbanks-Morse Co., Montreal.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
D'Este Co., Julian, Boston, Mass.
Liberty Mfg. Co., Pittsburg, Pa.
Lunkenheimer Co., Cincinnati, O.
Mason Regulator & Engineering Co., Montreal.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor.
Watson & McDaniel Co., Philadelphia.

STEAM TRAPS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Anderson Co., Y. D., Cleveland, O.
Canadian Fairbanks-Morse Co., Montreal.
Can. Sirocco Co., Windsor, Ont.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
Davis Regulator Co., G. M., Chicago.
D'Este Co., Julian, Boston, Mass.
Elliott Co., Pittsburgh, Pa.
J. T. Long, 84 Adam St., Montreal, Que.
Can. Morehead Mfg. Co., Woodstock.
Mason Regulator & Engineering Co., Montreal.
Nashua Mach. Co., Boston, Mass.
Sarco Co., Inc., New York, N.Y.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Watson & McDaniel Co., Philadelphia.

STEEL BARRELS
Smart-Turner Machine Co., Hamilton, Ont.

STEEL DRUMS
Smart-Turner Machine Co., Hamilton, Ont.

STEEL TANKS
Babcock & Wilcox, Ltd., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.

STOKERS
Babcock & Wilcox, Ltd., Montreal.
Ed. Bennis & Co., Little Fulton, Bolton, Eng.
Detroit Stoker Co., Detroit, Mich.
Galt Foundry Co., Galt, Ont.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Dertoit, Mich.

STRAINERS
Babcock & Wilcox, Ltd., Montreal.
Bawden Machine Co., Ltd., Toronto.
Elliott Co., Pittsburgh, Pa.
Self-Cleansing Strainer Co., Chicago.

STRUCTURAL STEEL WORK
Babcock & Wilcox, Ltd., Montreal.
MacKinnon, Holmes & Co., Ltd., Sherbrooke, Que.

SUPERHEATERS, STEAM
Babcock & Wilcox, Ltd., Montreal.

SWITCHBOARDS
Can. General Electric Co., Toronto, Ont.

SWITCHES AND SWITCH BOXES
Can. H. W. Johns-Manville Co., Toronto, Ont.

TACHOMETERS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Foxboro Co., The, Foxboro, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

TANKS, BLOW-OFF
Darling Bros., Montreal.
John McDougall Caledonian Iron Works, Montreal
Waterous Engine Works Co., Brantford.

TANKS, FREEZING, STORAGE AND WATER COOLING
Frick Co., Waynesboro, Franklin Co., Pa.

TANKS, OIL
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Bowser & Co., Inc., S. F., Toronto, Ont.
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

TANKS, WATER
Inglis Co., The John, Toronto, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

TAPPING MACHINES
Mueller Mfg. Co., H., Sarnia, Ont.

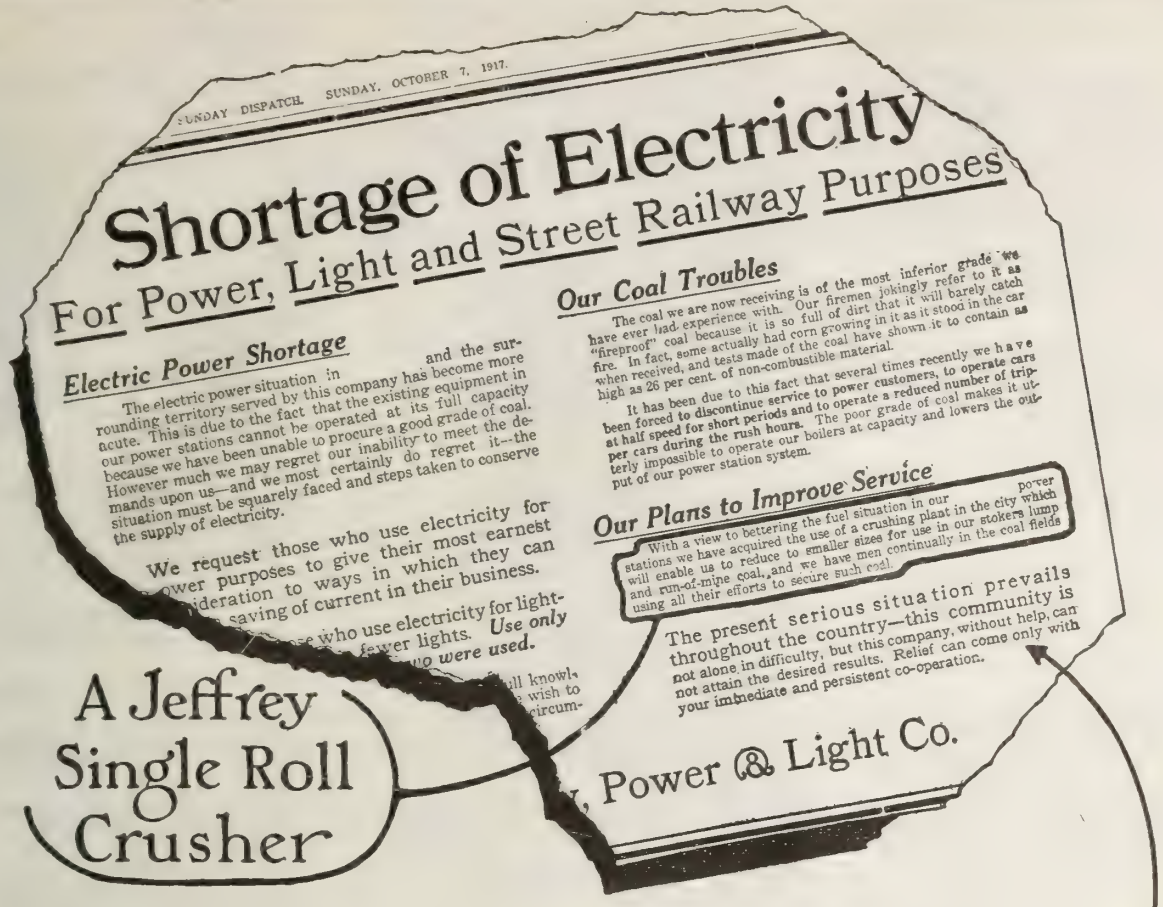
TECHNICAL BOOKS
MacLean Publishing Co., Toronto.

THERMOMETERS
Foxboro Co., The, Foxboro, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.

THERMOSTATS
Sarco Co., Inc., New York, N.Y.

TOOLS
Mueller Mfg. Co., H., Sarnia, Ont.

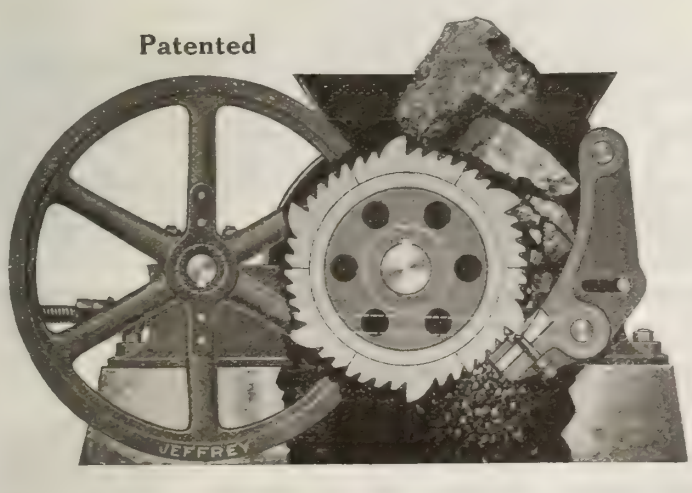
TRANSFORMERS
Can. General Electric Co., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.


SUNDAY DISPATCH. SUNDAY, OCTOBER 7, 1917.
Shortage of Electricity
For Power, Light and Street Railway Purposes
Electric Power Shortage
The electric power situation in and the surrounding territory served by this company has become more acute. This is due to the fact that the existing equipment in our power stations cannot be operated at its full capacity because we have been unable to procure a good grade of coal. However much we may regret our inability to meet the demands upon us—and we most certainly do regret it—the situation must be squarely faced and steps taken to conserve the supply of electricity.
We request those who use electricity for power purposes to give their most earnest consideration to ways in which they can saving of current in their business.
who use electricity for lighting fewer lights. Use only were used.
Our Coal Troubles
The coal we are now receiving is of the most inferior grade we have ever had experience with. Our firemen jokingly refer to it as "fireproof" coal because it is so full of dirt that it will barely catch fire. In fact, some actually had corn growing in it as it stood in the car when received, and tests made of the coal have shown it to contain as high as 26 per cent. of non-combustible material.
It has been due to this fact that several times recently we have been forced to discontinue service to power customers, to operate cars at half speed for short periods and to operate a reduced number of trip-per cars during the rush hours. The poor grade of coal makes it utterly impossible to operate our boilers at capacity and lowers the output of our power station system.
Our Plans to Improve Service
With a view to bettering the fuel situation in our power stations we have acquired the use of a crushing plant in the city which will enable us to reduce to smaller sizes for use in our stokers lump and run-of-mine coal, and we have men continually in the coal fields using all their efforts to secure such coal.
The present serious situation prevails throughout the country—this community is not alone in difficulty, but this company, without help, can not attain the desired results. Relief can come only with your immediate and persistent co-operation.
Power & Light Co.
A Jeffrey Single Roll Crusher

Are You Facing a Similar Situation?

If so, why not Crush your Run-of-Mine or Lump Coal right in your own Power House with a

Patented



JEFFREY

SINGLE ROLL

Coal Crusher

One operation reduces Lump or Run-of-Mine Coal to the proper size for maximum heat efficiency in stokers.

Bulletin No. 141-4 fully describes this machine — tells what it has done for others. Send to-day for your copy.

THE JEFFREY MFG. CO.

Canadian Branch and Warerooms, - MONTREAL

Headquarters for Chains and Attachments, Sprockets, Elevators, Buckets, Boots, Casings, Spiral and Belt Conveyer, Gears, Etc.

TRANSMISSION MACHINERY
American Pulley Co., Philadelphia, Pa.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Goldie & McCulloch Co., Galt, Ont.
Jeffrey Manufacturing Co., Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Waterous Engine Works Co., Brantford.

TRAPS, STEAM AND WATER-LINE
D'Este Co., Julian, Boston, Mass.

TRUCKS, FACTORY
Beveridge Paper Co., Ltd., Montreal, Que.
Canadian Fairbanks-Morse Co., Montreal.

TUBE CLEANERS
Babcock & Wilcox, Ltd., Montreal.
Elliott Co., Pittsburgh, Pa.
Liberty Mfg. Co., Pittsburg, Pa.
Pilley Packing and Flue Brush Mfg. Co., St. Louis, Mo.

TUBE CUTTERS
Babcock & Wilcox, Ltd., Montreal.
Liberty Mfg. Co., Pittsburg, Pa.

TUBES, BOILER
Babcock & Wilcox, Ltd., Montreal.

TUBE EXPANDERS
Babcock & Wilcox, Ltd., Montreal.
Liberty Mfg. Co., Pittsburg, Pa.

TUBING, FELXIBLE METALLIC
Pennsylvania Flexible Metallic Tubing Co., Cleveland, O.

TUNGSTEN LAMPS
Bawden Machine Co., Toronto.

TURBINE OIL
Kellogg & Co., E. H., New York, N.Y.

TUNGSTEN LAMP (Vacuum and Gas Filled Types)
Can. Laco-Phillips Co. of Toronto, Ont.

TURBINE WATER WHEELS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Boving Co., Hamilton.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.

TURBINES, STEAM
Belliss & Morcom, Birmingham, Eng.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Coe Co., C. T., 10 Johnson St., Newark, N.J.
Coppus Engr. & Equip. Co., Worcester, Mass.
Escher Wyss & Co., Montreal, Que.
Kerr Turbine Co., Wellsville, N.Y.
Laurie & Lamb, Montreal.
John McDougall Caledonian Iron Works, Montreal.
Sturtevant Co. of Canada, B. F., Galt, Ont.

UNIONS
Canadian Fairbanks-Morse Co., Montreal.
Dart Union Company, Toronto.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.

UNIONS, BALL JOINT, COMBINATION, FLANGED PIPE, GROUND JOINT, MALLEABLE IRON, FLANGE, PIPE, SWING
Jefferson Union Co., Lexington, Mass.
Dart Union Company, Ltd., Toronto, Ont.

VACUUM GOVERNORS
Smart-Turner Machine Co., Ltd., Hamilton.
Canadian Steam Boiler Equipment Co., Toronto
G. M. Davis Regulator Co., Chicago.
Leitch Co., Arthur S., Toronto, Ont.

VACUUM REGULATING VALVES
Darling Bros., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

VACUUM TRAPS
Can. Morehead Mfg. Co., Woodstock, Ont.
Can. Sirocco Co., Windsor, Ont.
Cole, Ltd., Geo. W., Toronto.
Nashua Mach. Co., Boston, Mass.

VALVE DISCS
Wm. C. Wilson & Co., Toronto.

VALVE LEATHER
Beveridge Paper Co., Ltd., Montreal, Que.
Can. B. K. Morton Co., Toronto, Montreal.
Graton & Knight Mfg. Co., Montreal.

VALVE RESEATING MACHINES
Darling Bros., Montreal.

VALVES
Babcock & Wilcox, Ltd., Montreal.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Frick Co., Waynesboro, Franklin Co., Pa.
G. M. Davis Regulator Co., Chicago.
D'Este Co., Julian, Boston, Mass.
Homestead Valve Mfg. Co., Pittsburg.
Jenkins Bros., Montreal.
Kerr Engine Co., Walkerville, Ont.
Liberty Mfg. Co., Pittsburg, Pa.
Lunkenheimer Co., Cincinnati, O.
Mason Regulator & Engineering Co., Montreal.
Mason Regulator Co., Boston, Mass.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor.
Pratt & Cady, Hartford, Conn.
Watson & McDaniel Co., Philadelphia.
Wm. C. Wilson & Co., Toronto.
York Manufacturing Co., Philadelphia.

VALVES, ACID RESISTING
Homestead Valve Mfg. Co., Pittsburg.
McAvity & Sons, T., St. John, N.B.

VALVES, BACK PRESSURE
Can. Allis-Chalmers, Ltd., Toronto, Ont.

VALVES, BLOW-OFF
Babcock & Wilcox, Ltd., Montreal.
Canadian Fairbanks-Morse Co., Montreal.
Elliott Co., Pittsburg, Pa.
Homestead Valve Mfg. Co., Pittsburg.
Jenkins Bros., Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Watson & McDaniel Co., Philadelphia.

VALVE CHAIN WHEEL
Babbitt Steam Specialty Co., New Bedford, Mass.

VALVES, FOOT
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Smart-Turner Machine Co., Ltd., Hamilton.

VALVES, GATE
Babcock & Wilcox, Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

VALVES, MULTIPORT
Can. Allis-Chalmers, Ltd., Toronto, Ont.

VALVES, NON-RETURN STOP
Canadian Fairbanks-Morse Co., Montreal.

VALVES, REDUCING
D'Este Co., Julian, Boston, Mass.
Leitch Co., Arthur S., Toronto, Ont.
Liberty Mfg. Co., Pittsburg, Pa.
Mason Regulator Co., Boston, Mass.
Jas. Morrison Brass Mfg. Co., Toronto.
Mueller Mfg. Co., H., Sarnia, Ont.
Watson & McDaniel Co., Philadelphia.

VALVES, RELIEF
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
McAvity & Sons, T., St. John, N.B.

VALVES, RADIATOR
Jenkins Bros., Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.

VALVES, POP
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.

VALVES, PUMP
Beveridge Paper Co., Ltd., Montreal, Que.
Canadian Fairbanks-Morse Co., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

VALVES, SAFETY THROTTLE
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Detroit Lubricator Co., Walkerville, Ont.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.

VALVES, VACUUM
Sarco Co., Inc., New York, N.Y.

VAULTS AND VAULT DOORS
Canadian Fairbanks-Morse Co., Montreal.
Goldie & McCulloch Co., Galt.

VENTILATING APPARATUS
Sturtevant Co. of Canada, B. F., Galt, Ont.

VOLTMETERS
Can. H. W. Johns-Manville Co., Toronto, Ont.

WASHERS, FIBRE
Beveridge Paper Co., Ltd., Montreal, Que.

WASHERS, LEATHER
Graton & Knight Mfg. Co., Montreal.

WASTE
Wm. C. Wilson & Co., Toronto.

WATER COLUMNS, GAUGES
Babcock & Wilcox, Ltd., Montreal.
Elliott Co., Pittsburg, Pa.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.
W. J. Wall, Montreal.

WATER HOSE
Can. H. W. Johns-Manville Co., Toronto, Ont.
Liberty Mfg. Co., Pittsburg, Pa.
Pennsylvania Flexible Metallic Tubing Co., Cleveland, O.

WATER LIFTERS
Watson & McDaniel Co., Philadelphia.

WATER MOTORS
Elliott Co., Pittsburg, Pa.

WATER PURIFIERS, SOFTENERS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Laurie & Lamb, Montreal.
Scaife & Sons, Wm. B., Pittsburgh, Pa.

WATER SUPPLY SYSTEMS
Mueller Mfg. Co., H., Sarnia, Ont.

WATER WHEELS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Escher Wyss & Co., Montreal, Que.
MacKinnon, Holmes & Co., Sherbrooke, Que.
John McDougall Caledonian Iron Works, Montreal

WATERWORKS SUPPLIES
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
McAvity & Sons, T., St. John, N.B.

WATTMETERS
Can. H. W. Johns-Manville Co., Toronto, Ont.

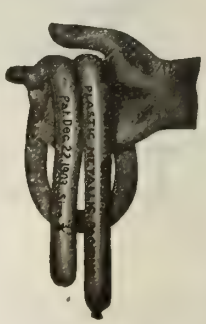
WHISTLES, PLAIN OR CHIME
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.

WIRE BRUSHES
Pilley Packing and Flue Brush Mfg. Co., St. Louis, Mo.
Penberthy Injector Co., Windsor, Ont.

WRENCHES
Greene, Tweed & Co., New York.
Trimont Mfg. Co., Roxbury, Mass.
Williams & Co., J. W., Brooklyn, N.Y.

WATER SOFTENING OR FILTRATION
FOR BOILER FEED AND ALL INDUSTRIAL USES
WM B SCAIFE & SONS CO PITTSBURGH PA

SAFETY PLASTIC
METALLIC PACKING
FOR STEAM, WATER, AIR, GAS, ETC.
Pat. Dec. 22, 1903 Highest Award World's Fair, St. Louis, 1904
GUARANTEED TO LAST THREE YEARS
WITHOUT RENEWAL
Drop us a line and let us tell you all about this Remarkable Packing.
STEEL MILL PACKING CO., WINDSOR, ONT. Established 1899
Self-Lubricating

In Bulk
Practically Frictionless

In Cotton Tubes

Don't buy that New Electrical Apparatus Just Yet

WE can supply you with high-grade apparatus that has been slightly used and discarded through no fault of its own, at an **immense saving in cost.** For instance, in many cases we take over entire plants simply because of changed conditions such as increased capacity, change of system, etc.

EVERYTHING IS OVERHAULED AND REFINISHED BY US AND **GUARANTEED** AS GOOD AS NEW, BOTH ELECTRICALLY AND MECHANICALLY.

Our catalogs of offerings should be in the hands of every power plant superintendent each time they are gotten out, and it will be worth while for anyone interested in this class of power plant equipment to be on our mailing list to receive all offerings.

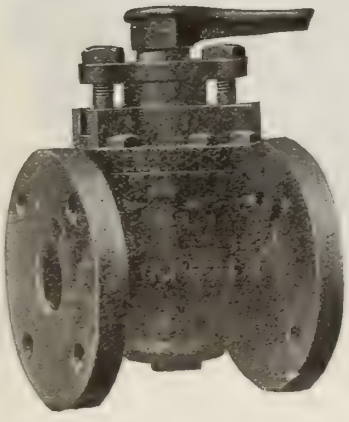
Nearly all of the principal power, lighting and street railway plants in the United States are our customers.

WRITE FOR OUR LATEST CATALOG of **Power House Equipment, Street Cars, Motors, Hoists, Compressors, etc.**

MACGOVERN & COMPANY, Inc.

114 Liberty St., New York City

Little Leaks Must Stop



Yes—It will mean endless watchfulness as long as ordinary valves are used.

But—Consider the economy of better valves.

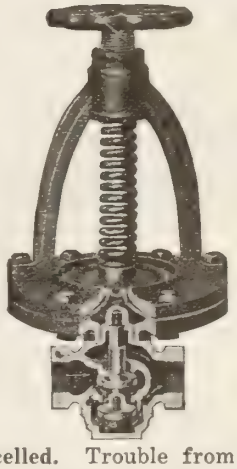
Homestead Quarter Turn Valves

Stop leaks permanently. They last several times longer than ordinary valves. Consequently the economy of using Homestead valves on all your pipe lines—and particularly on those that are now most troublesome—is obvious. Convince yourself with one Homestead Valve on trial. **Write:**

Homestead Valve Mfg. Co.
HOMESTEAD, PA.

CURTIS Engineering Specialties

CURTIS Water Pressure Regulator



The Economy of this Curtis Water Pressure Regulator (See Illustration) lies in the fact that it greatly reduces the cost of keeping plumbing in order — This by obviating the wear and tear of water hammer or concussion in pipes.

This regulator is warranted to maintain the pressure desired, **with perfect uniformity, regardless of any fluctuations of outside pressure.** The workmanship and material of the Regulator **cannot be excelled.** Trouble from rust or clogging is **entirely avoided.** Delivery of water into service pipes at any desired pressure **is guaranteed.**

Send for special leaflet and price list to the manufacturers.

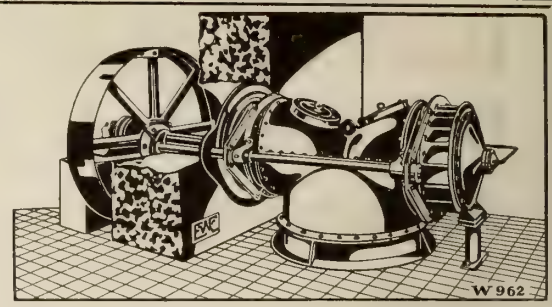
JULIAN D'ESTE COMPANY
26 Canal Street, BOSTON, MASS.

WATER - TURBINES

Francis and Tangential Wheels

GOVERNORS

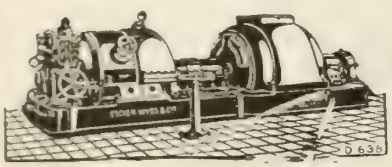
PIPELINES



ESCHER WYSS & Cie. S.A.
Zurich
Switzerland
A 173

Zoelly Steam Turbines

Turbo-Pumps



MONTREAL OFFICE : 211 Coristine Building

62-17

INDEX TO ADVERTISERS

	PAGE
A	
Albany Lubricating Co.	71
Alberger Heater Co.	52
American Steam Gauge & Valve Mfg. Co.	50
American Steam Pump Co.	8
Anderson Co., V. D.	79
Armstrong Cork Insulation Co.	11
B	
Babbitt Steam Specialty Co.	58
Babcock & Wilcox	76
Bennis & Co., Ltd., Ed.	4
Beveridge Paper Co.	75
Boiler Inspection Dept.	75
Boving Hydraulic & Eng. Co.	74
Bowser, S. F., & Co., Inc.	63
C	
Can. Assoc. Stationary Engrs.	68
Can. Bond Hanger & Coupling Co.	71
Can. Detroit Lub. Co.	66
Can. Fairbanks-Morse Co.	49
Can. General Electric Co.	9
Can. H. W. Johns-Manville Co., Ltd.	67
Can. Morehead Mfg. Co.	79
Can. S K F Co.	54
Canuck Supply Co., Ltd.	64
Chaplin-Fulton Co.	58
Cling-Surface Co.	71
Cole, Geo. W.	47
Coppus Eng. & Equip. Co.	6
Crane Packing Co.	66
D	
Darling Bros.	66
Dart Union Co.	61
Davis Regulator Co.	61
D'Este Co., Julian	85
Difford Engineering Co.	54
Dixon Crucible Co., Jos.	55
Dominion Belting Co.	72
Dominion Coal Co.	74
Durabla Mfg. Co.	50
E	
Economy Fuse & Mfg. Co. of Canada	4
Engineering and Mach. Works of Canada, Ltd.	2
Escher Wyss & Co.	86
F	
Federal Engineering Co.	79
Financial Post	60
Francis, Walter J., & Co.	55
Frick Co.	11
G	
Galt Foundry Co.	5
Garlock Packing Co.	70
Garth Co.	74
Gates, John W.	48
Goldie & McCulloch Co.	16
Graton & Knight Mfg. Co.	53
Greene, Tweed & Co.	51
H	
Holmes Metallic Packing Co.	74
Homestead Valve Mfg. Co.	85
Hoyt Metal Co.	2
I	
Inglis Co., John.	Inside back cover
J	
Jamison Cold Storage Door Co.	12
Jefferson Union Co.	65
Jeffrey Mfg. Co.	83
Jenkins Bros.	59
K	
Jones Underfeed Stoker Co., Ltd.	4
Jordan Bros., Inc.	8
Kellogg & Co., E. H.	55
Kerr Engine Co.	58
L	
Ladd Co., The Geo. T.	75
Laurie & Lamb	13
Leitch Co., The Arthur S.	6
Liberty Mfg. Co.	45
Linde Canadian Refrigeration Works Co.	10
Lunkenheimer Co.	62
M	
MacGovern & Co.	85
MacKinnon, Holmes & Co.	55
MacLean's Magazine	56
Magnolia Metal Co.	72
Mason Regulator Co.	6
Mason Regulator & Eng. Co., Ltd.	7
McAvity & Sons, T.	62
McDougall Caledonian Iron Wks. Co.	14
McGhie, W. C.	74
McLaren, D. K., Ltd.	69
Merchants Rubber Fdy.	48
Morrison Brass Mfg. Co., Jas.	Outside back cover
Morse Chain Co.	73
Mueller Mfg. Co., H.	57
Murphy Iron Works	3
N	
National Boiler Seam Protector Co.	74
P	
Penberthy Injector Co.	Front cover
Pennsylvania Flexible Metallic Tubing Co.	50
Pilley Packing & Flue Brush Mfg. Co.	75
Power Plant Equipment Co.	58
Pratt & Cady Co.	52
S	
Sarco Co., Inc.	55
Scaife, Wm. B., & Sons Co.	84
Schaeffer & Budenberg Mfg. Co.	6
Shell-Bar, Boico Supply, Ltd.	3
Smart-Turner Mach. Co.	75
Starrett, L. S., Co.	76
Steel Mill Packing Co.	84
T	
Taylor Instrument Co.	8
Thomson-Gordon, Ltd.	63
Trimont Manufacturing Co.	76
U	
Uehling Instrument Co.	81
United States Rubber Co.	Inside front cover
V	
Vilter Mfg. Co.	10
W	
Wall, W. J.	48
Waterous Engine Works Co.	1
Watson & McDaniel Co.	74
Williams & Co., J. H.	63
Wilson, Wm. C., & Co.	55
Y	
York Mfg. Co.	12

INGLIS BOILERS

Built for all Services

Made in Canada

Built to Last

INGLIS BOILERS have been used in Canada for over half a century with unqualified success. Best of materials and best of workmanship are represented in their construction, and they give long, efficient and economical service.

We are also sole Canadian makers of Erie City Water Tube Boilers, Vertical and Horizontal.

Our representatives will be pleased to show installations of our different types of boilers to prospective customers.

Write for Prices and Specifications

The John Inglis Company, Limited

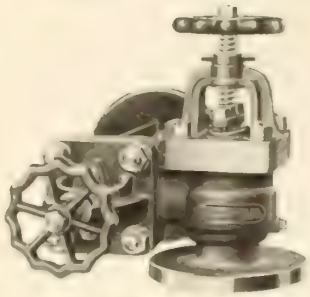
Engineers and Boiler Makers

14 Strachan Avenue TORONTO, Canada

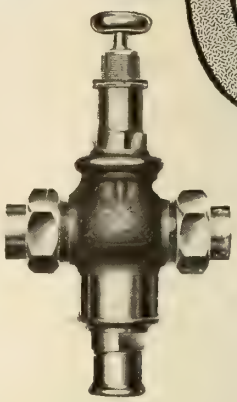
MORRISON'S

Steam Goods and Specialties

EVERYTHING FOR THE ENGINE AND BOILER ROOM



Beaver Combined Stop and Check Valve

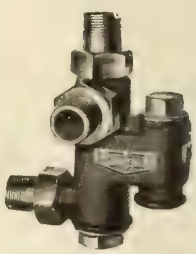


J.M.T. Reducing Valve

SOME OF OUR LINES

Stop Valves	Steam Gauges
Check Valves	Vacuum Gauges
Gate Valves	Ammonia Gauges
Safety Valves	General Boiler Mountings
Relief Valves	Gauge Board Outfits
Reducing Valves	Lubricators
Steam Traps	Pipe Fittings
Injectors	Steam Whistles
Ejectors	Engine Indicators
Inspirators	Pipes, Tools, etc.
Jet Pumps	

J.M.T. Valve

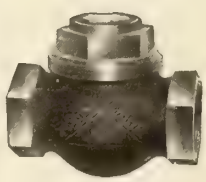


J.M.T. Injector

Gem Ejector

Beaver Valve

Pressure Gauges and Recording Instruments



J.M.T. Check Valve

J.M.T. steam goods are approved by provincial and marine inspection.

We have a valve for every purpose. Full information on request.

Made to Give Long and Efficient Service

J.M.T. products are thoroughly reliable. They are made from best materials and represent the highest type of workmanship. Every article is factory tested and guaranteed.

The James Morrison Brass Manufacturing Company, Limited

93-97 Adelaide Street West, Toronto, Ontario, Canada

POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power; and to the operation of Refrigerating Machinery.

Published by The MacLean Publishing Company, Limited, 143-153 University Ave., Toronto

MONTREAL: Southam Bldg. LONDON, ENG.: 88 Fleet St., E.C. WINNIPEG: 1207 Union Trust Bldg.

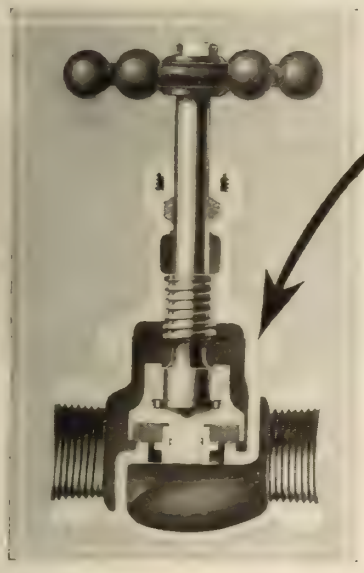
Vol XI—No. 3 Publication Office, Toronto—March, 1918 Published Monthly $1.00 per Year.

THE REASON WHY

TRADE PENBERTHY MARK **VALVES**

last longer and give so much **BETTER SATISFACTION** than other valves is due to their

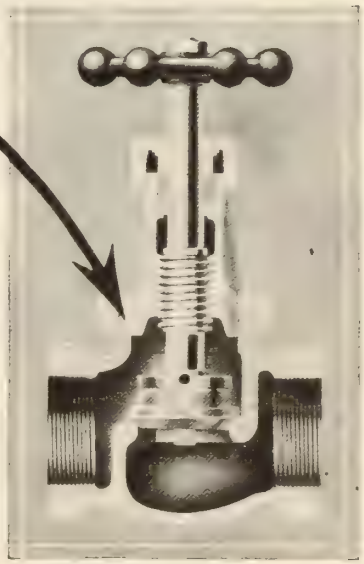
SUPERIOR CONSTRUCTION



ALL PENBERTHY VALVES HAVE THE EXTERNAL THREAD CONSTRUCTION

This Improved Construction Threads Outside of Body

(NOTE ARROWS ABOVE)



COMPODISK **REGRINDING**

Makes valve always accessible. Eliminates corrosion of threads. No corrosion prevents all strains in taking valve apart. Prevents spreading of body—causing a loose-fitting and unsafe bonnet. Makes a steam tight connection—no leaks. Permits of a more compact valve—consequently a stronger one.

For More Efficient Service Specify Penberthy

"ALL QUALITY VALVES"

Manufactured by

PENBERTHY INJECTOR CO., Limited, Windsor, Ontario

Nationalized Service In Mechanical Rubber Goods

NEVER in the history of the mechanical rubber goods industry has the public ever enjoyed so great convenience as now in securing the widest possible range of mechanical goods of the highest known quality.

That this has been accomplished in the face of these trying and unusual business conditions is due to the splendidly efficient organization of this department of the United States Rubber Company.

Our factories are located in the big centers of the east and west. Branches have been established in all the most important cities. Agents have been appointed everywhere. By this development we have created the maximum ability to serve in manufacture and distribution of the most complete line of mechanical rubber goods ever brought together under one master mark.

This line includes such famous brands as Peerless Rainbow Belting, Rainbow Packing, Sawyer Canvas Belting, Eureka Fire Hose, Giant Steam Hose, Rinex Soles, Supremo Conveyor Belting, Holdtite Friction Tape, Peerless Honest John Packing, Relio Belting, Usco Radiator Hose, Rainbesto Packing, Buckeye Splicing Tape, Four Ace Seamless Belting, Paragon Fire Hose, Anaconda Tender Hose, Peerless Air Hose, Kold-Pak Jar Rubbers, Revero Garden Hose, Spring Step Heels, Giant Seamless Belting, Giant Suction Hose, Usudarian Packing; as well as hundreds of miscellaneous rubber items such as rubber soles and heels, rubber tiling, matting, mats, plumbers' supplies, rubber thread, rubber toys and golf balls.

That dealers and buyers may recognize in all future purchases that they are receiving the superfine product in mechanical rubber goods of "the largest rubber manufacturer in the world," these goods will retain their own famous brand names, and will also bear as master trade-mark — the great seal of the United States Rubber Company—a certain means of identification.

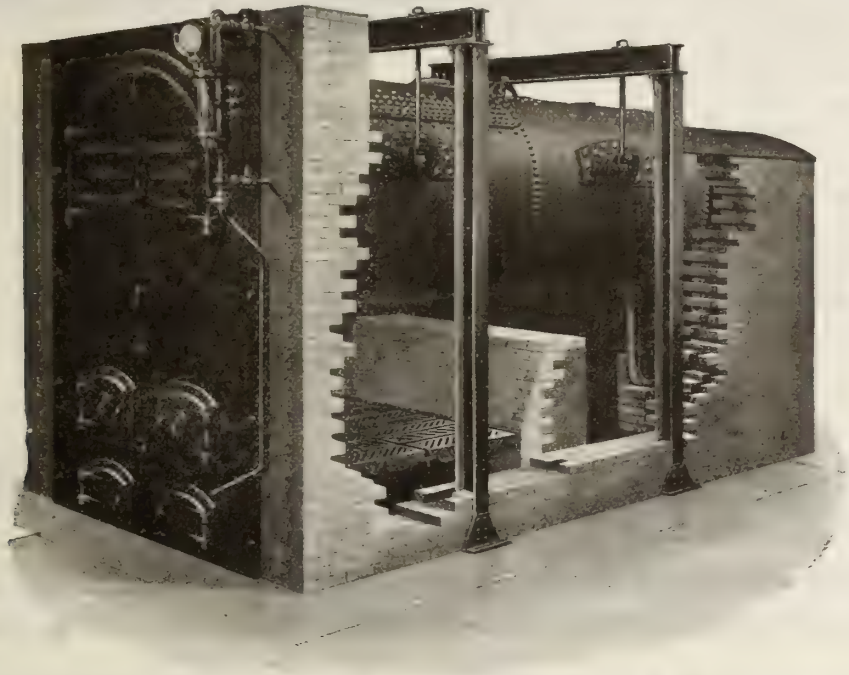
By this greatly improved representation we have nationalized mechanical rubber goods service in its broadest sense. By this increased capacity to serve, every factory, every branch, every agency becomes the actual presence, in each territory, of mechanical rubber goods headquarters.

United States Rubber Company

Mechanical Goods Division

NEW YORK

BOILERS



WATEROUS Return Tubular Boilers are quick steaming, economical of fuel and absolutely reliable.

Power Boilers up to 165 H.P. Heating Boilers in sizes to 72″ x 16′—most standard sizes carried in stock.

We can supply brick or all-steel settings designed and dimensioned to give best results with whatever fuel you are using.

Boilers in stock for immediate shipment

1—42″ x 12′
2—48″ x 14′
3—54″ x 14′
7—60″ x 14′
5—72″ x 18′

Catalogue on Request.

Waterous

BRANTFORD, ONTARIO, CANADA

If any advertisement interests you, tear it out now and place with letters to be answered.

By all means Be Sure You Get Good Babbitt Service

Good babbitt service plays an important part in industrial efficiency and economy. Thousands of horsepower are wasted every day in Canadian power houses by using inferior babbitts, when HOYT BABBITTS might just as well be used. There's no waste of power through friction in the plants where the Hoyt metals have been adopted—no fear of cutting, no over-heating of shafts. Wheels turn more smoothly and more economically with Hoyt's assistance.

There's over $5,000,000 worth of Hoyt Babbitts sold to the allied nations annually, an indication of its merits.

FROST KING Hoyt's famous general purpose babbitting metal has been introduced into the most particular power plants in the world, and is there to stay. Represents the accumulated experience of 40 years. A trial will prove its value in your plant. plant.

NICKEL GENUINE Gas and gasoline engines, marine engines and automobile engines run better with Nickel Genuine babbitting. If you once try it you will always use it. Why not put it to the test?

The Hoyt Catalog describes **Frost King** and **Nickel Genuine** and all our specific service babbitts thoroughly. Have us send it to you—contains valuable information.

Hoyt Metal Company, Toronto

NEW YORK, N.Y. LONDON, ENG. ST. LOUIS, MO.

Boilers for Quick Shipment

2 72 x 18 H. R. T., 125 lbs. W. P. Ontario Code
1 60 x 16 H. R. T., 125 lbs. W. P. Ontario Code

Locomotive Type

12 50 H.P. 125 lbs. Ontario.
1 50 H.P. 100 lbs. Quebec.
1 40 H.P. " " "
2 30 H.P. " " "
1 20 H.P. " " "

Verticals

3 25 H.P. 100 lbs. Ontario.
5 20 H.P. " " "
4 12 H.P. " " "
1 10 H.P. " " "
3 20 H.P. " " British Columbia.
1 15 H.P. " " "
1 10 H.P. " " "

Subject to prior sale we are quoting special prices on the Locomotives and Verticals.
Kindly address nearest office.

Engineering & Machine Works of Canada

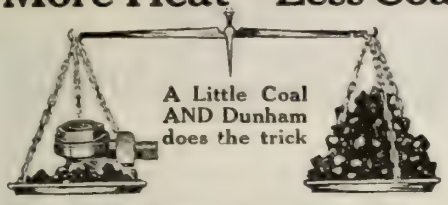
LIMITED

Formerly
The Jenckes Machine Co., Ltd.
St. Catharines Works

General Offices:
ST. CATHARINES, ONT.

Sales Offices:
710 C. P. R. Building, Toronto
344 St. James St., Montreal

More Heat—Less Coal



The Dunham Radiator Trap —the Equalizer

Made Entirely of Brass and Bronze

The Dunham Radiator Trap is the foundation of The Dunham Heating Service. It occupies a position at the outlet side of each and every radiator. It automatically allows the air and water to escape and KEEPS IN THE PRECIOUS HEAT. Right here—at the point where, in ordinary heating systems, much coal is wasted—many buckets of coal are saved daily by Dunham Service users.

In these War times it is imperative that coal be saved wherever possible. Save coal! Save coal! Save coal! is the cry that is sounding all over the Country.

The DUNHAM HEATING SERVICE

What the Dunham Radiator Trap Means to *You*

Five to ten inches of vacuum WITHOUT USE OF JET WATER.

No broken vacuum because of LEAKY TRAPS.

Superior and sustained circulation, easily *maintained on low pressure* because air and water are eliminated.

MORE HEAT—LESS COAL—LESS LABOR.

Write us today.

C. A. DUNHAM COMPANY

Toronto, Canada

Branch Offices:

Halifax, Montreal, Ottawa, Winnipeg, Vancouver, Calgary

Branches in Principal Cities in the U.S.

Murphy AUTOMATIC Furnace

FOR THE YEAR 1917

We received **60 repeat orders** for 144 Murphy Stokers—47,000 H.P. Two of these contracts covered 1500 H.P. from an industrial corporation which has had **24 years' experience with Murphy Stokers!**

We made one new installation of 10 400 H.P. units—4,000 H.P. in Canada, and under date of **January 12, 1918**, we have: "**The stokers are proving very satisfactory** and **we are well pleased with them.** The stokers **burn the coal without smoke**, and on looking at the top of the stack it is often very hard to tell there is any fire in the boiler room."

For printed matter address

MURPHY IRON WORKS,

DETROIT, MICH., or BUFFALO, N.Y.

If any advertisement interests you, tear it out now and place with letters to be answered.

An Ordinary Fireman is the Deil's Competitor at Burning Coal.

Your fireman isn't an ordinary fireman—few Canadian firemen are. Nevertheless, it is humanly impossible for a man's hands and a scoop to save the coal you can save with

JONES UNDERFEED STOKER

With Jones Stokers 85 tons of coal go as far as 100 without them. That's how soon "a Jones" will pay for itself.

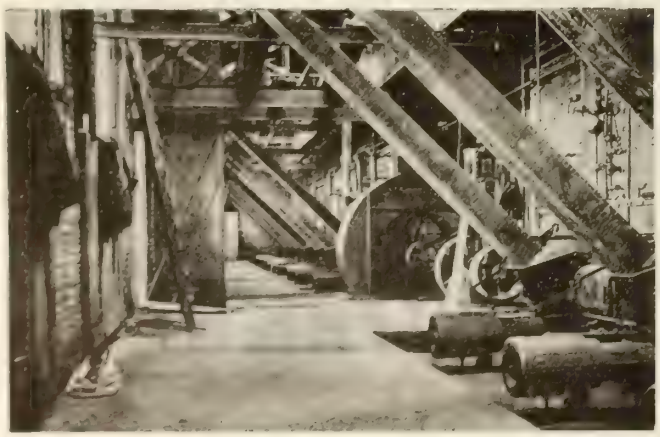
The Jones Underfeed Stoker automatically maintains a uniform steam pressure. It responds instantly to load fluctuations.

Once and for all time it eliminates the smoke nuisance.

It saves you the wages you pay your firemen.

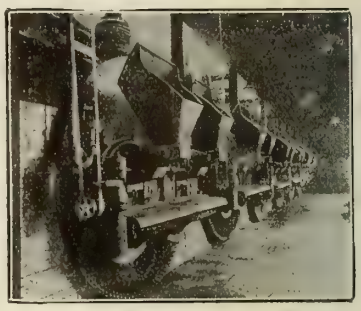
Let us get in touch with you.

Jones Underfeed Stoker
Company, Limited
37-41 Britain St. - TORONTO



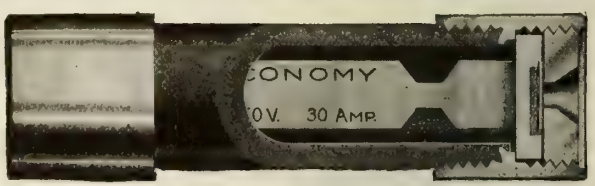
Double Your War Output

Impossible? Put a "Bennis" Machine Stoker on your boiler and see the result. There will be an immediate increase of boiler duty which will enable you to cope with heavier demands. Combined with a "Bennis" coal handling equipment the result will astonish you. Catalogues free.



Ed. Bennis & Co., Ltd.

Little Hulton, Bolton and 28 Victoria St. London S.W.I.



ECONOMY
Renewable
FUSES

Cut Annual Fuse Maintenance Costs 80%

Economy "Drop Out" Renewal Links are responsible for this saving.

A "Drop Out" Renewal Link restores a blown Economy Fuse to its original efficiency.

A sustained arc is impossible.

It's the work of a moment for even a novice to replace the link and renew the fuse.

First in its field—first in efficiency.

Order from your dealer

Economy Fuse & Mfg. Co.
Kinzie & Orleans Sts., Chicago, U.S.A.

Sole manufacturers of "ARKLESS"—The Non-Renewable Fuse with the 100% Guaranteed Indicator.

SCIENTIFIC APPROVAL

OAKLAND TECHNICAL HIGH SCHOOL,
42d and Broadway

Oakland, California,
February 2, 1917.

Magnolia Metal Co.
Gentlemen:—

The Allied Industries Department of this institution is devoted to the practical teaching of applied mechanics; including a thorough knowledge of the various materials that will enter into the student's regular work, which we regard as highly important.

We have used your MAGNOLIA METAL in our speed lathes. As an anti-friction alloy, combining the ability to withstand heavy pressures and keep cool under high speeds, with long-wearing and low oil-consuming qualities, we find that there is none superior to it.

In saying this we feel that we are only giving credit where credit is due.

Yours very truly,
WILBUR WALKER, Jr.,
M. W. HAWS,
Machine Shop Instructors.

PRACTICAL ENGINEER POCKET BOOK:
Over 600 pages. A valuable reference work imported from England and sold as an advertising medium at the low price of 40c post paid.
Address Montreal Office.

SOLD BY LEADING DEALERS EVERYWHERE OR BY
MAGNOLIA METAL CO.
OFFICE AND FACTORY:
225 St. Ambroise St. MONTREAL

Rid Your Boiler of Every Bit of Scale

BOICO
Will do it

Let us prove to you that Boico is the quick remover and positive preventive of boiler scale. And while using Boico note that it never injures packings or valves; that it never carries over in the steam or causes foaming or priming. Now **write for our liberal trial offer.**

25% More Heat to Fuel Gases Prevents Clinkers

Formation of clinkers indicates waste of fuel gases—imperfect combustion. With ample air there will be great heat, and with heat enough there cannot be clinkers.

Anti-Clinker
Shell Bar Grates

Copper Asbestos Boiler Gaskets never blow out and never stick. Made of corrugated copper, with pure asbestos, cord-filled corrugations. Use them and end all leak in pipe lines.

Daniel's P.P.P. and Ebonite Packings for all pressures. Only packing backed with scientific proof that it reduces friction.

Long tests by Mechanical Engineers proved that P.P.P. saved 75% or more friction losses. Automatically regulates bearings on rod to requirements.

insure perfect combustion, the utilizing of all fuel gases, no clinkers, no waste. Half of their total surface is air space. They are always clean and never warp. Burn slack, coal, coke or wood economically.

Write for full particulars.

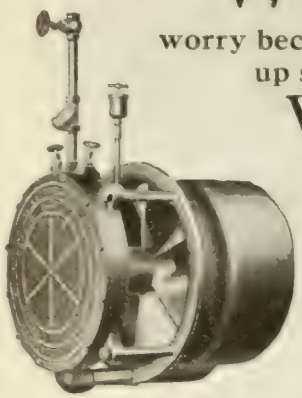
Shell-Bar Boico Supply, Limited
376 Dufferin St., Toronto, Canada

If any advertisement interests you, tear it out now and place with letters to be answered.

WHY

worry because you cannot keep up steam pressure

WHEN



it is so easy and cheap to overcome your difficulties by installing a

COPPUS TURBO BLOWER

It means constant steam pressure, regardless of uneven loads, poor draft and poor coal, and it will pay for itself in a short time on account of better combustion. It also will increase your boiler capacity to 200, and even 300%, of its normal rating without injury to the boiler. Cut out this Ad., put your name and address on the margin and mail to us. Without further trouble you will get all the particulars.

500,000 H.P.

In boilers equipped with Coppus Turbo Blowers in four years. The Coppus has replaced a great many other blowers, but no other blower has ever replaced a Coppus.

Coppus Engineering & Equipment Company
167 Union Street, Worcester, Mass.
Montreal Sales Agents:
Mason Regulator & Engineering Co.
Toronto Sales Agents:
The Power Plant Equipment Co., Toronto

MASON

Reducing Valves

Pump Regulator
Balanced Valves
Damper Regulators

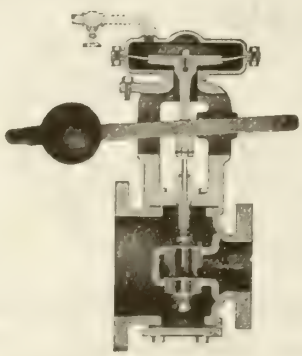
If you order a Mason you will get absolute satisfaction. This we guarantee you. You simply cannot make a mistake.

Dependable regulation under every possible condition.

Our complete catalog tells you WHY. Let us mail you a copy.

Mason Regulator Company
BOSTON, MASS.

TORONTO REPRESENTATIVES:
The Arthur S. Leitch Co.,
506 Kent Bldg., Toronto.



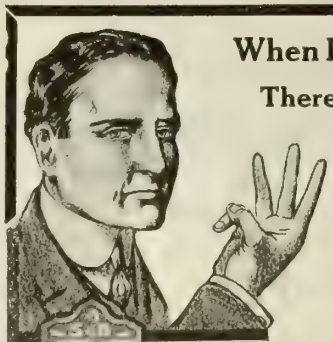
Kieley & Mueller Specialties

Regulating Valves
Back Pressure Valves
Pump Governors
Separators
Traps

FOR EVERY SERVICE

SALES ENGINEERS

THE ARTHUR S. LEITCH CO.
TORONTO



When Buying Thermometers

There's Just Three Things to Remember—

First, you must have accuracy and sensitiveness—

Second, durability is absolutely essential—

Third, the thermometer must be suitably constructed for the intended application.

Accuracy, sensitiveness and durability are absolutely guaranteed in

"Crescent" Thermometers

And with nearly seventy years of experience to our credit, we are qualified to properly interpret your needs.

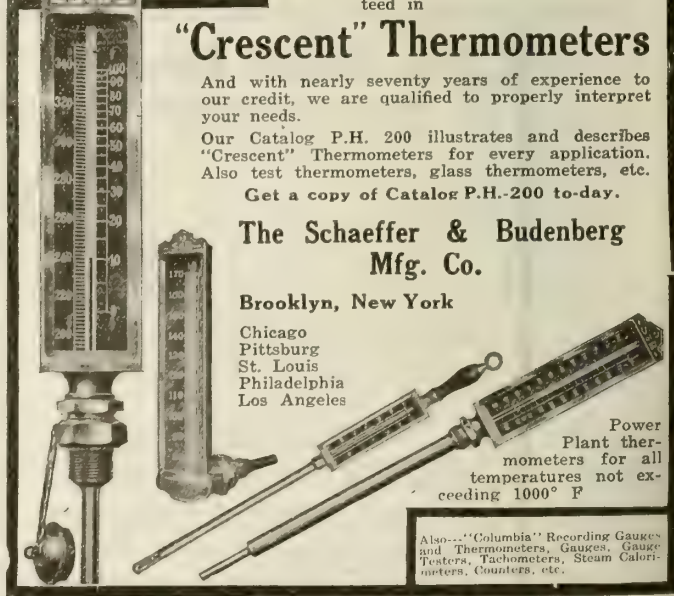
Our Catalog P.H. 200 illustrates and describes "Crescent" Thermometers for every application. Also test thermometers, glass thermometers, etc.

Get a copy of Catalog P.H.-200 to-day.

The Schaeffer & Budenberg Mfg. Co.

Brooklyn, New York

Chicago
Pittsburg
St. Louis
Philadelphia
Los Angeles



Power Plant thermometers for all temperatures not exceeding 1000° F

Also—"Columbia" Recording Gauges and Thermometers, Gauges, Gauge Testers, Tachometers, Steam Calorimeters, Counters, etc.

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

If Quality of Manufacture and Reliability in Service

have any meaning in the Engineering World, this list of our leading specialties should appeal to the best judgment of every Engineer and Power Plant Superintendent.

Mason Standard Bronze Reducing Valve

Mason Reducing Valves (Genuine),
Mason Pump Governors,
Mason Pressure Controllers.

Bundy Steam Traps for every service,
Coppus Turbine-driven Blowers,
Sims Hot Water Generators.

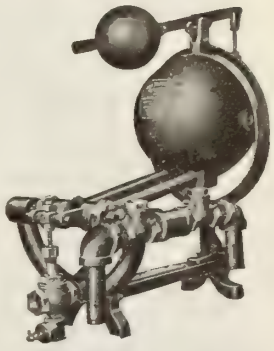
Sims Storage Heaters,
Sims Open Feed Water Heaters.

Bundy Oil Separators,
Ashton Gauges and Safety Valves.

Federal Metallic Packing,
Everlasting Blow-off Valves.

Bawden Pumps (Reciprocating & Centrifugal)
Stratton Steam Separators.

Reilly Multicoil Feed Water Heaters,
Reilly Evaporators and Distillers,
Reilly Multiscreen Feed Water Filters.



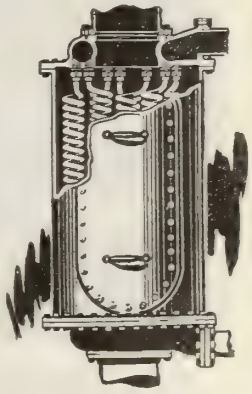
New Bundy Return Trap

Mason No. 55 Pump Pressure Regulator

ABOVE EVERYTHING

our Sales Engineers know the *practical application* of our lines to *actual conditions,* and sell from *knowledge,* not from *catalogs.* We furnish *results,* not merely *machinery.*

THIS MEANS REAL SERVICE



Reilly Multicoil Feed Water Heater

Bulletins and full information gladly furnished.

The Mason Regulator & Engineering Co., Limited

Successors to H. L. PEILER & COMPANY

MONTREAL, 380 St. James Street — FACTORY, 960 St. Paul Street, Montreal

TORONTO REPRESENTATIVES, The Arthur S. Leitch Co., 506 Kent Building, TORONTO

This book should be in the hands of every pump user. A postal will bring your copy promptly

MARSH and AMERICAN

Steam and Power Driven Pumps and Air Compressors

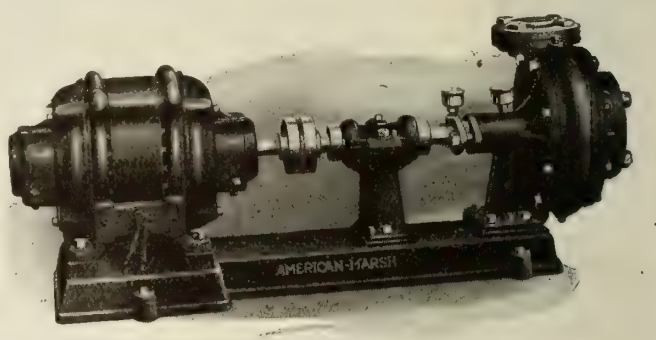
Marsh and American Pumps are especially adapted for long, hard service because they are *extra heavy* in design and of *extremely rigid construction.* Every unit is built amply strong to withstand 24-hour-a-day service and to stand up under any unforeseen strain which may be placed upon it. Piston rods on the steam pumps are extra large and made of solid bronze. The water ends are equipped with heavy cast bronze removable bushings.

This superior construction not only insures continuous and satisfactory operation, but practically *eliminates expensive shut-downs.* Marsh and American Pumps are the product of over 25 years' experience in the design and construction of high grade pumping machinery. Over 135,000 in actual service throughout the world.

The AMERICAN-MARSH LINE OF CENTRIFUGAL PUMPS is composed of both single and double suction types which are designed for heads up to 125 feet. They are equipped with wide ring oiled bearings and the single suction type has overhanging casing enabling the discharge to be taken at any angle desired.

CANADIAN AGENTS

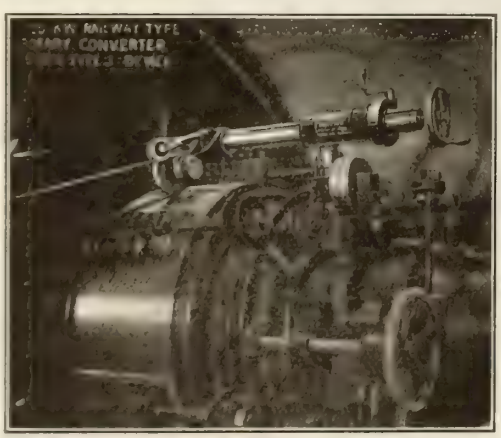
A. R. Williams Machinery Co., Toronto.
Williams & Wilson, Montreal.
London Engine Supplies Co., London, Ont.
Stuart Machinery Co., Winnipeg.
Mechanics' Supply Co., Quebec, Que.
Gorman, Clancy & Grindley, Limited, Edmonton and Calgary.
Taylor Engineering Co., Ltd., Vancouver, B.C.



American-Marsh Centrifugal Pump.

American Steam Pump Company

Battle Creek, Mich.



COMMUTATOR TRUING DEVICE

Trues your commutator without removing armature from its bearings. Send for Booklet No. 5.

Jordan Bros., Inc.

82 Beekman St. New York City, N.Y.

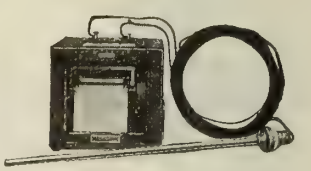
Canadian Representative :
CANADA SALES CO., 183 Church Street, Toronto, Canada

Tycos

TEMPERATURE INSTRUMENTS

Indicating Recording Controlling

Mercurial, Recording and Index Thermometers for all industrial and laboratory applications.
Electric Contact Thermometers.
Temperature, Pressure and Time Regulators.
Mercury Column Vacuum Pressure and U Gauges.
Base Metal, Rare Metal and Radiation Pyrometers.
Fery Radiation Pyrometers.
Hygrometers.
Hydrometers.
Mineral Oil Testing Instruments.
Aneroid Barometers.
Mercurial Barometers.
Recording Barometers.
Pocket Compasses.
Surveying Compasses.
Rain Gauges.
Anemometers.
Air Meters.
Thermographs.
Hand Levels.
Aviation Barometers.
Inclinometers.
Sphygmomanometers.
Fever Thermometers.
Urinary Glassware.
Thermometers of all kinds for home and general use.



Tycos Recording Pyrometer

Tycos Pyrometers are a necessity in every industry involving the application of high temperatures.

Just write for our catalogue describing these efficient *Tycos* aids.

Taylor Instrument Companies
ROCHESTER, N.Y.
201 Royal Bank Bldg., Toronto, Ont.

67

Speed up with Electric Power

C-G-E Motors and Control increase production and reduce maintenance.

Here are some of the ways in which modern industry has been speeded up by putting electric power to work in the right place.

Metal mines have boosted output to meet world-wide demands. All tonnage records have been smashed in the steel industry. Greater automobile output has lowered prices and given better road transportation. More and better cloth has been produced at lower power costs. Contractors find electric drive faster, more elastic and cheaper than any other for hoists, pumps, concrete mixers, cableways and other equipment.

On the left is shown the standard C.G.E. induction motor for general purposes. The C.G.E. mill type motor, on the right, is specially designed for the severe service of steel mills, but is equally applicable to crane, shovel, bridge and other heavy duty.

Any problem involving the use of power can be simplified by the application of electricity. The Canadian General Electric Company is well equipped to lend valuable assistance in working out such problems and is glad to co-operate with contractors, manufacturers and engineers in every possible way.

C-G-E Motor Drive

For further particulars write to our nearest office.

CANADIAN GENERAL ELECTRIC CO.

LIMITED

Manufacturers of Electrical Apparatus and Supplies for Railway, Light and Power Purposes

Head Office: Toronto. Sales Offices: Montreal, Halifax, Sydney, Ottawa, Cobalt, South Porcupine, London, Winnipeg, Calgary, Edmonton, Nelson and Vancouver

— LINDE —

REFRIGERATING MACHINERY

Is known and recognized the world over as

The Standard Refrigerating Machine

We have carefully studied Refrigeration under all conditions in Canada for the past 25 years and know what is best in this line. *Special attention given to Fish Freezing and Storing Plants.*

Our Machinery is "Made in Canada"

The Linde Canadian Refrigeration Co., Ltd.

MONTREAL: 37 St. Peter Street

TORONTO, WINNIPEG, CALGARY, EDMONTON, VANCOUVER

Twenty-five Years' Service to Canadian Users.

Vilter Refrigerating and Ice-Making Equipment

is recognized as standard throughout the world. Our product is built in all sizes and capacities, suitable for every service to which refrigeration is applied. Write us for an estimate covering your requirements.

BULLETINS SENT UPON REQUEST.

THE VILTER MANUFACTURING CO.

242 Beecher St. Milwaukee, Wis.

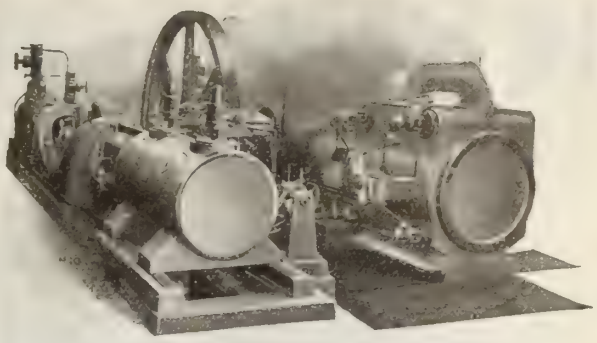
ECONOMIZE

The word that means most to American business to-day.

To Economize in the ice-making and refrigerating business means to

Save LABOR
Save FUEL
Save AMMONIA
Save REPAIR COSTS

These are the Cardinal Points by which Frick designers have guided the building



of FRICK MACHINES from their earliest beginning.

During nearly forty (40) years' experience this policy has proven itself a money saver for Frick users.

Frick Machines prove their worth. Ask us to show proof.

Frick Company
WAYNESBORO, PA. U.S.A.
ICE MACHINERY SUPERIOR SINCE 1882

Canadian Representatives:

FRICK ICE & REFRIGERATING COMPANY, MONTREAL, CANADA

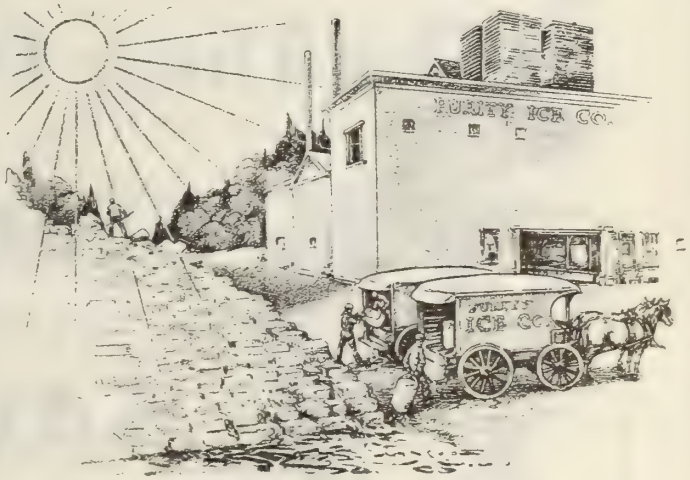
Would You Store Ice in the Sun?

—a foolish question, of course, but leaving brine or ammonia lines exposed to the heat of the atmosphere is just as illogical. The heat of the air readily passes through the conductive pipe metal, and a big loss of refrigeration results. Of course, all of this loss cannot be eliminated, but 80% of it can be saved by the use of

Nonpareil Cork Covering

For Brine, Ammonia and Ice Water Lines

Under average conditions, 330 tons of refrigeration, costing approximately $245.00, is the loss per year from only 200 feet of 2-inch bare, cold pipe. *If your brine or ammonia lines are uninsulated, you are losing in the same proportion.*



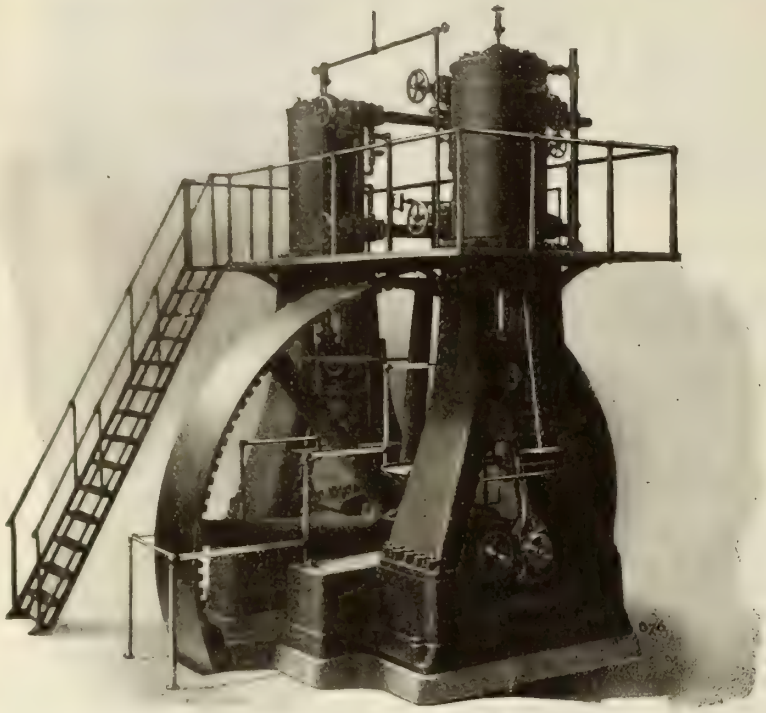
Nonpareil Cork Covering, composed of pure, compressed, granulated cork, bound together with the natural cork rosin, makes the most efficient type of cold pipe insulation yet devised; an excellent non-conductor, practically non-absorbent, trim and neat, and exceedingly durable in service.

Why not find out how much Nonpareil Cork Covering will save in your plant? Complete information and sample, on request.

ARMSTRONG CORK & INSULATION CO., 504 McGill Building, Montreal, Que.

Also manufacturers of Nonpareil Corkboard for cold storage rooms; Nonpareil Insulating Brick for boiler settings, etc.; Nonpareil High Pressure Covering for steam lines; Nonpareil Cork Machinery Isolation for deadening the noise of machinery; Circle A Cork Brick for cold storage room floors; and Linotile for office floors, residences, etc.

REFRIGERATION



Owing to the conditions imposed by the War, the use of Mechanical Refrigeration was never more of a necessity than now.

Our mission is to advise with prospective customers concerning their requirements and then to furnish a plant best suited to meet existing conditions.

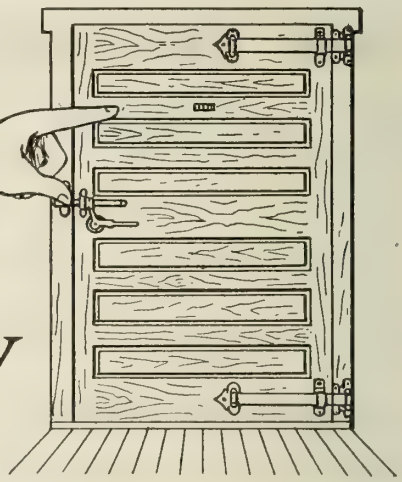
There is a YORK Machine to meet every practical condition of MECHANICAL REFRIGERATION.

WRITE US ABOUT IT

York Manufacturing Co.
(Ice-Making and Refrigerating Machinery Exclusively)
York, P.A.

Represented in the Dominion by
CANADIAN ICE MACHINE COMPANY
Toronto, 82 Chestnut St. Montreal, 626 Coristine Bldg.
Winnipeg, 85 Lombard St.

These Doors SERVE Because They SAVE

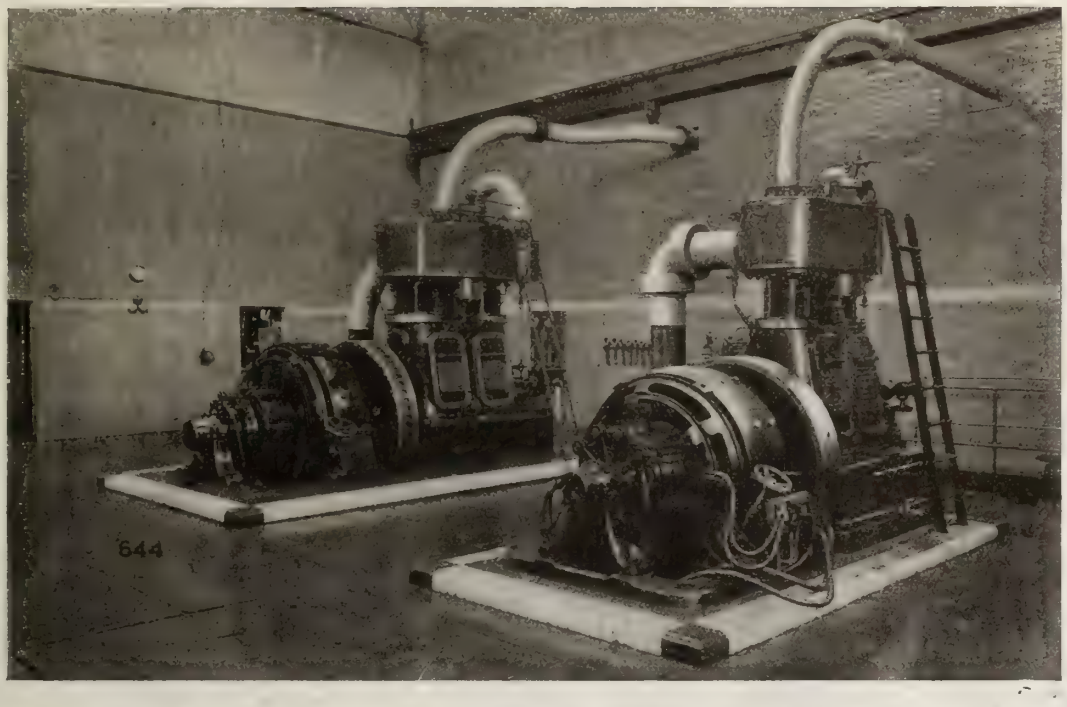


That these DOORS do SERVE and SAVE is evidenced by the fact that OVER 50% of our business is REPEAT ORDERS. No, not for replacements, but FOR ADDITIONS! JAMISON DOORS promote EFFICIENCY and ECONOMY to the extent larger facilities and new plants are necessary. Our motto is: "Build for your customers' success—your own must follow." We long ago substantiated our claims and established our present enviable prestige through competitive tests, and now, are advocates of the most thorough investigation into relative merit of various makes prior to ordering. There is a reason: our latest catalog explains it.

Jamison Cold Storage Door Company

Formerly Jones Cold Storage Door Co. P.O. Box 93 HAGERSTOWN, Md., U.S.A.

BELLISS & MORCOM, LTD.
Engines and Air Compressors



Belliss & Morcom Engines installed in McGill University Power House
Total Horse Power, 1010 B.H.P.

We have for immediate delivery several Engine Generator Sets. Write for Particulars.

Send Us Your Enquiries For

Steam Engines	Condensing Plants	Hydraulic Pumps
Gas Engines	Centrifugal Pumps	Hydraulic Accumulators
Oil Engines	Boiler Feed Pumps	Pressure Filters
Diesel Engines	Water Wheels	Gravity Filters
Steam Turbines	Water Meters	Water Softening Plants
Air Compressors	Hydraulic Presses	Refuse Destructors

Activated Sludge Sewage Disposal Plants

Complete Power Plants Designed and Erected

LAURIE & LAMB

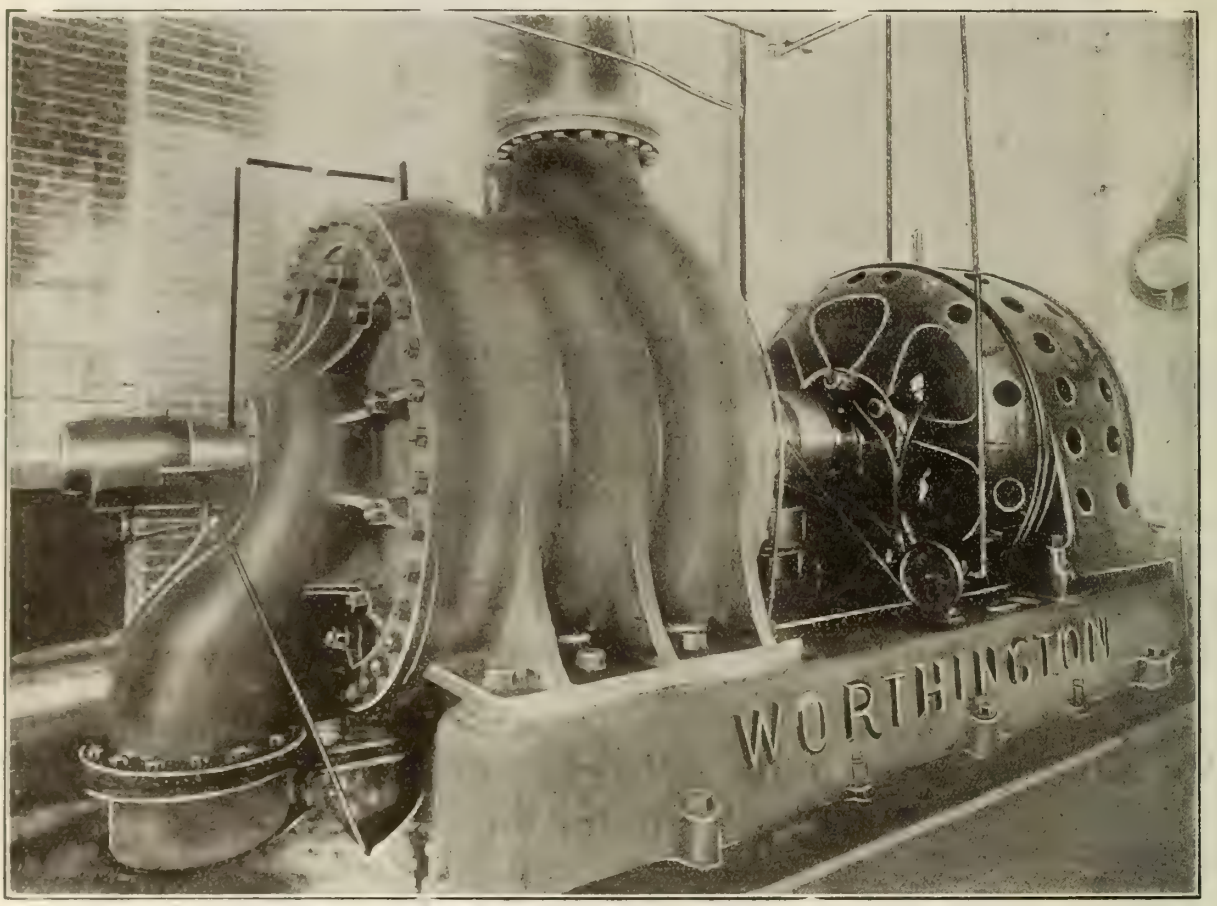
Engineers

211 Board of Trade Bldg. :-: :-: MONTREAL

THE JOHN McDOUGALL CALEDONIAN IRON WORKS CO., Limited

Manufacturers of Boilers, Castings, Condensers, Elevators, Engines, Filters, Forgings, Hydraulic Machinery, Pumps — centrifugal and reciprocating, Steam Turbines, Tanks, Water Wheels, Water Works Plants

Works: Seigneurs and William Streets, MONTREAL



5,000,000 gallons daily—Montreal Water Works—Driven by 400 H.P. Induction Motor.

Our Engineers have spent many years developing Centrifugal Pumps and we are now able to offer you perfected designs in any size pump from inch and a half and up for any service you may desire, and to be driven either with motor, engine or belt.

Write us for Engineering information, or prices, any time.

Sole Canadian Agents for H. R. Worthington Co.

Keeping in Stock at Montreal a large assortment of their Boiler, Feed and General Service Pumps

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

The Publisher's Page

TORONTO MARCH, 1918

CONDITIONS AFTER THE WAR*

By LT.-COL. THOMAS CANTLEY
Chairman of the Board, Nova Scotia Steel and Coal Co.

ALTHOUGH the transition from war to peace conditions—whenever it may come—must cause some temporary difficulty and disorganization, there is a confident feeling that there will rapidly develop a huge demand for the products of the steel industry in order to make good the devastation of war, and also to cover the vast arrears of commercial work which have been so long held up.

There is the further fact that the world scarcity of food, the devastated farms, manufacturing plants, towns and homes of Europe will make for an enormous immigration to Canada, to accommodate which will cause the opening up of vast new agricultural areas, with a consequent demand for railways, bridges, buildings, tools and implements. The prosperity enjoyed by the agricultural population should also result in a very great demand for farming implements. Railway equipment and rolling stock in Canada, and in fact the shortage of railway equipment throughout the world, is great, while needed replacements are not being made, and there is a veritable famine for equipment of this character everywhere.

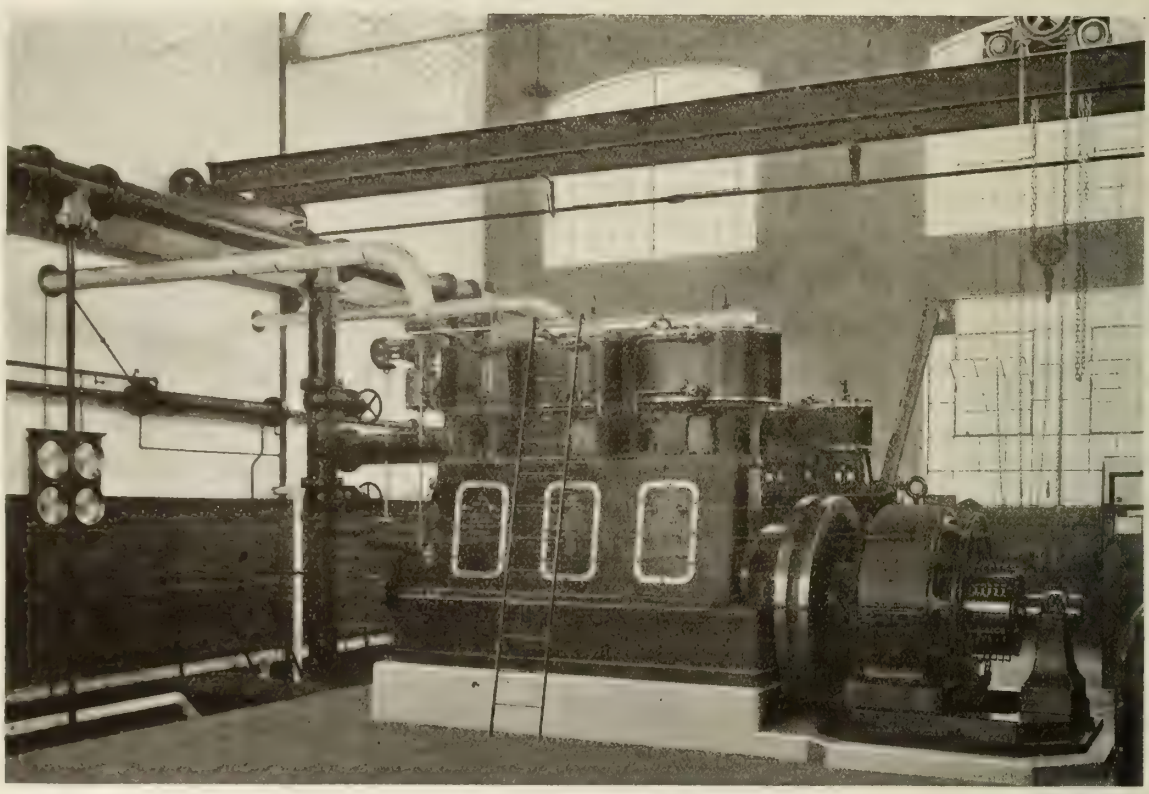
These facts seem to lead to the inevitable conclusion that while there may be a slight hiatus immediately following the war's end, within a very short time thereafter Canada will embark on an era of unexampled and unprecedented development and prosperity, while the iron and steel industry of the Dominion will be one of the first to participate.

May the day soon dawn when Canada's heroic sons, who have so gloriously battled for liberty and world freedom, will be triumphant and free to return to their homes and again take their place in their old-time peaceful pursuits, honored by all for what they dared and what they have done.

*Extract from an article in "Industrial Canada"

POWER EQUIPMENT

Built to Meet Your Own Requirements



A corner in the Engine Room of our New Power Plant recently erected at our Main South Works. Equipped with G. & McC. Co. Three-Cylinder Compound and Two-Cylinder Compound Vertical Forced Lubrication Steam Engines.

G. & McC. CO. ENGINES and BOILERS

will provide your plant with

A Continuous and Economical Service

WE BUILD

Horizontal and Vertical Steam Engines; Steam Turbines; Return Tubular and Water Tube Boilers; Heaters; Tanks; Pumps and Condensers; Transmission Machinery; Safes, Vaults and Vault Doors.

The advice of our Engineering Experts, our Catalogues, Specifications, Photographs, etc., will be cheerfully supplied to interested parties.

The GOLDIE & McCULLOCH CO., Limited

Head Office and Works: GALT, Ontario, Canada

TORONTO OFFICE: Suite 1101-2, Traders Bank Bldg.

WESTERN BRANCH: 248 McDermott Ave., Winnipeg, Man.

QUEBEC AGENTS: Ross & Greig, 412 St. James St. Montreal, Que.

BRITISH COLUMBIA AGENTS: Robt. Hamilton & Co., Vancouver, B.C.

Notes on the Design and Testing of Air Lift Pumps

B. A. W. Purchas *

The air-lift pump has become one of the most economical methods of raising water, the simplicity of construction and the almost entire absence of moving parts giving reliability in operation and avoiding the necessity for skilled supervision. The design of these pumps being subject to more or less development the subject matter of the following article is of more than passing interest.

THE subject of air-lift pumping has not received the attention it deserves from engineers, and has fallen into disrepute with many. There are several good reasons for this, among which may be mentioned the lack of a satisfactory theory, the low efficiency of most installations, and the lack of complete and accurate reports of tests, so that the causes of the low efficiency are obscured.

An attempt is made in this paper to rectify the first, to show how the second can be improved, and to point out in what respects many reports of tests are lacking in information essential to a thorough analysis for checking theoretical formulae and deductions.

An account is given of several series of tests, with a description of the methods and the equipment. The theory of the pump is then reviewed, and a novel method of approaching the subject is given, from which it should be possible to evolve rational formulae for designing.

Equipment and Methods for Testing

General.—The wells on which these tests were made form part of a water supply system, of which an account was presented to the Institution of Civil Engineers some time ago. Series A of tests was given at that time, but further investigation showed that the author had wrongly calculated the actual volume of air used, and the average velocities of the rising mixtures in the eduction-pipe. By their kind permission, it is possible to reproduce these test figures with the errors corrected, and other valuable deductions added.

On pulling the eduction-pipes from the wells, after they had been in operation for some length of time, the interior surfaces were found to be heavily encrusted with nodules of rust, some ⅜-inch high, of such rugged outline as to leave no trace of smooth contour on the surface of the pipe. The tests of Series A are of one eduction-pipe when newly installed, and the tests of series B are of the same pipe when encrusted as described above. A comparison of these two series shows some very interesting points, Fig. 9. The eduction-pipe used in the tests of series C was badly encrusted, but that of series D was clean.

Air-Injection Foot-Pieces.—The foot-pieces used in the various tests are shown:—

For Series A in Fig. 1
For Series B in Fig. 1A
For Series C in Fig. 2 and 2A
For Series D in Fig. 3

The merits and faults of these are discussed later under the theory of the pump (page 13).

*Read before the Institute of Electrical Engineers, November, 1917.

Lift

In series A and B this was measured by lowering a float on the end of a steel-tape line between the eduction-pipe and the well-casing. The float was a piece of wood ¼ inch by 1 inch in section, and 6 feet long, weighted to float upright with about 5 feet submerged. This method, however, is not recommended, as the float will sometimes become wedged between the pipe-couplings.

In series C and D the lift was measured with the device shown in Fig. 4. This consists of a piece of heavy brass-pipe, inside which a small copper-float is free to slide at the least impulse. The whole is suspended by a duplex rubber-covered cable, graduated in feet, one wire of which is connected to the case, and the other terminating in a lump of solder on the lower side of the insulator, which forms the top of the case. At the top of the well an electric bell and batteries completed the installation. The case was lowered into the well, and its reaching the water surface was indicated by the bell at the ground surface ringing. By this means it is possible to measure the depth to the water surface within an inch. It is absolutely impossible to estimate correctly the lift from the gauge-pressure of the air at the well-head, and this should never be attempted. Some injection foot-pieces put from 5 to 10 lb. per square inch extra pressure on the air, and there sometimes is a loss of 5 lb. pressure due to friction in the air-pipe. A combination of these losses might make an error of 30 feet in the estimated lift. To estimate the lift from the air-pressure required to start the well flowing is equally impossible since, once the well is started, the lift nearly always increases. Reference to tests 1, 2 and 3 of series D, among others, shows that under certain conditions the air-pressure at the well-head may be less than that equivalent to the submersion head of the foot-piece. This may be accounted for by noting that a column 600 feet high of air under 135 lb. per square inch pressure will exert an additional pressure on the base of a column of 3.25 lb. per square inch, due to its weight.

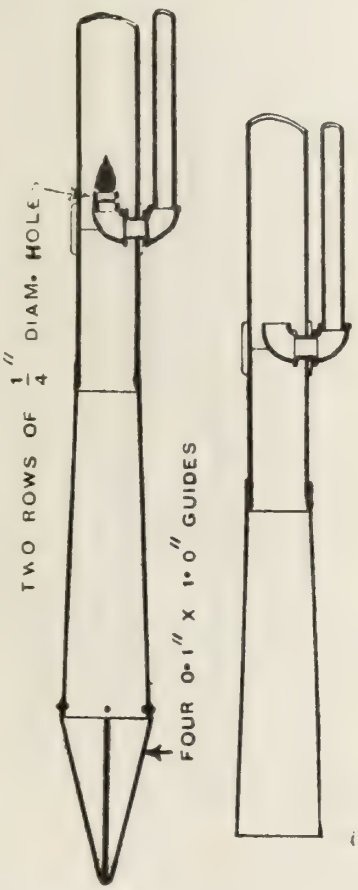


FIG. 1, SERIES A.

FIG. 1a, SERIES B.

An alternative method of measuring the lift is recorded by Mr. Kenneth Allen in a paper read before the Engineers' Club, of Baltimore (in 1908, on the wells at Atlantic City, U.S.A.

Air-Compressor and Measurements of Air Used

The air-compressor is a two-stage, with both air and steam cylinders compounded. The sizes of the more important parts are as follows:

	Inches
Diameter of the air-cylinders	10 and 18½
Diameter of the steam-cylinders....	12 and 22
Stroke of all pistons	18

The air is drawn through a combined forecooler and filter outside and on the shady side of the building, and passes through an intercooler between the two air-cylinders. The cooling water is circulated by a double-acting piston pump of 5½ inches bore, and 5 inches stroke, driven direct from the crank-shaft of the compressor. The suction valves of the low-pressure cylinder are semi-rotary, and are mechanically opened and closed by an eccentric on the main crank-shaft. All other air-valves are automatic, spring loaded and air-cushioned.

Many tests, which would otherwise be of the greatest value to the designer, are rendered of only doubtful value because the volume of air used was not carefully measured; hence the average velocities of the rising mixture can only be approximated. These velocities are the most important items affecting the efficiency of the pump, and those on which more than any other accurate data are required at the present time.

It is found in checking the published figures from too many tests that the volume of air used was calculated from the known displacement of the low-pres-

sure piston of an air-compressor allowing volumetric efficiencies of 95 per cent. and 97 per cent. Considering the types of compressors used, these figures are impossible, and are based on lineal measurements from indicator diagram on the assumption—unjustified by experiment—that the temperature at the beginning of compression is the same as that of the air at the intake.

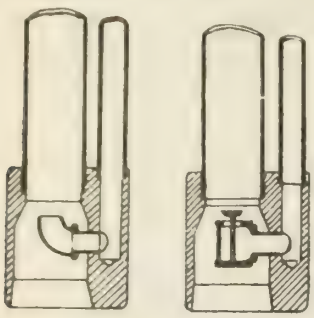


FIG. 2a. SERIES C. FIG. 2.

The true volumetric efficiency of a compressor based on the ratio of air drawn in at atmospheric pressure and temperature to the displacement of the low-pressure piston will vary:

For single-stage compressors, from..... 50-70%
For two-stage compressors, from..... 60-80%
For three or more stage compressors, from 80-95%

The above figures are taken at random from various sources, and it is impossible to state average values.

Returning to the tests here recorded, prior to each series the air-valves of the compressor were examined, and their seats put into good condition. On 25th and 26th April, 1914, tests were made of the volumetric efficiency of the compressor, and again on 7th and 8th May, at the end of each test of the air-lift pump. The discharge from the compressor was measured by means of an orifice, the form of which and the method of connexion to the air-receiver are shown in Fig. 5. This meter is a duplicate of that used by Professor R. J. Durley, of McGill University, Montreal, to determine the coefficients of the discharge or air through certain forms of orifice. An account of his work is to be found in the Transactions of the American Society of Mechanical Engineers, vol. 27.

The formula given in the above paper for calculating the flow through the orifice, is:

$$Q = 0.6207\ Cd^2 \sqrt{\frac{i}{T}},$$

in which—

Q is the weight of air passing through the orifice in pounds per second.

C is the coefficient determined by experiment.

d is the diameter of the orifice in inches.

i is the pressure inside the meter-box in inches of water.

T is the absolute temperature F. inside the meter-box.

This formula only applies to sea level, so as the plant at Oilfields is 700 feet above, the following formula was used to compute the discharge:

$$Q = 0.1632\ Cd^2 \sqrt{\frac{i}{T}}\ P^a$$

P^a is the absolute pressure in pounds per square inch of the air inside the meter-box. This equals the barometric pressure, plus 0.036 i.

For testing air-lift pumps, it is probably more convenient to install a meter in the air line between the compressor and the well. This is more expensive to install, but the volumetric efficiency of a compressor is a very variable quantity, which cannot otherwise be measured during the tests of the well-pump. Such a meter is shown in Fig. 6. The principle is identical with the foregoing, and the same coefficients of discharge

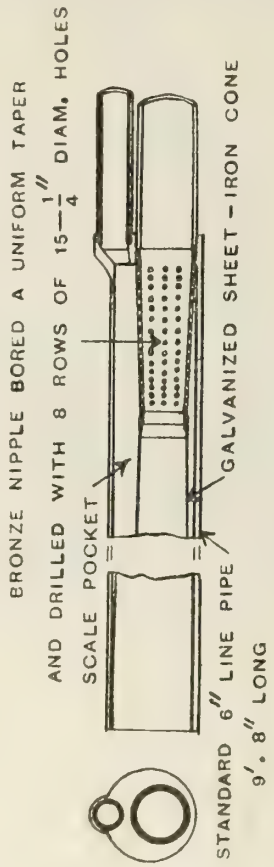

BRONZE NIPPLE BORED A UNIFORM TAPER
AND DRILLED WITH 8 ROWS OF 15—1/4" DIAM. HOLES
SCALE POCKET
GALVANIZED SHEET-IRON CONE
STANDARD 6" LINE PIPE
9'. 8" LONG

FIG. 3. SERIES D.

may be presumed to apply, if the velocity of approach and the head be maintained within the limits tested by Professor Durley. In this meter the discharge will be found by means of the formula:

$$Q = 0.1632\ Cd^2 \sqrt{\frac{i}{T}}\ p,$$

in which—

i is the difference of pressure on the two sides of the orifice, measured in inches of water.

p is the average of the absolute pressures of the air on the two sides of the orifice.

From the foregoing formulae, the volume of air is found by the formula:

$$W = \frac{p}{53.17\ t},$$

in which—

W is the weight in pounds per cubic foot.

p is the absolute pressure in pounds per square foot.

t is the absolute temperature F.

A third and similar method of measuring the volume of air is possible through the research of Professor William Watson and Mr. Herbert Schofield, who determined the coefficient of orifice placed in the suction-pipe of a compressor.

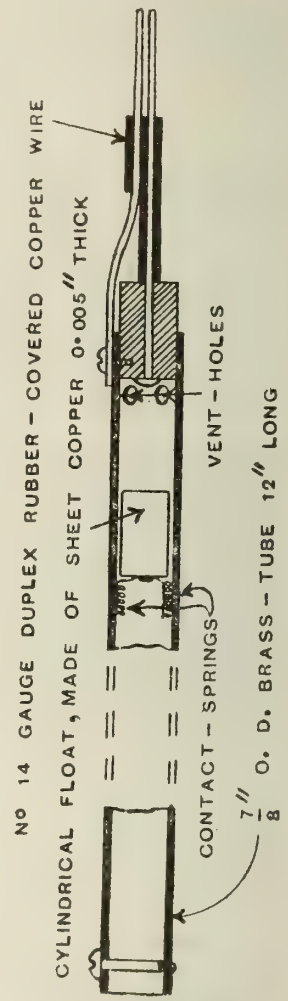

No 14 GAUGE DUPLEX RUBBER-COVERED COPPER WIRE
CYLINDRICAL FLOAT, MADE OF SHEET COPPER 0·005" THICK
VENT-HOLES
CONTACT-SPRINGS
7/8" O. D. BRASS-TUBE 12" LONG

FIG. 4. APPARATUS FOR MEASURING LIFT.

Quantity of Water Raised

The discharge-pipes of the wells at Oilfields rise about twenty feet above the ground, and discharge over the rims of small tanks, against curved hoods which deflect the water downwards. The pipes are bent to gradual curves, and the last few feet are inclined about 70 degrees to the vertical. Permanent derricks of a light California oil-well pattern are built over the wells, and were the discharge-tanks erected vertically over the wells, they would have to be removed each time the eduction-pipes were pulled. From these small tanks the water gravitates through 6-inch mains, laid along an overhead platform,

to two 84,000 gallon corrugated galvanized iron tanks and one wooden tank of like capacity. The iron tanks average 32 feet 9 inches in diameter, and 13 feet 4 inches in depth. The circumference of each ring of these tanks was carefully measured and checked, also the depth of the corrugations and the thickness of the plates. These measurements were taken when the tanks were full to the level at which the measurements were being taken, and from these figures a table of capacities was prepared for each eighth of an inch of depth.

Prior to each test, the well was pumped for sufficient time to allow all conditions to become constant, and the water meanwhile delivered into one tank. At the commencement of the test the water was diverted into another tank and switched back into the first again at the end of the test. All outlets from this measuring tank were closed and under observation at all times during the test.

Such facilities for measuring the quantity of water are rarely available, but there are several alternatives, such as weirs or Venturi tubes, which give equally accurate results. Many tests record only the combined performance of two or more wells; this is unfortunate both from the owner's point of view, and from that of engineers, as the information is too general; the extra cost of individual meters for each would undoubtedly be justified by showing some chance of improvement in the efficiency of one or more of the wells.

One writer who has contributed the results of some very instructive tests, measured the quantity of water pumped in a reservoir, the size of which unfortunately would only permit of runs of ten minutes' duration. It is the author's opinion that no test of an air-lift pump should be of less than one hour's duration, and that it is better to run this length of time and measure the water with some form of calibrated meter, than to run shorter tests and measure the water in any other way.

Indicated Horse-Power of Compressor-Air Cylinders

For this purpose an external spring Tabor indicator was used. This instrument had seen but little use, and was in perfect condition throughout. Great care was exercised throughout the tests to obtain true representations of what was taking place inside the cylinders. The revolutions of the compressor were recorded by an Ashcroft counter, and were controlled by a steam throttle-governor, which was operated by the variation of both the speed of the engine and the pressure of the air in the receiver.

Nature of the Discharge from the Wells

These observations were taken by two observers for three periods of five minutes each during each test. Where the discharge was 50 per cent. or more of the total cycle, the intervals were remarkably constant. The values here given are averages of times observed with an ordinary watch:

Series A.—These observations were recorded in the paper presented to the Institution of Civil Engineers, and are therefore not repeated.

Series B—

Test 1. Periods of discharge of thirty-five seconds' duration at intervals of one minute and twelve seconds.

Test 2.—Periods of discharge of forty-three seconds' duration, followed by a pause of five seconds, then a discharge of perhaps ten gallons, followed by a pause of thirty-three seconds before the cycle recommenced.

Test 3. A steady flow of emulsion ending in two short and violent ejections, the whole lasting thirty-three seconds. After a pause of five seconds, there would be a discharge of ten to twenty gallons, followed by a pause of twenty-eight seconds before the cycle recommenced.

Test 4. Periods of discharge of thirty-three seconds' duration at intervals of twenty-three seconds. During the interval there would be one fairly strong spurt lasting one second.

Test 5. Periods of discharge of one second at half-second intervals.

Tests 6, 7 and 8. Discharge similar to that of Test 5, but at higher velocities.

In all cases the discharge consisted of an emulsion of air and water, and not of alternate volumes of air and water, as Dr. Pohle claimed for his system.

Series C—

Test 1. Periods of discharge of forty-two seconds' duration at intervals of two minutes and seven seconds.

Test 2. Periods of discharge of thirty-six seconds' duration at intervals of fifty seconds.

Test 3. Periods of discharge of forty-one seconds' duration at intervals of twenty-six seconds.

Test 4. Periods of discharge of two to four seconds' duration at intervals of two to five seconds. Very irregular.

Test 5. Very similar to that of Test 4.

Test 6. Similar to Tests 4 and 5, but the intervals did not exceed half a second.

Tests 7 and 8. Very similar to Test 6.

Series D—

Test 1. Periods of discharge of forty seconds' duration at intervals of fifty-two seconds. During these intervals, however, there were five discharges of one to ten gallons each.

Test 2. Periods of discharge of five seconds' duration at intervals of five seconds.

Test 3. Periods of discharge from five to ten seconds' duration at intervals of five seconds.

Test 4. Periods of discharge of short duration, one beginning before the previous one had quite subsided. The velocity of discharge did not appear to be as high as in Tests 2 and 3.

Test 5. Similar in nature to that during Test 4, but at higher velocity.

Tests 6, 7 and 8. Practically continuous discharge of emulsion of small air bubbles and water.

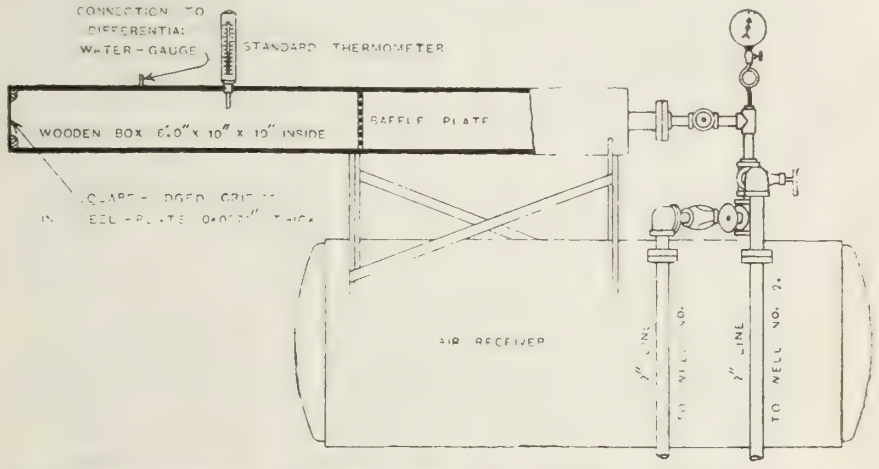


FIG. 5. ORIFICE METHOD FOR MEASURING THE VOLUMETRIC EFFICIENCY OF A LOCOMOTIVE AIR COMPRESSOR.

Method of Recording Observations

The comparison and analysis of published tests will be greatly simplified, if some standard form can be adopted. Most of the published tests lack certain important items, and other information, such as the submersion, is given in different ways, so that their analysis requires considerable work.

The author has adopted what he believes to be the most convenient form, and one which includes all details necessary to examine the behavior of the pump itself. The observations might, of course, be extended to include every part of the plant down to the fuel consumption, but such details can be foretold with fair accuracy by the manufacturers of the compressor. Since efficiencies of 80 per cent. seem possible with the air-lift pump in the near future it would not seem inopportune for some authoritative body to outline a method of making and recording tests of the air-lift pump, and its reverse the entanglement type of hydraulic air-compressor.

Probable Accuracy of the Tests at Oilfields

Lift.—This was measured within one foot equipment to 0.4 per cent., and did not vary more than 1.5 feet during any one test.

Quantity of Water Pumped.—The depth in the measuring tank was recorded by three independent readings to the nearest eighth of an inch, which is equivalent to:

8.7 cu. ft. in	2,652	or 0.33%	in Test 1 of Series	A
" "	1,284	" 0.68%	" "	B
" "	1,458	" 0.60%	" "	C
" "	2,340	" 0.37%	" "	D

Revolutions of the Air-Compressor.—The probable maximum error would be 5 in 7,750 in Test 8 of series D.

Volumetric Efficiency of Compressor.—The probable error in measuring the volume of air flowing through the orifice during the tests of series D is not more than 2 per cent., as the pressures and temperatures were all recorded within this margin. The values assumed for the tests of series A, B, and C, were based on the experiments made in April and May, 1914, taking into consideration the following :

(1) The speeds of the compressor.

(2) The known condition of the air-valves and guides.

(3) The volumetric efficiency shown on the indicator cards.

(4) The temperature of the air in the compressor suction pipe.

(5) The known condition of the scale in the cooling jackets, and the quantity of cooling water supplied. The cooling water was supplied by a piston pump driven direct from the compressor crank-shaft, in all cases.

It is difficult, therefore, to form a definite opinion of the probable accuracy of these latter values.

Indicated Horse-Power.—The maximum difference between the highest and the lowest "mean effective pressure" recorded during any one test, for the same end of a cylinder was 1.3 per cent. for the low-pressure cylinder, and 1.8 per cent. for the high-pressure. Considering the attention paid to details in the use of the indicator and the low speed of the compressor, the probable accuracy of the values given for the indicated horse-power is within 1 per cent.

Theory of the Air-Lift Pump

This subject is here treated in the following sequence:

(1) Design of air-injection foot-pieces.

(2) Nature of the rate of change of velocity of the mixture to the eduction-pipe.

(3) Operation of the pump as a whole.

(4) Submersion of the injection foot-piece.

Foot-Pieces.—The design of the foot-piece does not play such an important part in the ultimate efficiency of the pump, provided:

(1) That the fundamental laws of the losses in transmission of air and water are carefully kept in mind, when designing; and

(2) That the air is injected into the water in the form of small bubbles.

Any attempt to use the injector principle is pure waste of time, and generally leads to throttled air and water passages, and a back pressure on the air of two to five pounds per square inch, which represents so much wasted energy, for which no corresponding gain can be shown elsewhere. This throttling effect is very marked in the tests by Messrs. Brown and Behr, which were made with an inch diameter air-line terminating in a ⅝-inch diameter nozzle. Some of the tests by Messrs. Davis and Weidner show the same fault.

Fig. 1 shows the foot-piece used by the author in the tests of series A. Its obvious fault is the contracted water-passage, and its only excuse is its cheapness. The real reason that this was abandoned was the choking of the bottom of the air-pipe with rust and scale, so that eventually it caused an additional air-pressure of 30 lb. per square inch. Alternate exposure to warm air and water will corrode steel at an extraordinary fast rate. Before putting the eduction-pipe back into the well, after discovering this trouble, the "eddy cone" was removed, and series B of tests was made with the foot-piece shown in Fig. 1A. The foot-piece shown in Fig. 2 was originally used in Well No. 1, the aim being to inject the air in the form of small bubbles. This type suffered from the same faults as the previous ones. Series C of tests was made with the type shown in Fig. 2A.

When Well 2 was last re-tubed, it seemed probable that the eduction-pipe then inserted would be the largest ever required, and therefore full advantage was taken of previous experience and first cost was not so important. Fig. 3 shows the design of the resulting foot-piece, and this is the type used in series D of tests. The following points were aimed at in the design:

(1) To avoid loss of air-pressure in transmission from the well-head to the foot-piece, and keep the air-pipe outside the eduction-pipe without resorting to the use of the annular space around the outside of the eduction-pipe. An air-pipe run inside the eduction causes additional frictional losses in the rising mixture, with no corresponding gain elsewhere.

(2) To provide a pocket to catch such scale and rust as may form in the air-pipe, and thence fall into the foot-piece.

(3) To introduce the air into the water in the form of small bubbles, as it has been claimed that the velocity of slip of an air-bubble through water varies as the square root of its volume. Since designing this foot-piece the author has found that Mr. Joseph P. Frizell, member American Society of Civil Engineers, outlined the same type of foot-piece in 1880, and in "Engineering News" of 8th June, 1893, referring to the reverse process of compressing air by entanglement with falling water, wrote: "This method was suggested by observing the very moderate velocity with which bubbles of air rise in still water, the velocity varying with the size of the bubble, from nine inches per second or thereabouts for minute bubbles such as result from a slight agitation of the water, to as many feet per second in the case of great masses of air."

Mr. Kenneth Allen, describing the equipment and tests of the wells under his charge at Atlantic City, U.S.A., in a paper read before the Engineers' Club of Baltimore in 1908, also from his experience supports the same.

Mr. Edmund M. Ivens, on page 143 of his book, "Pumping by Compressed Air," writes: "The small openings mentioned divide the air bulk into small streams and thoroughly aerate the column. Considerable gain in economy over other systems is realized thereby, as may be seen by comparison of the curves and tables."

(4) To provide orifices for the air that would not corrode and choke up, as did those drilled in steel and used in the foot-piece shown in Fig. 1

(5) To so proportion the water passages that there should be no sudden change in the velocity of the rising column. The water-passage at the bottom is 6 inches in diameter. From this point upwards the passage gradually contracts, and the water therefore is gradually accelerated until it reaches the bronze taper-nipple. As the water rises through this, it is assumed that the air is uniformly admitted through the 120 ¼-inch holes, and that the velocity of the mixture is constant. Beyond this nipple the velocity of the mixture gradually increases until the size of the eduction-pipe is increased.

(6) To provide some form of guide on the lower end of the foot-piece as shown in Fig. 1, to prevent its catching in the joints of the well casing when being lowered into the well.

There is no necessity for the foot-piece to be as long as that shown, unless it is so built as to form an auxiliary air-reservoir at this point; a feature which has some advantages. It is equally possible to combine all the above points with the exception of No. 1 in a

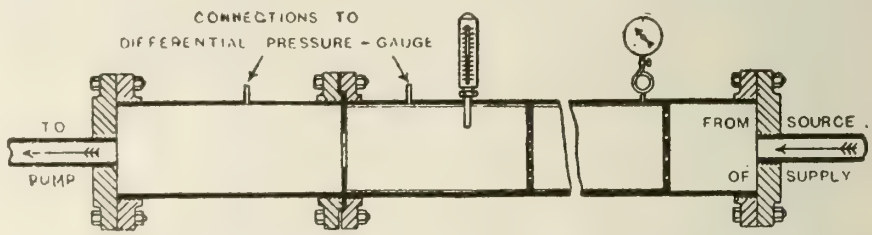


FIG. 6. HIGH-PRESSURE AIRMETER ORIFICE TYPE.

foot-piece to be used on an air-line inserted inside the eduction-pipe, and this latter construction is sometimes necessary if the well casing be small.

Velocity of the Rising Mixture

The air in the eduction-pipe expands as it rises, due to the diminished head of liquid above it, and it may safely be assumed that it does so isothermally on account of the large volume of water by which it is surrounded. In the case of a single bubble of air rising through water, the pressure on the bubble will vary directly as the head of water above it. In an air-lift pump in operation the air-bubbles are rising through a mixture of variable density, since the ratio by volume of air to water per foot length of eduction-pipe increases as the outlet is approached. Under these conditions the pressure in the eduction-pipe will vary as the ordinate to a hyperbolic curve, and the volume of each bubble as the ordinate to a straight line.

To find the volume of air passing any point in the eduction-pipe per unit of time:

Let P_1 be the absolute pressure of the atmosphere.

P_2 be the absolute pressure, equivalent to the head of submersion of the foot-piece.

V_1 be the volume of air delivered per second to the pump, measured at pressure P_1, and a temperature equal to that of the liquid being pumped.

x be the distance of the point under consideration above the point of air injection in feet.

L be the distance in feet from the point of air injection vertically to the outlet of the eduction-pipe.

The same weight of air, and likewise the same weight of water must pass each point of the eduction-pipe per unit of time; the volume of air flowing per second through the outlet of the pump is V_1 cubic feet, and the volume of air entering the eduction-pipe during the interval is $V_1\frac{P_1}{P_2}$. The increase of volume of the air in ascending the eduction-pipe is—

$$V_1\left(1-\frac{P_1}{P_2}\right),$$

and the total volume of air passing the point under consideration per unit of time is—

$$V_1\frac{P_1}{P_2}+\frac{x}{L}V_1\left(1-\frac{P_1}{P_2}\right).$$

The sum of the volume of air and water passing per second being thus found and cross-sectional area of the pipe being known, the average velocity can be calculated. This average of what is in some cases a widely varying quantity is the only value that can be calculated, and forms a very valuable deduction in analyzing the results of tests and in designing the pipe for a new installation. In cases where the air is injected in the form of small bubbles, and the pump is run at or over its most economical capacity, the velocity at any point appears to remain fairly uniform, and as has been pointed out above, these conditions should exist in a well-designed pump; therefore the average velocity calculated by the above method will be a close approximation to the true value.

FUELS OF CANADA

B. F. HAANEL, chief of the division of fuels and testing of the Dominion Department of Mines read a paper on "The Fuels of Canada" before the Canadian Society of Engineers, at Montreal on Jan. 22. Mr. Haanel prefaced his remarks by saying that Canadians were realizing that Canada was dependent on the American coal supply and was at the mercy of foreign strikes or industrial disorganization. Canada's supply of fuel might, therefore, be cut off at any moment. He continued:

"But there is even a more important factor which we must consider, namely, the necessity which may occur for the United States to keep her fuel within her own country. Such a situation may not arise for some time, but the indications are that we may have to meet such an emergency in the near future."

"Canada, to-day, is facing a fuel situation of great gravity, a situation which was not created by any special conditions in this country, but by those obtaining in the neighboring country. The United States is suffering from a shortage of fuels as a result of the withdrawal of skilled labor from the coal mines to other occupations, and, perhaps more directly, owing to the abnormal demand on the transportation facilities of that country for the carrying of material directly connected with the conduct of the war.

"We are not wholly dependent on the United States for our fuel supply, but we are dependent to the extent of 55 per cent. of our total coal requirements and 98½ per cent of our crude and refined oil products. Large and important sections of Canada, moreover, are almost wholly dependent on imported coal for house-heating purposes. This is a matter for grave reflections, since in a country such as ours, where artificial heat must be supplied during eight months of the year for the sole purpose of maintaining life, a continuous and dependable supply of fuel is absolutely essential.

"The present unsatisfactory—indeed alarming—situation can be improved only by a determined and energetic exploitation and utilization of our own vast fuel resources.

Canada's Needs

"The total fuel requirements of this country during the year 1916 amounted to nearly 30,000,000 tons of coal; 299,426,121 imperial gallons of crude and refined oil products, and firewood valued approximately at $60.000.000.

"Compared with her annual requirements, Canada's production of fuels for the same period amounted to 14,483,395 tons of bituminous coal, of which 2,135,359 tons were exported; 6,934,288 imperial gallons of crude oil and wood fuel to the value of $60,000,000. To meet our own needs, therefore, it was necessary to import 17,580.603 tons of coal, and 292,426,131 imperial gallons of crude and refined oil products.

"Of this quantity of oil, approximately 50,000,000 gallons were used on the railroads; 30,000,000 gallons for steamships, and the remainder 210,000,000 gallons, was used for lighting and heating, in the form of kerosene and, to a large extent, in the form of gasoline, for power purposes."

The principal fuel resources of Canada, Mr. Haanel said, were bituminous and anthracite coal, lignites and peat. The coals were in the extreme east and west, the lignites were in Alberta and Saskatchewan, and within the limits of these deposits were 12,000 square miles of peat bogs.

Bituminous coal as such was of use only in industries, but an excellent substitute for anthracite, for domestic use could be produced from bituminous coal by a process of carbonization at low temperature and briquetting, which was in actual operation to-day. Lignite and peat required preliminary treatment before becoming available for general fuel purposes. If this treatment was given them the fuel situation would be greatly improved.

Mr. Haanel was of opinion that, at comparatively small outlay of money it would be possible to establish a commercial plant to demonstrate that the lignites could be converted into a fuel entirely satisfactory for domestic and industrial purposes.

As for peat resources, the speaker said that an economic process for the manufacture of raw peat into an excellent fuel for domestic and to some extent industrial purposes was in use to-day, and had been employed for many years in European countries, notably Russia.

"Not until the utilization of a natural substance is forced by absolute necessity," he said, "will the most sincere and earnest efforts be put forth to successfully and economically convert it into a usable product. It appears to me that the time is at hand when necessity will decide that we Canadians utilize our peat resources, and in the most efficient manner. . . . We not only have the process for manufacturing peat fuel, but also sufficient detailed information concerning peat bogs of immediate importance to make a good start in the formation of a peat industry. . . . Seven bogs, conveniently situated with respect to Toronto, could supply that city with 26,500,000 tons of fuel, and seven bogs, within easy reach of Montreal, could supply 23.500.000 tons.

"The fuel situation in Canada, as I view it, is not a gloomy or a discouraging one, for we are endowed with fuel deposits on a magnificent scale. All that is necessary now is that proper exploitation and economic use be assured."

Electricity and Hydraulics

PRINCIPLES AND OPERATION OF MODERN ELECTRICAL EQUIPMENT—I.

By A. M. Pére.

ELECTRICITY plays a most important part, not only in modern civilization but in the very nature of this universe. To such an extent is this true, that scientists tell us that matter itself, formerly supposed to be entirely distinct and separate from energy, is in the ultimate composed of electricity.

In all walks of life a certain knowledge of the laws governing the supply and use of electricity is becoming more and more necessary every day, and to a man engaged in an occupation dealing with the production and utilization of power this knowledge is essential to his advancement.

A series of articles of which this is the first, will deal with the practical applications of electricity in the fields of industrial and power engineering, and is arranged to fill the needs of those who desire a knowledge of the principles underlying the operation of dynamo-electric machinery and auxiliary apparatus, and who at the same time wish to obtain instruction relating to the proper operation and care of such apparatus as they may have in their charge.

It is felt that, in many cases, text books and other sources of information

FIG. GENERATOR FOR BELTED SERVICE

deal with subjects removed from the sphere of the operating engineer and so contain information of little or no value to him. To meet this objection, as far as possible, all apparatus dealt with will be of standard types in everyday use and wherever feasible the questions of operation and the location of trouble and its remedy will be included.

A series of problems carefully selected and graded as to usefulness and difficulty will form part of the series. Certain of the articles will not admit of the giving of numerical problems and examples, in which case questions in the nature of a review involve a knowledge of the more important features of the article will be given in their stead. Problems will be worked out in detail in the issue following their presentation.

The Dynamo

Dynamos are divided into two general classes according to the character of the current they deliver. A direct current dynamo delivers a current that always flows in one direction; that is, the current never reverses although it may change in strength. Alternating current generators or alternators, on the other hand, deliver current that periodically reverses its direction of flow, the number of reversals per second, or the frequency, depending on the speed of rotation.

The modern direct current dynamo, while appearing in many forms and special designs, has comparatively few fundamental parts upon which it depends for its operation, the magnetic circuit, the armature conductors, the commutator and its collecting devices.

In order to gain an idea of dynamo design and operation and to familiarize the reader with its parts a commercial type of dynamo is illustrated, Fig. 1, and the remainder of this first article will be devoted to a description of its parts and a preliminary study of their relations.

The Magnetic Circuit

The magnetic circuit of a direct current dynamo consists of the field magnets with their exciting coils and the armature core. The field magnet is formed of a suitable frame made in various shapes depending upon the design of the machine and has two or a greater even number of pole-pieces partially engaging the armature circumference. On each pole of the frame is a magnetizing coil. Fig. 2 shows a four-pole field magnet and the relations of these various parts will be made clear by reference to the illustration.

The armature core also shown in Fig. 2 is built up of numerous laminations of sheel steel varnished and assembled on the shaft. As shown this armature core is slotted for the armature conductors. This type of core is standard for the larger designs of generators and motors, but some of the older types of machines made in the smaller capacities have a smooth iron core over which the coils have been wound.

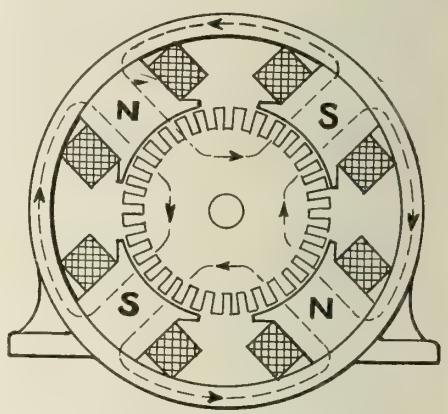


FIG. 2. FOUR POLE FIELD MAGNET WITH ARMATURE CORE IN POSITION

There are four materials which are commonly used in the construction of the magnetic circuit of a dynamo or motor; cast iron, wrought iron, sheet steel and cast steel. Efficiency, cost, weight and regulation determine the choice of material for any one machine. While cast iron is the cheapest material used for the construction of field-magnets its comparatively poor magnetic properties render it necessary to use a larger quantity of it than would be necessary say of wrought iron or steel.

An increase in the amount and cost of copper also results from its use owing to the greater length required. Steel is one of the best materials to use as regards its electrical properties.

The Armature

The revolving part of the direct current dynamo is called the armature, and it consists essentially of a number of copper wires or conductors joined together and grouped in a particular way, for the generation and circulation of the currents produced, these wires or conductors being placed in the slots of the core mentioned above, and held in place by binding wires or wedging devices.

The core is keyed firmly on the armature shaft and when the armature is revolved the conductors are whirled around at a high speed. Since the revolving armature occupies a central position and is surrounded by the poles of the field magnet, the conductors cut the magnetic lines of force, which are generated by

the field magnet and forced by it through the air gap and iron core of the armature.

This cutting of the magnetic lines of force, as will be explained later, gives

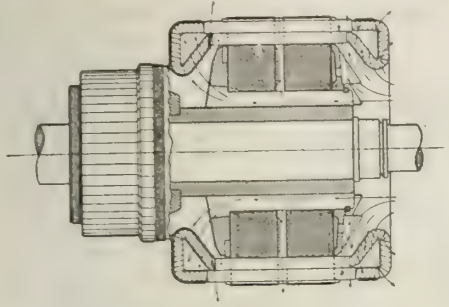


FIG. 3. SECTION THROUGH ARMATURE SHOWING CONSTRUCTION AND ARRANGEMENT FOR VENTILATING.

rise to electro-motive forces which tend to drive currents along the copper conductors and so, if the revolving conductors are connected in a circuit, currents will be generated.

Commutator and Brushes

Since these currents are generated in the revolving conductors it becomes necessary to employ some kind of a collecting device. On direct current dynamos and motors this portion of the machine is called a commutator. In addition to the collection of the generated currents the commutator in a manner explained later also serves to transform the alternating current generated in the armature into a continuous or one-direction current.

The poles of the field magnet are of two kinds or polarities, north poles and south poles arranged alternately. Since the revolving conductors on the armature are moved first past a north pole, then past a south pole, then past another north pole and so on in continual succession it follows that the potential created in the armature conductors will tend to cause a current to flow in first one direction and then in the other.

On inspection a commutator will be found to be built up of numerous strips

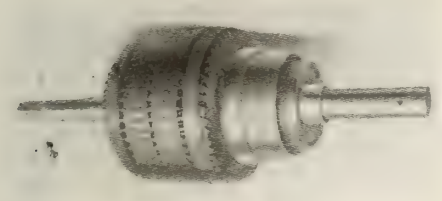


FIG. 4. ARMATURE COMPLETE ON SHAFT.

or bars of copper separated by narrow strips of mica. The copper used in the better class of machines is usually rolled or drawn so as to make it as hard and uniform as possible, thus eliminating all soft bars.

The mica used for insulation is usually a built up product consisting of flakes of natural mica, mixed with a binding material and combined into a solid mass by the aid of heat and pressure. This results in a uniform product of even thickness.

These bars are shaped with dovetail corners on their under side so that they can be securely clamped between end-cheeks and mounted on a shell or hub that is secured on the armature shaft. Insulating collars of built up mica are interposed between the bars and the clamping cheeks of the shell, so that each individual bar is electrically insulated from contact with a neighboring bar and with the shaft and other metallic parts of the armature.

At the end of each bar is formed a projection or riser by means of which the bar is connected to the armature windings. Thus if the commutator has 111 bars, there will be 111 risers connected to the windings at 111 equidistant points.

Brushes and Brush Gear

The name brushes is given to the stationary contact pieces which collect the current from the commutator, because in the early machines they were made of bundles or brushes of springy brass

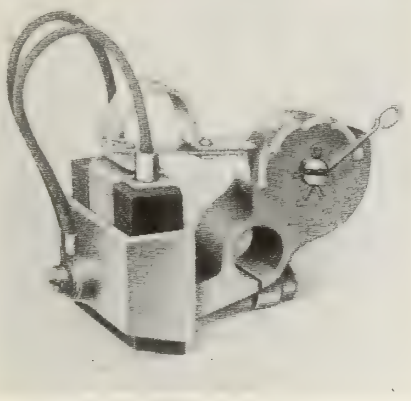


FIG. 5. TYPICAL BRUSHOLDER SHOWING MEANS FOR ADJUSTING BRUSH PRESSURE

wire. In present day practice they are frequently made of copper gauze or copper strips clamped in suitable brush-holders or more often of blocks of fine carbon held in holders with springs which press the carbon blocks with a springy pressure upon the surface of the revolving commutator.

In order to adjust the brushes to the proper position to collect the current without sparking they are fixed to a suitable frame or rocker which is itself supported on the bearing or to some other part of the machine frame.

This Month's Problems

Name the three most important features of direct-current generator construction.

What parts of the generator comprise the magnetic circuit?

What materials are used in the construction of the magnetic circuit?

Of what materials is the commutator made?

What three materials are used in the making of brushes for collecting the current?

READERS' QUERIES

Question.—Why does the negative pole of an electrical polarity indicator turn red while in circuit?

Lockport, N.S. Jno. Lousby.

Answer.—This action depends on the electrolysis of the solution contained in the tube forming the indicator. A solution of some salt of one of the alkaline metals is placed in the container together with the proper amount of some substance which will indicate the presence of an alkaline or basic substance. Phenolphthaleine is a substance which has the property of turning red in the presence of a base such as sodium in hydroxide or caustic soda.

In the case of a salt such as sodium sulphate the result of passing a current through the solution is the formation at the negative pole or kathode of a solution of sodium hydroxide or caustic soda, and at the positive pole of a solution of sulphuric acid. The solution of caustic soda momentarily existing at the negative pole causes the indicator or the phenolphthaleine to turn red. On the interruption of the current the sodium hydroxide and the sulphuric acid reunite and thus restire the neutral character of the solution and in consequence the red color disappears.

The above substances are merely given as an illustration of the principle upon which an indicator works and are not necessarily those actually employed in the commercial article.

Question.—I would like to obtain full information regarding the construction of an efficient storage battery large enough for lighting and with some power to spare for a medium small farm home. The voltage to be about 8 to 9 volts.—A. C. Holts.

Answer.—The making of lead storage batteries while simple enough as an experimental task is quite difficult and expensive for the amateur when the making of one large enough for house lighting is attempted, and it is recommended that the complete outfit be purchased from some reliable manufacturer. By doing this you would receive better satisfaction from the equipment as a whole and would be buying it much cheaper than the individual parts could be purchased.

The lead storage battery in the charged state consists of a positive plate of lead peroxide and a negative plate of finely divided lead, both dipping into sulphuric and of about 1.2 specific gravity. When discharged the surface of both plates has been changed to lead sulphate. The plates are brought back to the charged condition by sending a current through the battery in the reverse direction

* * *

Question.—Would you be so kind as to give me a simple rule for calculating the torque of motors?

Answer.—Multiply the E.M.F. in volts by the current in amperes and this pro-

duct by seven. Divide the product so obtained by the R.P.M. and the quotient will be the force exerted at a radius of one foot from the center of the shaft.

Turning moment in ft. lbs. $= 7W \div$ R.P.M.

The above approximate formula applies to any motor with the precaution that in calculating the torque for alternating current machines the true value for the watts as read on a wattmeter.

Question.—I would like to know if two single phase transformers would carry their full rated load when connected, open delta on a three phase circuit?

Answer.—On account of the fact that there is a thirty degree displacement between the voltage and current in transformers connected open delta and carrying a load of unity power factor, the capacity of the transformers is only 0.866 times their rated capacity.

Hence two-500 K.V.A. transformers connected in open delta on a three phase circuit will only carry 866 K.V.A..

Question.—In what manner is the speed of an alternating current motor calculated, the frequency and the number of poles having been given?

Answer.—It is current practice to base the speed of an induction motor on an allowance of 4 per cent. slip. In which case the following formula is used

$$\text{R.P.M.} = \frac{\text{Cycles} \times 60 \times 96}{(\text{Poles} \div 2)\ 100}$$

INDUSTRIAL PLANT FURNISHES STREET RAILWAY POWER

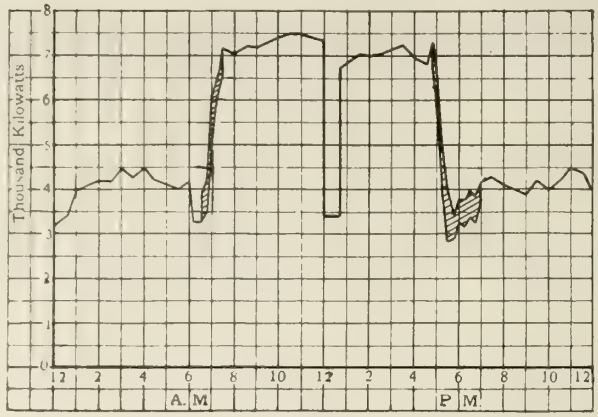
OBTAINING a high load factor is one of the problems to which the operating engineer of an industrial power plant gives practically no attention. Usually he can do nothing with the problem because the amount of the load and the time at which it is required is entirely out of his control.

Since his plant serves but one industry there is no opportunity for him to secure the diversity of use which is the salvation of the central station. However, it is often possible by looking around to find outside uses which will extend the period of peak load without increasing its magnitude, and at the same time materially benefit the new power user.

An interesting example of this is the supply of direct current by the Westinghouse Electric and Manufacturing Company to the Pittsburgh Railways Company for the operation of their cars in and about East Pittsburgh, Pa. Due to the tremendous increase in employees at the Westinghouse plant, the present overhead equipment of the street railway was overtaxed for about two hours morning and evening.

Since the railway company's generating plant was also heavily loaded at these times, it was considered better to buy current from an existing plant rather than erect a railway substation or string additional copper in feeders. Accordingly connections were made between the railway feeder system and the Westinghouse Company's rotary converter capacity in its power house and arrangements were provided to supply direct current at 500, 550, 600 or 650 volts according to the railway need.

As will be seen from the daily load



DAILY LOAD CURVE. SHADED PORTION INDICATES POWER DRAWN BY RAILWAY COMPANY.

curve the amount of the day's demand was not increased but its duration was somewhat lengthened, the shaded area indicating the power furnished by the manufacturing company.

As will be seen from the map, Figure 2, street railway transportation to East Pittsburgh is furnished over but three lines north-west and one line east. On this account the traffic congestion is very great at morning and evening. With the old conditions there were often annoying or even serious delays due to

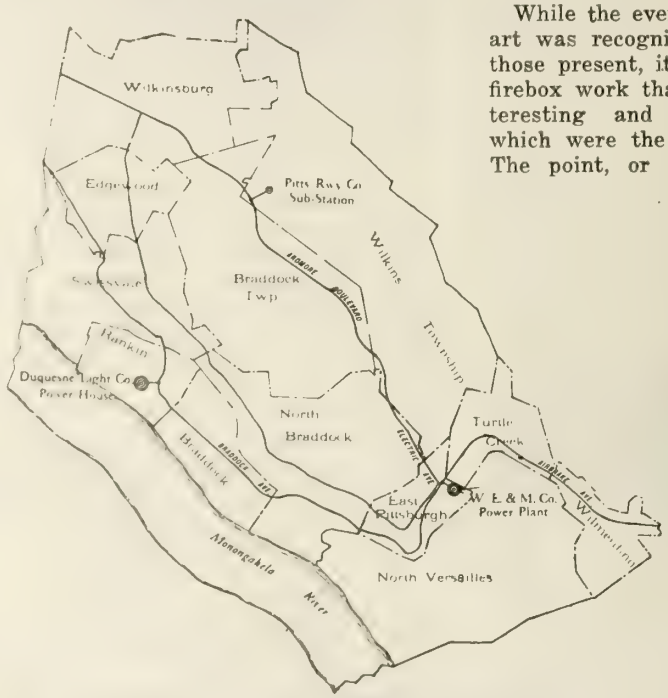


FIG. 1. VICINITY OF EAST PITTSBURG, SHOWING TROLLEY LINES SERVING THE DISTRICT.

power shortage. Since this new arrangement has been in operation, however, there has always been plenty of power to move cars at any time.

There are no doubt many industrial companies similarly located with respect to transit lines extending out a considerable distance beyond the last substation which could use such a method with great advantage. While the revenue from the sale of power is of course desirable the principal benefit will be found to be in the getting of employees to and from work on time in which an ample supply of power is a very important factor.

WELDING OF LOCOMOTIVE FIRE BOXES

THE importance of ovy-acetylene and electric welding in relation to the iron and steel industry was amply demonstrated at the December meeting of the Canadian Railway Club in Montreal, when the subject of the evening was a paper on "Oxy-Acetylene and Electric Welding and Cutting Processes in Locomotive Works." The subject matter of this paper (a reprint of which appeared in a recent issue of this publication) dealt largely with the application of these two processes as practised at the Point St. Charles shops of the Grand Trunk Railroad. While the paper in itself was of a highly interesting character, it was the discussion that followed which impressed all present with the rapid development and growing importance of this method of construction and repair in relation to locomotive and marine activity.

While the ever widening scope of this art was recognized and appreciated by those present, it was its adaptability to firebox work that brought forth the interesting and instructive arguments which were the features of the debate. The point, or points, upon which the discussion revolved were the debatable questions of the advantages and disadvantages of lap and butt welding when used in places where these joints would be exposed to the excessive heat of the fire on the one side and subjected to the high steam or water pressure on the other. From the statement of Mr. Dyer it is interesting to note that the Stratford shops use the oxy-acetylene process, while the electric process is the one adopted at the Montreal shops; the method in either case for general purposes being the butt welded joint. Apparently, considerable success has been attained from the butt welding process, as gathered from the experience of the Grand Trunk officials.

Prefers Lap to Butt

In direct contrast to this, however, Mr. Barry, of the St. Lawrence Welding Company, stated, that after a lengthy period of practical experience in the handling of firebox work, of a wide and varied character, it was his firm opinion that, irrespective of the process used, the lap weld was to be preferred over that of the butt weld. He also stated, however, that a satisfactory job might be accomplished by either methods, according to the skill and ability of the operator; but that this was a factor so uncertain that no guarantee could be given, even by the most experienced operator, that the weld was "perfectly sound."

He cited an instance where a tank head had been welded by the oxy-acetylene process by means of the butt method and had stood a test of 50 per cent. over the working pressure without the least sign of a "weep." Nevertheless, after being three weeks in service the head suddenly blew out, and upon examination it was found that, while the external appearance was in every respect perfect, the weld had not been made through the entire thickness of the plate. The head had come away so suddenly that no previous warning was given, but fortunately no one was hurt. Mr. Barry contended that had this been a lap joint, with the pressure tending to keep the surface in contact, that the head could not have come away before first giving some warning. He said "The factor of safety is something that cannot be overlooked. The question of safety is much more important than a firebox going out of service."

Apart from the advisability of using either method of weld, the problem of the man operating the blow pipe is probably the all-essential factor in the successful accomplishment of oxy-acetylene welding; the same also applying to the manipulation of the arc in the electric process. In speaking on the ability of the operator to do efficient work, Mr. Royer of the Welding and Supplies Company said, "One of the principal drawbacks in connection with the process of oxy-acetylene welding is the long time it takes to educate men to weld properly. A poor operator is liable to either stick the added metal to the plate or to burn the metal, and it takes time for the men to properly handle the blowpipe so as to neither get adhesion or burning, and to judge the correct temperature when to start the weld."

Need of Trained Men

A common fault of the beginner is to keep the flame of the blowpipe playing too long in one particular spot, thus localizing the heat and preventing the proper fusing of the adjoining metal, with the additional possibility of burning the steel or other material. The flame of the blowpipe should be kept continually moving with a slight elliptical motion, so as to distribute the heat evenly at the portion being welded. Speaking further, Mr. Royer said, "There is no doubt that a considerable amount of boiler work can be done very satisfactorily, if the men are properly trained, however, discrimination should be exercised in boiler work, in using only reliable welders on jobs where failure would be dangerous, and apprentices and beginners can be used on those parts where failure will not produce accidents. If a shop could get efficient welders, it would save thousands of dollars in maintenance costs."

Mr. Buckland of the C.P.R., speaking on the effectiveness of the weld in relation to the ability of the operator, said "A blacksmith will not take a piece of metal and try to weld the tip of it to the tip of another piece. He wants the metal properly heated to produce a successful weld. I think we should pay more attention to selecting good men for this class of work. If you are making a weld in a firebox on a long narrow strip, you localize the heat along that weld and it cools rapidily, and there must be an initial strain on that weld, which should, to my mind, be removed by slight annealing after the weld has been made." This brought out the fact that in the repairing of marine boilers in Europe, the practice of hammering the weld with a small hammer, immediately after the weld had been made and while the metal was still red hot, was extensively adopted. This was intended to take the place of the rolling process to which the plate was originally subjected. Following this hammering process the entire welded portion and its surrounding parts are annealed by bringing it and the adjoining sections to a cherry red by means of the blowpipe. By this method it has been claimed that the strength of the joint would be increased from 85 to 95 per cent. of the strength of the plate.

Clean Metal Essential

One of the objectionable features in reference to lap welding, as emphasized by Mr. Buckland, was the extreme possibility of the presence of scale on the sheet, which if not previously removed would undoubtedly result in a very poor weld. To overcome this it would be necessary to take off all the scale and see that the sheets are properly prepared.

In answer to a question from one of the members in connection with the improvements that had been made in getting away from the double thickness of metal, on or adjoining the fire line, Mr. Barry said, "We do not put patches in fireboxes that come in line with the fire. Anyone who does that should not be allowed to use the boiler. The reason is that the fire causes such an amount of expansion and contraction that the weld cannot last. You have to get above the fire line a foot or more, and the higher you get above the fire line the better the patch will hold. Any weld alongside of the fire line is going to burst sooner or later—generally sooner."

Educational Research Needed

With the process of oxy-acetylene and electric welding occupying such an important position in the metal working industries it would appear that the time is opportune for the formation of some form of research bureau to thoroughly study the many questions that are involved in this comparatively new but rapidly developing science, with the purpose of putting the practice on a more certain basis regarding the efficiency of the work and the education of the men that are necessary for the production of reliable and satisfactory work. At present the art is greatly curtailed owing to the lack of knowledge on the part of the majority of operators regarding the fundamental principles pertaining to the technical characteristics of the processes. It would also appear that for men to become thoroughly efficient at this work they must acquire considerable knowledge pertaining to the physical nature of the different metals upon which they are required to make welds. The chemical reaction that must necessarily accompany the fusing of the two metals and the addition of the filling rod must change the nature of the weld from that of the metal in the body of the plate or object being welded, and it is this change that eliminates the possibility of placing a known factor of safety on this particular class of work.

A NOVEL SCHEME FOR WRECKING OLD MASONRY

THE expansive force of quicklime has lately been used in breaking up brick masonry. It was necessary to remove three foundation piers, each 12 ft. by 20 ft. in area, and 12 ft. high, and similar piers supporting working engines on each side prevented blasting. Cutting and breaking up by hand being too slow and expensive, the new method was tried. Vertical holes three inches in diameter and three feet deep were drilled three feet apart in both directions, and were filled to within six inches of the top with quicklime, fresh and well slaked. Water was poured in and the holes were closed with brick dust, well tamped. Cracks started in ten minutes and soon broke the pier top into three foot cubes, making subsequent hand operations easy.

STREET VACUUM CLEANER

A vacuum street cleaner has been purchased for use on streets in the Panama Canal zone and was placed at work this week. It is a motor propelled vehicle carrying a sheet steel bin divided into two compartments. A large blower is driven by a 18 horsepower gasoline motor, and by this means dust and dirt are lifted from the street just as a vacuum cleaner for house use does its work. Stiff brushes mounted in front of the suction-head stir up the dirt so that it may easily be lifted by the suction. The cleaner covers 12½ feet at each operation, and runs at from three to five miles an hour. It operates on dry streets, does away with the cost of sprinkling, and saves in labor cost, as it cleans about 200,000 square yards in eight hours, and is operated by one man, the chauffeur.

Steam and Its Generation

MODERN CONDENSER PRACTICE*

By D. D. Pendleton

FOR high duty work, 28-inch vacuum or better, the type of condenser to be selected should be thoroughly studied, taking into consideration the engineering, physical and commercial conditions. The question of water is of prime importance and should be studied as to : Quantity, kind, clean, dirty, acid, etc.; pumping head; source, natural or artificial; average temperature. With these points settled, the commercial vacuum which is practical to maintain may be determined, always bearing in mind that the average log of a properly designed, rated and operated surface condenser will show better vacuum than a jet machine and in turn better than a barometer machine, due principally to the conditions as to air leaks and exhaust piping losses.

Surface Condensers

The surface machine also allows the condensate to be reclaimed as pure, distilled water for boiler feed, thus requiring only a moderate amount of make-up water to be treated in cases of unsuitable boiler feed supply. There is no limit to the size of surface equipments—they are now being made in sizes from 100 square feet up to 70,000 square feet.

The barometric condenser is limited in size by the expensive exhaust piping. The low level jet is also limited as to size. This is due to the removal or tail pump and air pump limitations and to the power necessary for driving the pumps. Units of 7,500 to 10,000 kilowatts seem to be the practical limit for these pumps, although there have been installed in certain cases twin jets of 20,000 kilowatts capacity.

A 20,000 kilowatt turbine consuming 12½ pounds per kilowatt hour or a total of 250,000 of steam would require for surface work 31,250 gallons of water per minute at 15-degrees difference, with 70-degree water and 28-inch vacuum, against a 10-foot head. This would require approximately 100 horse-power, the air and condensate pump of the hydraulic type requiring 140 horsepower additional or a total of 240 horsepower with one set of auxiliaries.

The jet at a 5-degree difference would require 20,000 gallons per minute against a 40-foot head if no booster pump were required, or approximately 400 horsepower. The pump would require about 250 horsepower more, making a total of [illegible]

Conditions Influencing Choice

After considering the local conditions, the choice of a condenser should be made upon the power requirements of operating cost, always considering the points mentioned in the preceding paragraph. Assuming a case of 40,000 pounds of steam per hour, 28-inch vacuum with 70-degree water, the power requirements are as follows: Surface condensers at 15 degree difference would require 5,000 gallons per minute. Since the discharge should be sealed, a working head of 10 feet should be ample, under ordinary circumstances, requiring a water horsepower of 12½. At an efficiency of 75 per cent. on the centrifugal pump, a pumping horsepower of 16 2/3 would be required. Using the wet and dry system the air pump would require approximately six horsepower, the condensate pump about 2½ horsepower, making a total of approximately 25 horsepower. The low type jet owing to the low efficiency of the removal pump would require more power.

At a temperature difference of 5 degrees, however, less water, or 3,100 gallons per minute would be required. A head of 36 feet being the discharge head from the condenser, plus friction would make approximately 27.9 water horsepower. The efficiency of the removal pump being about only 50 per cent, it would require a total of 55.8 horsepower. The air pump, however, would be approximately twice as large as for the surface condenser and would require 12 horse power, giving a total of 68 horsepower for the jet system. The barometric type would require same amount of water, but the water must be lifted to the condenser head using the total static head plus suction and lift on the pump, less the suction effect of vacuum. This usually can be considered a net head of say 40 feet, making a total of 31 water horsepower; and at an efficiency of say 70 per cent. on the supply pump, a total of 44½ horsepower would be required.

The same air pump would be used as in the case of the jet, requiring 12 horsepower, making a total of 56½ horsepower. The hydraulic or other types of air pumps and the steam jet would materially increase the air removal power requirements.

Summing the case up we have: Surface, 25 horsepower; barometric, 65½ horsepower—an increase over the surface of 126 per cent. low type jet, 68 horsepower plus an increase over the surface of 172 per cent. The relative costs would be: One hundred per cent. for the low type jet; 100 per cent. for barometric, not including the exhaust piping; and about 200 per cent. for surface equipment.

The rating of the surface of a condenser depends principally upon the amount of heat that can be dissipated by each square foot of surface, this being determined by the heat transfer per degree difference between the mean circulating water temerature and the tempperature of the vacuum to be attempted.

Condenser Tubes

The tubes in surface condensers have been a source of much thought and experiment. The material used should be pure electrolytic copper, high grade spelter, having not over 0.07 per cent. lead, 0.03 per cent. iron and .05 per cent. cadmium, and pure tin. No scrap should be used. The most common mixtures are: Pure copper, muntz metal (60 per cent. copper, 40 per cent. zinc); admiralty (70 per cent copper, 29 per cent. zinc and 1 per cent. tin). The standard tubes usually are No. 16 or 18 B. w. g. in thickness and ⅝ inch, ¾ or 1 inch outside diameter, depending upon conditions.

The quality of water available and the temperature usually determine the vacuum which is practical to maintain. This quantity can be varied for the same vacuum by varying the assumed terminal temperature difference, which will directly vary the surface for any given rate of heat transfer. A terminal temperature difference of 5, 10, 15, or 20 degrees can be used. A ratio of heat transfer from 300 to 500 may be employed. For standard commercial work, a terminal temperature difference of 15 degrees is usually conceded the best practice and a heat transfer of 300 to 350 is conceded the most conservative.

Water Velocities

Eminently good engineers have advocated water velocities for surface condensers as high as 10 feet per second, stating emphatically that 8 feet is conceded practical and standard. From tests of large condensers, a water velocity of 4.7 feet per second seems to be the average; for the purpose of discussion, say 5 feet. Now suppose that this velocity be increased to 8 or 10 feet; the power requirements for such conditions would be excessive. All talk of 8 to 10 feet per second seems to be absurd, in view of the fact that there are very

few commercial and practical plants operating under such conditions.

Water quantities are usually figured at a 5-degree terminal difference as standard practice, although results have easily been maintained at the vacuum temperature or a 100-per cent. water efficiency.

The removal or tail pump, as already stated, requires the larger amount of power—usually on river conditions the water has to be supplied to a cold well by a booster pump, drawn into the condenser by suction and expelled against the vacuum plus any friction and outside static head. The booster pump power has not been considered in the example of power requirements for the types already given.

Air Pump Requirements

The air pump is required to remove air coming in with the water as well as air entering through leaks in the exhaust or other piping and air entering with the steam. Here also the water quantities are figured as in the low type jet machines. The water supply can be more easily figured for it can be pumped directly to the barometric head without booster or auxiliary pumps. The air pump requirements are the same as in the low type jet.

After fixing the type of condenser to be used, the next step should be a study of the auxiliaries for equipment. These can be divided into two kinds: Motor driven and steam turbine or steam engine driven. It is very easy to analyze the power requirements of the motor-driven air, circulating and hotwell pumps for the electrical energy is taken directly from the switchboard. Steam turbine or engine drives, however, bring up the question of the return of heat to the feed water or heat balance and this so often complicates matters that we lose sight of the true power consumed. Roughly, 90 per cent. of the steam of the auxiliaries will be returned as heat to the feed water provided there is enough water of a suitable temperature to absorb this heat. The amount of feed water available for absorbing this heat varies with the load on the main unit. The result is that at times of light load there is a grave danger of showing an excess of exhaust steam. This militates against the use of steam-driven auxiliaries to some extent and had led to the development of combined drives using turbines and motors.

In the case of steam jets, this device takes boiler steam, compresses the non-condensible vapors from the condenser and discharges the whole into a feed water heater working at atmospheric pressure. All of the heat except that lost in radiation and leakage is returned to the feed water and for that reason it would seem that the amount of steam required made little difference in the general economy of the whole plant. However, as pointed out previously, care must be taken to make certain that the available steam for heating the feed water is not excessive. One way of analyzing the steam consumption of such an apparatus as a steam jet air pump is as follows: Suppose the pump takes 3 per cent. of the main turbine steam and that the main unit is rated at 5,000 kilowatts or say 60,000 pounds of steam per hour, the steam jet, therefore, requires 1,800 pounds of steam per hour. If this steam were expanding through the same range, that is from boiler pressure down, in the main turbine, it would produce about 150 kilowatts per hour. This then, in a sense, is the power consumption of the air pump and is to be compared with the power that some other type of pump would require for the same condition.

Booster Pump

The efficiency of the booster pump for the low type jet and the supply pump for the barometric can be assumed as standard, consistent with good centrifugal pump design at a given head and quantity. However, the efficiency of the removal pump for the jet, owing to the slow entering water velocities in the impeller when pumping from a vacuum, is seldom over 50 per cent. The barometric, therefore, as far as power requirements are concerned is more efficient than the jet and less efficient than the surface. No condensate is reclaimed for boiler feed purposes in either case.

Where water supply is a serious problem some artificial method of cooling a given supply of circulating water is employed. This is done in several ways: Cooling towers of the natural draft enclosed type or of the natural draft open or rack type, forced draft, and combined forced and natural draft. In standard cooling tower practice it has been determined that with the air temperature at 75 degrees Fahr. and at 70 per cent. relative humidity, the most economical vacuum is 27 inches, based on a 30-inch barometer, or a vacuum having a temperature of 115 degrees Fahr.

Practical Cooling Limits

Rating all condensers on a 5-degree difference—surface, jet or barometric—thus requiring the minimum amount of water, it will be necesary to cool the water from 110 degrees Fahr. Commercially, under the given air conditions, it has been found practical to cool to only 85 degrees Fahr. or sometimes to 80 degrees Fahr., giving a 25 or 30-degree cooling range, which with steam at 1,000 B. t. u. per pound would require 25 and 33.3 pounds of water per pound of steam, respectively. The type of equipment to select would depend upon existing local conditions, such as space available and power consumption.

The natural draft open open type of cooler requires more ground space and can be placed only where the vapors and driftage will do no harm to surrounding buildings or property. This type requires a pumping head of approximately 30 feet and no other power. The natual draft enclosed chimney type takes less ground space, the chimney or stack is usually about 75 feet high.

Area of the Cooling Pond

It is impossible to state generally the area of a pond necessary for a given quantity of water, but generally speaking, at a working pressure on the spray nozzles of 6 to 7 pounds, a pond of 3 square feet per gallon of water sprayed will have to be used. The area of a natural cooling pond is obviously very large as the heat dissipated per square foot depends upon the relative humidity, the temperature of the water and the velocity of the air currents. These are naturally, on account of varied conditions, very discordant.

In any water cooling device 90 per cent. of the cooling effect is through evaporation and it is, therefore, vitally necessary that sufficient unsaturated air be given free access to the proper quantity of water. The air in all cases should go off the tower or pond in a saturated condition.

SETTING VALVES ON WHEELOCK ENGINES

READER'S QUERY—Kindly let me know if you have any information relating to the setting of the valves on the Jerome Wheelock engine.

W. P. SINCLAIR.

Medicine Hat.

The information requested above has been obtained from the manufacturer of these engines. It will be assumed that the valve motion and rods are all on the engine as shown in Fig. 1.

Exhaust Valves

In all cases the eccentric must follow the crank. The eccentric is first thrown as far as possible both ways and it is noted if the rocker arm A travels equal distances past the centre line; if it does not, lengthen or shorten the eccentric rod until it does.

Then place the eccentric on the extreme travel with the hook rod C in position. Drop a plumb line over the pin between the latch hook and the exhaust arm D. Measure from this line to the side of the valve spindle. Then throw the eccentric to the other extreme of its travel, drop the plumb over the other side of the pin and measure from the line to the side of the spindle. If these two measurements are not the same, adjust the hook rod C until they are.

This rod can only be adjusted on the rocker arm end and nothing less than one turn is possible. If adjustment is wanted closer than this to get the arm D to travel equal distances both ways, slightly lengthen or shorten eccentric rod B which has right and left hand threads. Set the exhaust arm E in the same manner as the arm D, any adjustment being obtained by lengthening or shortening the wiper rod G. After this is completed the three rods will be the proper length and the exhaust valves will be set.

Cut-off Gear

On Fig. 2, showing the cut-off arm P, note lines marked AB and CD; AB when plumb indicates the position of the cut-off valve when closed with the proper lap. CD, when plumb, indicates the

lead point, i.e., the point where the cut-off or steam valve is just opening.

The faces of the two cut-off arms have either lines or prick punch marks to correspond to Fig. 2. With the cut-off valves closed hang a plumb line over the face of each cut-off arm P and turn the eccentric dash pot studs I around until the line AB on each arm is plumb.

Care should be taken to have the two eccentric studs I set in the same relation to each other, either both towards the centre or towards the ends of the cylinder. The exhaust and cut-off arms are now set. To set the latch-hooks, throw the main eccentric ahead to the extreme position, then turn pin J at the frame or front end of the cylinder until the latch plate travels over the latch block 1-16 inch. Then throw the eccentric to the other extreme and set the other latch hook the same as above. Be sure studs J are in the same relation with one another.

To get the proper position for the eccentric on the crank shaft, put the engine on the forward dead centre, see that the front latch hook is engaged and turn the eccentric around on the shaft in the same direction as the engine runs until the line on the front cut-off arm, CD, is plumb. Secure the eccentric in this position.

Turn the engine the way it runs to the opposite centre and set the other cut-off arm the same, following the same instructions as before. If CD is not plumb on both ends adjust the eccentric a little to divide the difference between the two ends. After this is completed secure the eccentric on the shaft. This finishes the setting of the steam and exhaust valves.

Governor

On the front of the dash pots will be found two prick punch marks, one on the bottom of the dash pot and the other on the part that lifts. These punch marks should be the same distance apart when the dash pots are at rest.

If they are not, and the cut-off valves have been set correctly as described above, alter one set of marks to correspond to the other. Unhook the gab hook, S, and lift dash pot L till the line CD, Fig. 2, is plumb, as shown by a plumb line. Set a pair of compasses to the prick punch marks on the dash pot at this point. Raise the governor and fit a piece of wood into the slot in the governor top so that there is 5-16 inch between the bar connecting the governor arms and the top of the slot. Adjust the rod N until the dash pot trips off at the point when the prick punch marks are at the distance apart shown by the compasses. Set the dash pot M in the same manner, adjusting the rod O to trip dash pot off at the point where the prick punch marks are the distance apart shown by the compasses.

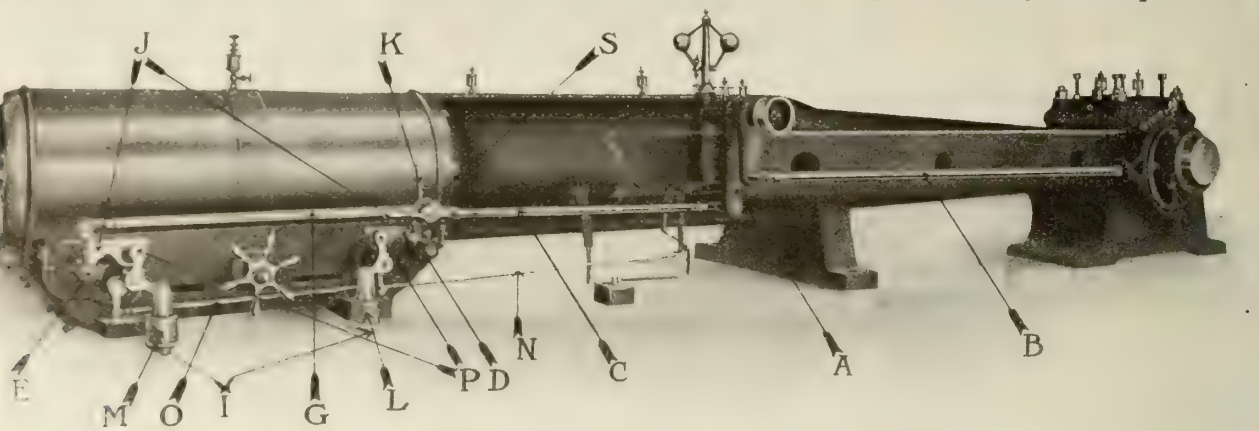


FIG. 1. STANDARD TYPE SINGLE CYLINDER WHEELOCK ENGINE.

FIG. 2. VALVE ARM

It is evident that the use of the prick punch marks and compasses is simply a more convenient way of working than with a plumb line on the valve arm, Fig. 2. Then drop the governor until there is 3-16 inch between the bottom of the cross bar and the bottom of the slot. Work the valve motion by means of a handle, K, and latch hooks should not hook on with the governor at this point. Be sure the latch hooks do not take hold when the governor is 3-16 inch from the bottom and also that they trip off when the governor is 5-16 inch from the top.

The speed at which the governor should run is 170 revolutions. Care should be taken to have all the joints of the governor rods free. Any binding in these will have a tendency to make

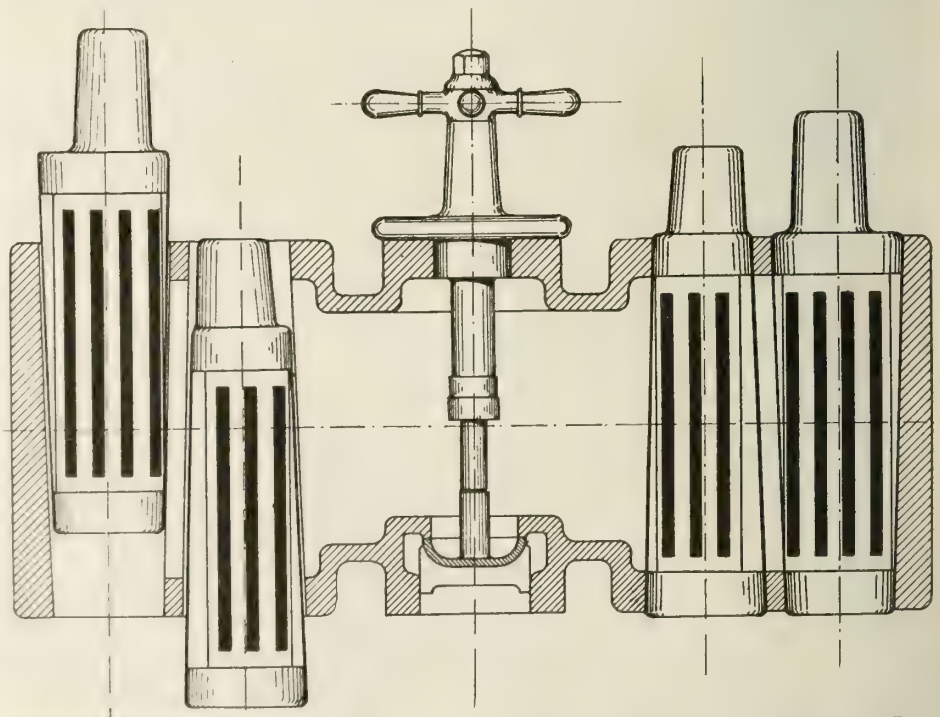


FIG. 3. ILLUSTRATION SHOWING THE REMOVAL OF VALVE PLUGS. NOTE: THEY COME OUT FROM OPPOSITE SIDES.

the governor unsteady. Should any of the acorn nuts screw a little too far and pinch the rods, put a small piece of lead in the bottom of the hole before screwing on. When valves are set in the shop the eccentric hook and wiper rods are all marked their proper lengths with chisel marks. The position of the eccentric on the shaft is also marked.

MODERN PRACTICE IN APPLYING GAS FIRING TO STEAM BOILERS*—II.

By T. M. Hunter, M.A., B.Sc.

Combustion of Gas

Apart from the question of calorific value, there is the question of the constituents of the gas. Two gases of similar calorific value can be shown which would give very different results on combustion. By-product producer gas, as is well known, is made by blowing steam and air blast into the producer fire, and the resulting gas contains hydrogen and CH_4. These gases, on burning, form respectively 1 and 2 cub. ft. of water vapor per cub. ft. of H_2 and CH_4, and the latent heat absorbed in forming this vapor, viz. 966 therms per lb. of vapor, is at present one of the inevitable losses in the use of the gas. The only way in which this heat could be recovered would be by cooling the chimney gases sufficiently to condense the water vapor, and this is impossible with our present economizers. To show the losses which are inevitable from this cause, the author gives the analyses of several gases, the net calorific value, and the number of therms lost by latent heat in the water vapor caused by combustion.

These analyses of gases, as in the case of any other analyses given in the paper, must be taken only as examples. They are analyses of gases with which the author has actually had to do, but it is well known that even on the same plant analyses of gas vary greatly from time to time.

	Coke-oven Gas. Per cent.	Blast-furnace Coke Gas. Per cent.	Moore Producer Gas. Per cent.	Mond Producer Gas. Per cent.
CO_2	——	12	12.7	16
CO	8.1	29	15.5	8
H_2	49.1	1.5	20.2	23.4
CH_4	32.6	0.7	2.2	3.2
C_2H_4	3.1	——	——	——
N_2	6.6	56.8	49.4	49.4
O_2	0.5	——	0.2	——
	Therms	Therms	Therms	Therms
Calorific value (cold gas)	540	112	132	130
Loss by latent heat in vapour of combustion	58½	1½	12½	17

This table shows the great value of the losses from this cause. The author has purposely chosen two producer gases of similar calorific value, in order to bring out the point that a gas is more valuable for boiler firing (or for combustion in any way) which has a greater proportion of CO to H_2, other things being equal. Producer buyers should look carefully into this point when specifying new plant. A certain amount of steam must be blown into the producer in order to recover the ammonia, but at present far more is used than the amount necessary for this purpose in order to cool the fire. The author believes that some other method should be adopted for this cooling. The Moore producer, mentioned above, does part of this cooling by means of a water jacket. It has been suggested that much of this cooling could be done by some method such as by blowing in boiler flue gases carrying, say, 15 per cent. of CO_2, and taking advantage of the absorption of heat which occurs when CO_2 is reduced to CO in the presence of heated carbon. This is known in America as the Eldred process. In this way the gas should be improved and much steam saved. The question, however, is still in the region of experiment.

Drying and Cleaning Gas

It is very important that the gas should be dry when burned. At any temperature from 0° to 100° C. gas will take up a known amount of water as vapor, and this amount can be found in an air-saturation table. If the gas has been cooled or washed in water, it is reasonable to assume that it is saturated with water to the amount corresponding to the lowest temperature to which the gas has been brought. As an example of the amount of water carried in this way, the author had recently to use, at 15° C. and 55° C. respectively, the two producer gases described in the above table. The former gas carried under 2 per cent by volume of water vapor, and the latter carried 15½ per cent. This vapor must all be heated when the gas is burned, and it not only lowers the flame temperature, but also is responsible for carrying to the chimney a large quantity of sensible heat.

To show the actual loss from this cause, let us assume that we have cleaned blast-furnace gas from the same furnace, in one instance at atmospheric temperature with 12 to 15 grammes per cub. metre of water vapor, and in the other instance gas saturated at 70° C., carrying about 362 grammes per cub. metre. The analysis of the gas at 0° C. and atmospheric pressure is:

Per cent.		Calorific Value
CO	29	965 calories per cub. metre 107 therms per cub. ft.
H_2	3	
CO_2	8	
N_2	60	

In both cases the gas is to be burnt under boilers with an excess of air of 25 per cent.

We have to ascertain, first of all, the air necessary for the combustion of this gas without excess of air, which is shown by the following table in cubic metres:

	1 cub. m. of Gas	Oxygen needed	CO_2	H_2O	N_2
H_2	0.03	0.015	——	0.03	——
CO	0.029	0.145	0.29	——	——
CO_2	0.08	——	0.08	——	——
N_2	0.60	——	——	——	0.60
	1.00	0.160	0.37	0.03	0.60

Air required:

$0.160 \times 4.77 = 0.78$ carrying N_2....0.62

Total N_2 ....1.22 cub. m

25 per cent. excess of air, $0.78 \times 0.25 = 0.195$ cub. metre.

The combustion temperature of this gas when burnt with an excess of air of 25 per cent. is 1,294° C., found thus, using the Le Chatelier formula:

Air and N_2	$1.415 \times (0.303t + 0.000027t^2)$
H_2O	$0.03 \times (0.34t + 0.00015t^2)$
CO_2	$0.37 \times (0.37t + 0.00022t^2)$
Total ..	$0.5758t + 0.0001241t^2 = 965$
	$t = 1{,}294°$ C.

Now take the gas at 70° C. Its temperature is about 55 degrees C. higher than atmospheric temperature, so that the additional sensible heat per cubic metre is 3 therms. This raises the calorific value of the gas to 110 therms. To this must be added the heat in the water vapor accompanying the gas, so that the calorific value of the gas plus the water vapor will be 113 therms or 998 calories. One cubic metre of aqueous vapor at 70° C. weighs 644 grammes (1 cub. metre of water vapor at 0° C. = 810 grammes: at 70° C. $\frac{810 \times 273}{273+70}$), so that 362 grammes of vapor carried by the gas will correspond to 0.562 cub. metres, and the combustion temperature is found thus:

Air and N_2	$1.415(0.303t + 0.000027t^2)$
H_2O	$0.592(0.34t + 0.00015t^2)$
CO_2	$0.37\ (0.37t + 0.00022t^2)$
Total ...	$0.775\ t + 0.000208\ t^2 = 998.$
	$t = 1{,}010°$ C.

This shows that there is a drop of 284° C. in the combustion temperature, which, of course, is a very serious matter. It is much more difficult to obtain complete combustion of this mixture of aqueous vapor and gas with an excess of air of 25 per cent. than if gas alone is dealt with. It is also a well-known fact that the efficiency of a boiler depends in the first instance on the initial temperature of combustion, and if the latter is lower the efficiency of the boiler is certain to decrease. The first thing to be affected will be the evaporation per square foot of heating surface, which is certain to be

*A paper presented before the Institution of Electrical Engineers.

considerably smaller if wet gas is used than with dry gas.

We have next to consider the effect of the water vapor on the efficiency of the boiler. From our former calculations the formula representing the loss is, in the case of the dry gas, $0.5758\,t + 0.0001241\,t^2$, and in the case of the wet gas $0.775\,t + 0.000208\,t^2$.

Let us assume that it would be possible to burn completely the dry and the wet gas with an excess of air of 25 per cent. and to pass the waste gas to the stack in both instances at a temperature of 250° C. The losses through waste heat in the case of dry gas would be $0.5758 \times (250 - 15) + 0.0001242 \times (250^2 - 15^2 = 204$ calories and in the case of the wet gas $.775 \times (250 - 15) + 0.000208 \times (250^2 - 15^2)$ 297 calories per cub. metre of the gas burned. The loss through waste gas for dry gas would be 21 per cent. of the total value of the gas, and for wet gas 29.8 per cent. Or, in other works, the presence of the water in the gas will cause an unavoidable and irredeemable loss of 8.8 per cent., in addition to the loss by the reduced flame temperature. Assuming in both cases 5 per cent. loss through radiation and conduction, the actual efficiency for dry gas would be 74 per cent., and for the wet gas 65.2 per cent., which is equivalent to a drop in the output obtainable from the same quantity of gas amounting to 12 per cent.

Effect on Evaporation

So far as regards the efficiency, but it will also be worth while to consider the evaporation obtainable in both cases. Let us assume that in both cases the boiler is working on its maximum load—that is to say, that the boiler flues pass the maximum quantities of gas and air which the chimney draught can convey at the most favorable position of the damper. Let us assume that we are dealing with a 30 ft. x 8 ft. Lancashire boiler and that with a dry gas under the above described circumstances the highest possible evaporation was 6,000 lb. of water from and at 212° F. As the total efficiency of the boiler is 74 per cent., the total quantity of gas necessary in order to provide this evaporation contains 7,830,000 therms. At 107 therms per cub. ft. 71,000 cub. ft. of gas must be burnt per hour in order to obtain this evaporation. It was found above that for each cubic foot of gas 0.975 cub. ft. of air are necessary for complete combustion with an excess of air of 25 per cent. The air passed through the boiler will be 69,000 cub. ft. per hour. In order to facilitate our calculation let us assume that the weights of the gas and the air are the same. Then the total weight of 140,000 cub. ft. of air and gas will be $140{,}000 \times 1.293$ oz. $= 11{,}310$ lb., which represents the total weight of products of combustion that the boiler can possibly pass. Now at 70° C. each cubic foot of gas carries 0.0228 lb. of water, whilst the weight of the products of combustion from each cubic foot of dry gas will be 1.975×1.293 oz. $= 0.16$ lb. The weight of the products of combustion of wet gas is increased by 0.0228 lb. for each cubic foot of gas, giving a total weight of 0.1828 lb. for each cubic foot of dry gas plus water. The boiler is not capable of passing more than 11,310 lb. per hour, so that the maximum amount of gas to be dealt with would be $11{,}310 \div 0.1828 = 62{,}000$ cub. ft. per hour. The total calorific value of the hot gas is 113 therms per cub. ft. The total heat admitted is $62{,}000 \times 113$, or 7,000,000 therms; the possible efficiency as above is 65.2 per cent.; the heat in the steam is, therefore, 4,670,000 therms, which corresponds to 4,725 lb. from and at 212° F.

This somewhat lengthy calculation is useful, as it shows that the simple presence of water in the gas can, under otherwise absolutely equal conditions, result in

(1) A drop of efficiency of nearly 9 per cent.
(2) A drop in evaporation of more than 21 per cent.
(3) The loss due to lower flame temperature, which the author has not attempted to calculate

From these calculations it is evident that an engineer who has to specify a producer plant, or a gas-cleaning plant, where washing of the gas is part of the process, should take care to specify the maximum amount of water vapor allowable in the gas supplied.

Effect of Dust

Contrary to a frequently expressed opinion the author does not believe that the dust in itself impairs seriously the heating value of blast-furnace gas; and the uncleaned gas has the advantage that it contains the sensible heat. The dust, however, may seriously affect the efficiency of the boiler. If two Lancashire boilers are run side by side, the one on cleaned and the other on uncleaned blast-furnace gas, it will be found that at first the results as regards both evaporation and efficiency are about the same. Soon dust will start to accumulate in the boiler flues, and as this dust is an insulating agent it will impair both the evaporation and the efficiency. After four or six weeks the dust accumulates in such large quantities that the evaporation falls and combustion may even take place partly in the stack instead of under the boiler. Where Lancashire boilers are to be fired, it will, therefore, generally pay to instal a gas-cleaning plant, even at the expense of the sensible heat which is lost in the cleaning process.

Conditions are much more favorable with water-tube boilers, as with these it is often possible to clean the tubes without stopping the boiler. If liberal use is made of the steam lance, the proposition to put in a cleaning plant will certainly not be such a favorable one as in the case of Lancashire boilers

It is not proposed here to enter into the advantages and disadvantages of the various systems of dry or wet cleaning. The ultimate choice in each case will depend on the first cost of plants and on the cost of attendance and maintenance. Heavy charges are involved for power consumption and for interest and depreciation on the capital outlay. But, whatever the cost should be, it must be borne in mind that the cheapest plant is not worth having unless it fulfils the following conditions:

(1) The gas must be clean.
(2) It must be dry, and this is even more important than the cleanness.

In some cases where the gas can be cooled to a temperature of 80° C. without water injection, and where the ores contain only a small percentage of moisture, it is possible with a dry cleaning plant to obtain a dry, hot gas; whereas, where wet cleaning processes are used, or where water is injected for the purposes of cooling the gas, the gas is saturated and this water has to be eliminated.

So far as the author can discover the cost of cleaning gas, inclusive of all charges, is about 4c per 35,000 cub. ft., and is practically the same whether the wet or the dry process is used.

The sensible heat in blast-furnace gas per cubic foot is approximately as follows:

Temperature of gas, C.....	200°	250°	300°	350°	400°
Sensible heat, therms per cub.ft..	7	9	11	13	15

As cold blast-furnace gas varies from about 90 to 110 therms per cub. ft., this sensible heat is a large percentage of the total heat of the gas. Firing water-tube boilers with properly designed burners, and using the steam lance, say, twice a day to clean the tubes, the efficiency with uncleaned gas is certainly within 10 per cent. of the efficiency with cleaned gas—probably within 6 per cent. On the other hand, with Lancashire boilers the average efficiency over 4 or 6 weeks with uncleaned gas is very considerably lower than with cleaned gas.

The decision as to whether it will pay to clean gas must, therefore, be made for each case separately, and depends on the peculiarities of the gas and of the dust, as well as on the kind of boilers used.

Heat Transfer

Gaseous fuel as usually burned does not give the intense local heat and the heat-radiating surface of the coal fire. Rather the problem is that of a very hot gas which is cooled gradually as it travels through the boiler. It is like the problem of a coal-fired boiler with the fire-grate entirely outside.

The transfer of heat through a steel wall from hot gases to water consists of three parts—transfer of heat from gas to metal, transfer of heat through metal, transfer of heat from metal to water. The resistance to the transfer of heat in the second and third parts is exceedingly small when compared with the resistance to the transfer of heat from gases to metal. It is calculated for one case that the resistance to transfer of heat from gas to metal was 622 times the resistance to heat passing through the steel. This shows that the advantage to be gained by fitting, say, copper tubes instead of steel would be very small indeed. Again, the transfer from metal to water, if the

metal has a clean surface, is also negligible compared with the gas-metal transfer. If, however, the metal carries scale on its surface the case is very different. Scale ¼ in. thick, assuming the scale to have the same conductivity as plaster of Paris, of which the specific resistance to the conduction of heat is 108 times that of iron, would add resistance to heat transfer equal to 18 per cent. of the resistance of transfer from gases to steel.

READERS' QUERY

Question.—Will you kindly advise me if there is any special formula for calculating the working pressure on a furnace for a vertical tubular boiler. Would you also give me the calculation of the following:

Furnace 46 ins. dia., 48 ins. high, ⅜ in. plate with staybolts ⅞ in. dia., and 4½ x 4½ in. pitch.—Reader's Query.

Answer.—The portions of the Ontario Boiler Act abstracted below cover this portion of the design of vertical boilers quite fully:

Section 63.—Internally Fired Furnaces or Parts of Boilers (other than ordinary fire tubes) subjected to compression.

The furnace plates in plain circular internally fired furnaces, not exceeding 42 ins. in diameter, if not found sufficiently strong must be stayed as flat surfaces, allowing in the calculations for such 75 per cent. of the value of the resistance to collapse as found by the following formula, the pitch of stays being computed by the rule for flat surfaces, but the pitch shall in no case exceed eight inches on the furnace plate. For furnaces over 42 inches in diameter no allowance for value of resistance to collapse shall be made. Care must be taken not to reduce the efficiency of the riveted joint when applying these stays

$$B = CT^2 \div (L_1 + 1)\ Dr$$

Where,—

Dr = outside diameter of furnace in inches.

T = thickness of plate in inches.

L_1 = length of furnace in feet, or length between rings.

B = working pressure per sq. in. which must not exceed that found by the limiting formula as follows:

$$\frac{10{,}000\ T}{Dr} = B$$

C = A constant according to the following circumstances:

Furnaces with butt joints and rivet holes punched small and reamed out in place.

112,500 where the longitudinal seams are double riveted, and fitted with single butt straps.

100,000 where the longitudinal seam is single riveted, and fitted with single butt strap.

112,500 where the longitudinal seam is single riveted and fitted with double butt straps, or where seam is welded.

Furnaces with lamp joints and rivet holes punched small and reamed out in place:—

96,000 where the longitudinal seams are double riveted.

87,500 where the seams are single riveted.

Section 55 Flat Surfaces

The formula for staying surfaces mentioned above is as follows:

The maximum stress allowable on flat plates supported by stays shall be determined by the following formula:

All stayed surfaces formed to a curve the radius of which is over 21 ins., excepting surfaces otherwise provided for, shall be deemed flat surfaces.

Working pressure = $ct^2 \div p^2$.

Where,—

t = thickness of plate in sixteenths of an inch where doubling plates are used, for "t" take .75 of the combined thickness of both plates.

p = pitch of stays in inches when equally spaced in both directions.

C = 112 for screw stays, with riveted heads, plates seven-sixteenths of an inch thick and under.

C = 120 for screw stays, with riveted heads, plates over seven-sixteenths of an inch thick.

C = 120 for screw stays, with nut outside sheet, plates seven-sixteenths of an inch thick and under.

C = 125 for screw stays with nut outside sheet, plates over seven-sixteenths of an inch thick and under nine-sixteenths of an inch.

C = 135 for screw stays with nut outside sheet, plates nine-sixteenths of an inch thick and over.

C = 175 for stays with double nuts, having one nut on the inside and one nut on the outside of plate, without washers or doubling plates.

C = 160 for stays fitted with washers or doubling strips which have a thickness of at least the thickness of the plate, and a diameter of at least .5 of the greatest pitch of stay, riveted to the outside of the plates, and stays having one nut inside of the plate and one nut outside of the washer, or doubling strip for "t" take 72 per cent. of the combined thickness of the plate and washer or plate and doubling strip.

C = 200 for stays fitted with doubling strips which have a thickness equal to at least the thickness of the plate reinforced, and covering the full area braced (up to the curvatum of the flange, if any) riveted to the inside of the plate and stays having one nut outside and one inside of the plate. Doubling plates to be substantially riveted. For "t" take 72 per cent. of the combined thickness of the two plates.

C = 200 for stays with plates stiffened with tees or angle bars having a thickness of at least the thickness of plate and depth of web at least one-fourth of the greatest pitch of these stays and substantially riveted to the plates and stays having one nut inside, bearing on washers fitted to the edges of the web, that are at right angles to the plate. For "t" take 72 per cent. of the combined thickness of web and plate.

Since the diameter of the furnace for which calculations are requested is over 42 ins., the working pressure cannot be calculated from the formula given in Section 63, but must be figured according to that given in Section 55, as follows: Furnace 46" dia., 48" high, ⅜" plate with stay bolts ⅞" dia. and 4½" x 4½" pitch.

Working pressure = $Ct^2 \div p^2$.

Where

t = 6

p = 4½"

c = 112

This works out at about 199 lbs. per sq. in. for this particular part of the boiler.

ELECTRIC POWER BY WIND

Windmills to generate enough electricity for a farm, or even for a small municipality, are now in successful operation, according to the "Electrical Experimenter." Indeed, such plants can be made to generate hundreds of horsepower. This magazine thus describes a plant suited to a small farm:

"In operation the power vanes are each rotated on their respective bearings in such a manner as to expose them to the wind at the angle of greatest efficiency at every degree of the circle, while traveling with, across and against the wind, there being about 30 degrees only of the circle when the vane comes against the wind edgewise to a degree where it is not efficient.

"Another feature of this design of wind-power wheel is the automatic controllability. By means of a centrifugal two-ball governor or by a resistance type electric governor, the vanes are varied in their angle to the wind in case of high wind velocity, so that the motion of the wheel is kept from running above a given speed. This protects both the power plant and machinery from unnecessary wear and strain.

"The automatic means for stopping the mill when the storage batteries are charged and throwing it in the wind when any given number of ampere-hours have been discharged, assure perpetual and abundant service without further expense or attention, except oil for the plant once a year, distilled or rain water for the batteries, and reasonable attention to the generator.

"The small farm type plant is automatic, starting and stopping according to the condition of the storage batteries. It charges the batteries about once a week on the average."

R. L. WIGG and L. R. Ferguson have carried out some interesting experiments bearing upon the effect of sea water on concrete. They have found, among other things, that the character of the workmanship has an important bearing on the ability of concrete to resist the action of sea water. Only contractors of experience, employing competent men, should, they urge, undertake important work in sea water. The difficulties usually encountered cannot be overcome by any but the best of organizations thoroughly equipped with the necessary tools and machinery.

Power Transmission Section

SPEED REDUCTION GEAR

RECENT developments in the use of prime movers having high rotational speeds have necessitated the employment, in many cases, of some form of speed reduction gear. The difficulties surrounding this application of gearing are well known. High peripheral speeds, proper lubrication, floor space occupied and lack of convenience and general adaptability combine to form a problem trying the designers' ingenuity.

A new form of speed reduction gear has recently been developed by the Pool Engineering Co., of Baltimore, the design being such that it may be used for either step up or step down service.

The high efficiency of the gear has been shown in a recent test where the gear gave an efficiency of 98.5 per cent. as an average of five readings.

The torque of a direct current motor was measured by means of a Prony brake at a certain number of armature amperes, volts and field amperes, the speed also being measured. The motor

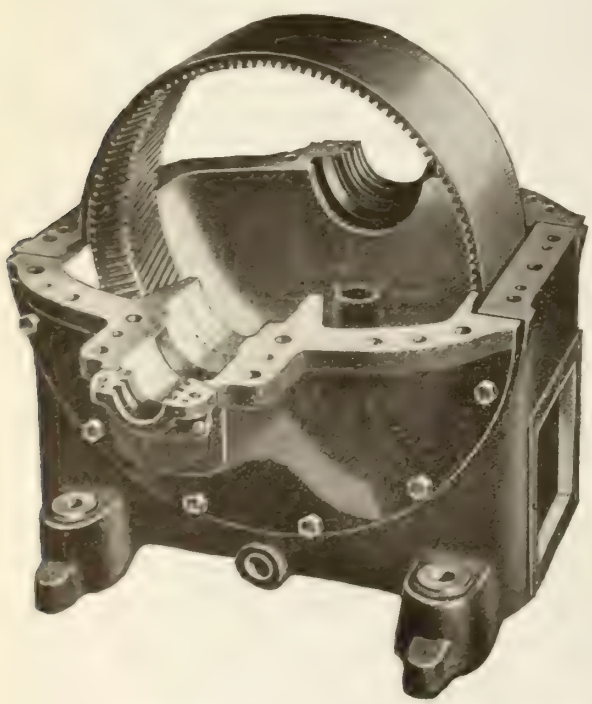


FIG. 1. LOWER HALF OF CASING SHOWING INTERNAL GEAR IN POSITION.

Prony brake attached to the gear. The load was then adjusted to give the same electrical readings and the torque then was then coupled to the gear and the read. The ratio of this second torque to the first multiplied by the gear ratio gave the efficiency.

$$\text{Efficiency} = T_1 \div T_2 \times 6.666$$

The totally enclosed feature makes it impossible for the workman to get his fingers or clothing caught in any rotating part or gear. This feature also makes for low maintenance cost and permits its use in wet, dirty, dusty or gritty places.

Low Maintenance Cost

After installation there is little or no maintenance expense attached to the operation of this gear. The only attention needed is to see that an adequate supply of oil is in the reservoir. This may be contrasted with a belt or chain drive where constant attention is needed due to the stretching of belts or the wear of chains and sprockets.

Owing to the self-contained nature of this gear the cost of installation is very slight. It is only necessary to provide a firm foundation and to insure that the alignment of the gear and the driving and driven unit is perfect. When mounted in accordance with sound engineering practice this reduction gear is practically noiseless and works without vibration.

The casing is horizontally split, so that by the removal of the casing bolts the tops may be removed for inspection without disturbing the gears or shafting in any way.

As the high speed and low speed shafts are in axial alignment and all tooth pressures are balanced there is no tendency to deflect the shafts and produce unequal stresses on the bearings. The bearings merely have to support the weight of the rotating members. In the case of motors connected to chains or belts there is always considerable side pull on the bearings, this causing wear and often heating.

The high and low speed shafts are each independently supported by the casing. The low speed shaft is sup by the casing. The low speed shaft is supported at each end by heavy duty S.K.F. ball bearings. One end of the high speed shaft is supported in a babbitt split bearing and the other end in a

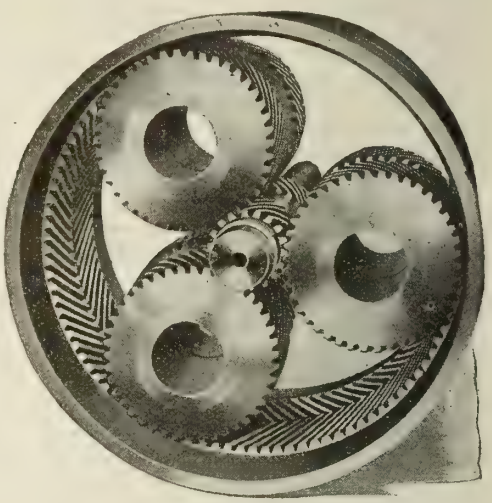


FIG. 2. GEAR MEMBERS.

bronze bushing inside the cage, which forms a part of the low speed member. The pinion is cut integral with the high speed shaft and is allowed to float and seek its equilibrium between the intermediate gears.

Three Line Tooth Contact

Another advantage of the construction adopted is that there are three lines of tooth contact as compared to the one line of contact of the ordinary herringbone and pinion. This results in a lower tooth pressure for equal horse-power transmitted and consequently in a longer life.

The gear will drive in either direction without any changes and both the high and low speed shafts revolve in the same direction. Speeds as high as 6,000 r.p.m. and over are successfully handled.

Turbine Drive

The high economy of the modern steam turbine makes it a desirable prime mover for the operation of various machines. Steam turbines to be economical must necessarily run at high speeds, yet many machines, such as centrifugal pumps, fans, generators, etc., require a speed much slower than that of the steam turbine. To reduce the speed of one or increase the speed of the other is a compromise which materially lowers the efficiency of both

units. The mechanical speed reduction gear offers an admirable solution of this problem.

The extensive application of electricity throughout the industrial world has demonstrated the efficiency of motor drive. It is impossible, however, to secure a really slow speed motor and it will often be found advisable to purchase a high speed one and to drive through a reduction gear.

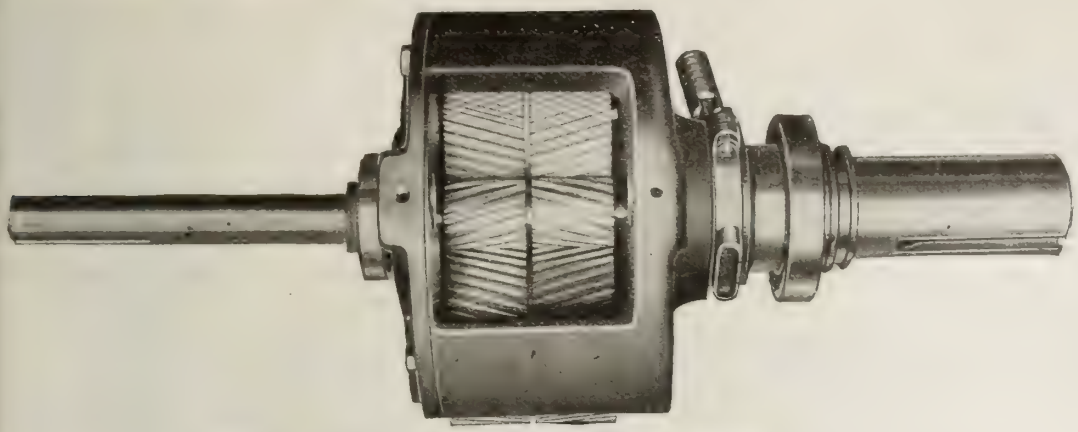


FIG. 3. GENERAL ASSEMBLY SHOWING PINION AND INTERMEDIATE GEARS (ONE INTERMEDIATE GEAR BEING REMOVED FOR CLEARNESS).

Construction

The gear members are cut on a gear generator which produces a true involute stub tooth of great accuracy and finish. These gears are not subjected to any process such as filing, scraping or polishing after being cut as this is unnecessary.

This speed reduction gear consists of an internal double helical gear, see Fig.1, made of a special analysis open hearth steel, forging heat treated to increase its ductility and to insure uniform hardness; a double helical pinion, Fig. 2, cut integral with the high speed shaft; intermediate double-helical gears shown in the same illustration made of high carbon steel forgings with large bronze bearings, mouted on hardened and ground steel shafts secured to the cast-steel slow speed member.

The high speed shaft and pinion as well as the slow speed members carrying the intermediate gears are accurately ground all over and are carefully tested for static and dynamic balance before being assembled.

The casing is made of tough, grey, cast iron, horizontally split. It is very substantial and well ribbed to provide a rigid support for the gear members, this insuring efficient and quiet operation.

The high-speed shaft has a central passage through which the oil is pumped, and continuous radial passages in the pinion. The oil after lubricating the gears and bearings is drained to the main oil reservoir in the base where it is filtered, cooled, returned to the pump and used over again.

Operation

The internal gear is held rigidly in place in the casing and is kept from turning by means of two keys which slip into two keyways in the gear and casing. The pinion meshes with the intermediate gears and the intermediate gears mesh with the internal gears.

Let us assume that we wish to drive a low speed machine with a high speed mover. The prime mover should be connected with the pinion shaft; this causes the pinion shaft to rotate and turn the intermediate or planetary gears. As the internal gear is held stationary, the intermediate gears must not only rotate but must of necessity revolve about the pinion shaft. This causes the low speed shaft, connected to the spider housing the intermediate gears, to rotate at the desired speed.

FIG. 4. TURBO-GEAR MOTOR LINE SHAFT DRIVE. 100 H.P. GEAR. SPEED REDUCTION 730-122 R.P.M.

Motor Line Shaft Drive

A very interesting application is found in Fig. 4, which shows two 100 h.p. motors direct connected to the line shafts through this device. It will be noticed that the gears and motors are mounted on base plates set upon concrete pillars.

An interesting application of a direct connected reduction gear and steam turbine is shown in Fig. 5. This illustrates a 100 horsepower turbo-gear direct connected to a Terry steam turbine reducing the turbine speed from 3,600 to 440 rev. per min., which is the speed of the driven unit—in this case a blower.

Two of the most noticeable features of this outfit are its compact and symmetrical appearance, together with the absence of offset shafts, the driving and driven shafts being in the same straight line. These features result in a considerable saving of floor space, as well as permitting a better grouping of the machines.

It is frequently found desirable to drive centrifugal pumps, fans, etc., with a law speed prime mover such as a gas engine. Fig. 6 shows an installation of this character where the engine speed is stepped up to the desired pump speed.

THE STEAM GUN

AT a time when many novel devices are being employed to hurl death and destruction at an enemy, it is interesting to recall that amongst the inventions of that remarkable genius, Jacob Perkins, was a steam mitrailleuse, which astonished the good people of 1826 no little, but which was never used to any more serious purpose. Jacob Perkins was the pioneer of really high pressure steam. A mere 200 lb. or so was nothing to him; he preferred to employ 1,000 lb., and spoke lightly of a hundred atmospheres.

The pressure used in the gun was probably irregular, but according to Perkins'

own statement it was at least 750 lb. The whole thing was extremely ingenious. The steam generator consisted of a stout steel tube 3 in. diameter and 6 ft. long, provided with headers into which a number of smaller tubes were welded. With the two headers were connected the ends of a coil of stout iron tube, 80 ft. in developed length, which was placed in a furnace. The coil and headers and pipes were filled with water, which circulated under the influence of the heat, and ultimately reached a very high temperature and pressure, the amount of which was controlled by a damper, regulated by the expansion and contraction of part of the tube system. When the generator was sufficiently hot water was injected into the space outside the tubes by a hand pump, and was rapidly converted into steam which was conveyed to the gun.

The gun was not more than a tube with a valve near the breech end, and just in front of the valve a hopper provided with a shutter for the bullets. On pressing the discharging lever the steam struck the bullet in the barrel and drove it out with considerable force. It was reported in 1826 that the gun had been brought to such perfection that it was exhibited before the Duke of Wellington.

Lead balls of an ounce in weight were driven at a range of 35 yards through an iron plate ¼ in. thick, or through eleven planks of hard wood one inch thick and placed one inch apart. But what most surprised the spectators was that the bullets issued in such rapid succession that a long plank was almost sawn in two longitudinally when the gun was swung round slowly in front of it. The piece with its generator was much too cumbersome and unwieldly for the field, but as an example of the use of very high pressure steam the invention is full of interest. Perkins was miles before his time if ever a man was, but his descendants are already beginning to see signs of the advent of much higher pressures than those in common use, even nearly a century after Perkins' time.—*The Engineer.*

FIRST CONCRETE SHIP TRIAL TRIP

THE Namsenfjords recently ran her trial trip. She is the first reinforced concrete full-powered vessel, built in Norway, to be completed. She has a length of 84 feet by 20 feet by 11 feet 6 inches draught, on which she carries 200 tons of cargo, and with her 80-horse-power Bolinder engine develops a speed of about 7½ knots. It was found on trial that vibration was practically non-existent, which speaks well for the method and material of construction. While on trial the vessel's sea-going qualities were thoroughly tested, and she behaved excellently. A large hold is arranged for, and a maximum-sized hatch will facilitate the loading and discharging of her bulky packages. The cargo will be dealt with by a powerful motor winch. The crew's quarters are forward, and the captain, mate, and engineers will be berthed aft on deck. Reinforced concrete vessels should prove valuable assets to those countries which have lost vessels during the war. If steel and wood were plentiful and could be released for commercial work, there is every probability that concrete construction for marine purposes would not have been studied to the extent that it has been. This development will no doubt prove to be one of the benefits the allies will gain through the war. There is a limit to the output of steel and properly-seasoned timber, but practically none to the production of cement.

There are, of course, drawbacks to every new industry, but, so far as can be determined, advocates of the reinforced concrete vessels believe they have only one, viz., heavier hulls than if steel or timber were employed. But against this, it is pointed out, there are advantages, such as increased cubic capacity, cost of upkeep practically nil, and reduced cost of repairs in the event of damage.

For quite a considerable period tug owners have been anxious to employ tugs fitted with oil engines in preference to steam engines on account of the reduced cost of running, but so far there has been a slight drawback—the reduced weight of machinery. With a cargo vessel this reduced weight is naturally of considerable benefit to owners, but with a tug, weight is essential. A reinforced concrete tug, fitted with an oil engine, would have a somewhat similar displacement to a steel vessel fitted with steam machinery. As a consequence, provided the experimental vessels now under construction in this country prove a success, tug owners may be expected to consider the oil-engine concrete tug proposition on really serious lines.—London Shipping World.

ICE PLANT MEN ARE WARNED TO BE SAVING OF AMMONIA

THE United States Food Administration has issued an appeal to owners and operators of ice making and refrigerating plants to do everything within their power to stop all waste and leakage in their use of ammonia.

"During 1918 the Government should have for munitions alone 20,000,000 pounds of ammonia more than it is possible to make by working all the plants producing ammonia in this country to their maximum capacity," the Food Administration declares in this appeal.

Shortage in Summer

"This shortage will be greatly increased by the ammonia that will be furnished ice making and refrigerating plants, but it is hoped that by appealing to the patriotism and business sense of all ammonia users, and urging them to stop all waste and leakage, that the usual consumption may be curtailed to such an extent as will permit at least the most efficient plants to run; particularly where natural ice is not available.

"A saving of 25 per cent. in the ammonia consumption of ice and refrigerating plants would mean several million pounds annually for munitions. Each pound will make 20 hand grenades. Late returns show this saving can be accomplished if all will stop the leaks."

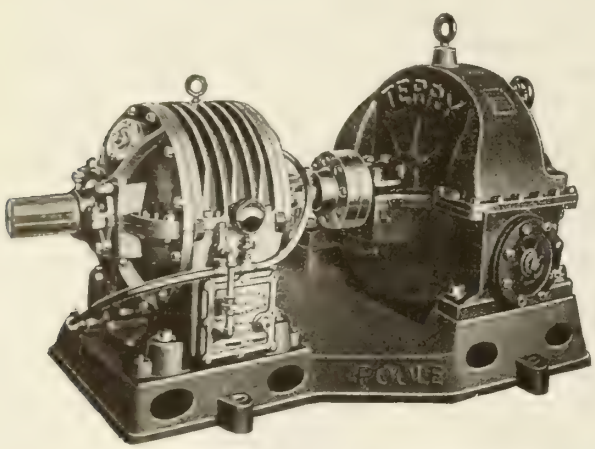


FIG. 5. STANDARD TURBINE INSTALLATION.

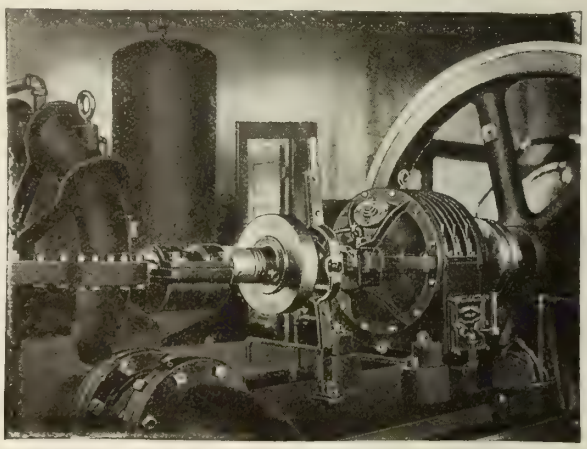


FIG. 6. 100 H.P. INSTALLATION STEPPING UP ENGINE SPEED TO THAT REQUIRED FOR PUMP.

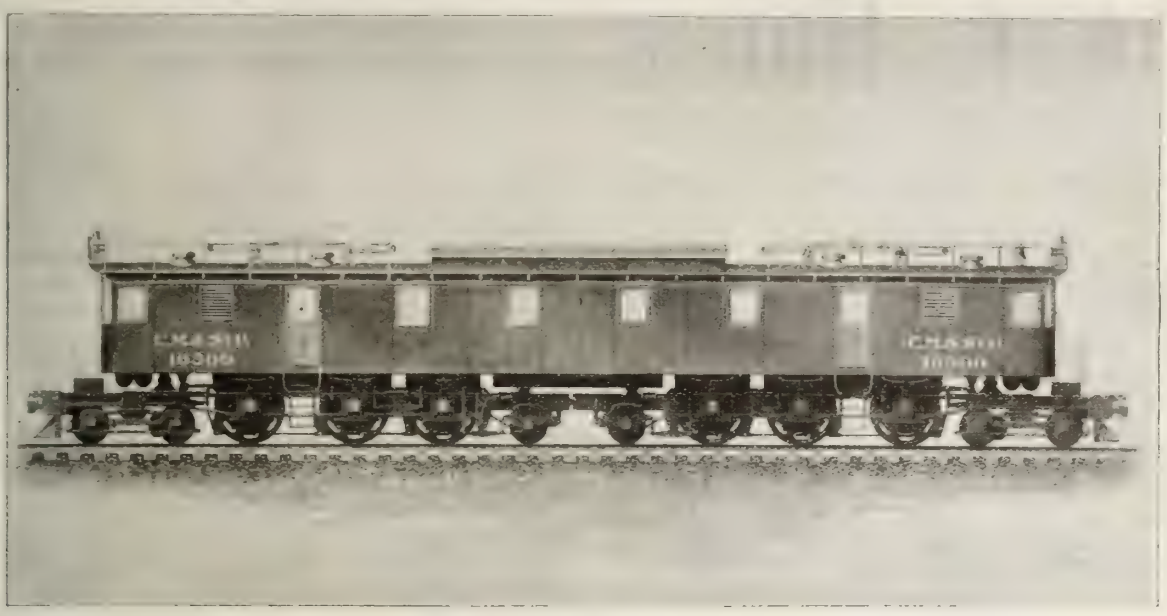
CANADIAN manufacturers now produce 800,000 complete shells every week, which is more than was produced, before the war, by any nation except Germany.

POWERFUL ELECTRIC PASSENGER LOCOMOTIVES FOR THE CHICAGO, MILWAUKEE & ST. PAUL RAILWAY

The concentration of enormous horsepower in a single locomotive unit has long been the recognized tendency in railway practice. This originated from considerations of crew-economy and the greater efficiency of large units. The limits of the two-man crew have been reached, while further increases in size will yield but small improvements in efficiency. Recourse must be had to some new form of motive power if necessary increases in hauling capacity are to be made.

It is fortunate in many ways that electricity has thoroughly proven itself for this purpose. On the Chicago, Milwaukee & St. Paul Railway, its use over the 440 miles of line over the Rocky Mountains has been so satisfactory in operating efficiency, hauling heavier trains and keeping traffic moving in all weathers that the railroad's decision has recently been made to electrify another mountain division—the 211 miles from Othello, Washington, over the Cascade Range to Seattle and Tacoma. With the completion of this work, a distance equal to that from New York to Cleveland will be under electrical operation. To handle passenger traffic over this and the Rocky Mountain division, the St. Paul has ordered ten electric locomotives.

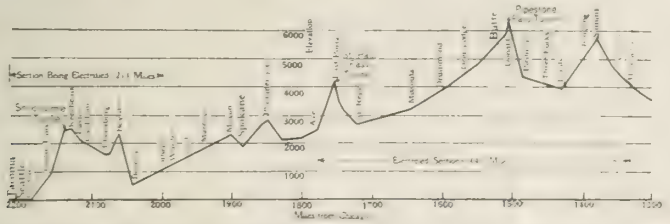
These locomotives will have a length of 90 ft. over couplings, and will weigh 266 tons when ready for service. Each machine will have a single cab, extending over practically its entire length. The running gear consists of two units of the familiar "Pacific" type placed back to back. Each will have a four-wheel guiding truck, three driving axles with 68-inch driving wheels, and a two-wheel trailing truck, connected by a heavy link and the cab will be free from pulling strains.



3,200 H.P. ELECTRIC LOCOMOTIVE.

Each locomotive will carry twelve motors, arranged in pairs permanently connected in series, each pair being geared to the same driving axle through a quill, whose spring mounting gives a certain amount of flexibility for cushioning the road and pulling shocks. By this means the only weight not spring-supported is that of the wheels, axles and journal-boxes.

These will be the most powerful locomotives in passenger service. Each can haul a 950-ton train of 12 coaches over the St. Paul's entire mountain section at the same schedule speed made by two or three steam engines. Each locomotive can deliver 3,200 h.p. indefinitely, and 4,000 h.p. for one hour. At starting, a pull of 112,000 lbs. can be exerted on a train, while the normal maximum speed on level track is 60 miles per hour and up a 2 per cent. grade, is 25 miles per hour.



PROFILE CHICAGO, MILWAUKEE AND ST. PAUL RAILWAY.

One great advantage of the electric locomotive is that it will maintain its efficiency over a wide range of speeds. For these locomotives there are nine economical running speeds, varying from 8 to 56 miles per hour. These are secured by various series and parallel groupings of the motors, and by placing shunts around the fields.

Of cardinal importance in these locomotives are the arrangements for regenerative braking. Due to long grades, wear on brake-shoes was excessive, and the possibility of accident from brake-failure was always present. Where the locomotive motors become generators there is no difficulty in bringing a train down the longest grade at a higher speed than before, since less margin of safety for equipment failures is required. In addition, a substantial saving in power is made.

In connection with regenerative features, each locomotive has generators geared to the axles of the pony trucks. These supply current to excite the main-motor fields during regeneration; at other times, while running, they supply current for the air-compressors. When this supply is not available the compressors take power from a small motor-generator set, or from the control storage battery. Thus a constant supply of compressed air is available at all times, whether the trolley is energized or not.

Due to the extremely cold weather common in the Rockies, train heating is of vital importance. To assure its independence of trolley-line conditions, each locomotive will carry an oil-fired steam boiler with storage tanks for 750 gallons of oil and 7,500 gallons of water.

Running gears and mechanical details for these locomotives will be furnished by the Baldwin Locomotive Works, and electrical equipment by the Westinghouse Electric and Manufacturing Company.

ONE of the chief points which Professor Edwards brought home to the users of high speed steel in a paper read before the Manchester Association of Engineers, was the importance of the temperature from which high-speed steels were hardened.

The MacLean Publishing Company
LIMITED
(ESTABLISHED 1888)

JOHN BAYNE MACLEAN - - - - - - - President
H. T. HUNTER - - - - - - - - - Vice-President
H. V. TYRRELL - - - - - - - - General Manager

PUBLISHERS OF

POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air, and Water Power, and to the design and operation of Refrigerating Machinery.

J. M. WILSON, Editor. Manager: B. G. NEWTON.

Associate Editors:

A. G. Webster. J. H. Rodgers W. F. Sutherland

OFFICES

CANADA—
Montreal—Southam Building, 128 Bleury St., Telephone Main 1004.
Toronto—143-153 University Ave., Telephone Main 7324.
Winnipeg—1207 Union Trust Building, Telephone Main 3449.
Eastern Representative—E. M. Pattison.
Ontario Representative—S. S. Moore.

Toronto and Hamilton Representative, J. N. Robinson.

UNITED STATES—
New York—R. B. Huestis, 111 Broadway, New York, Telephone 8971 Rector.
Chicago—A. H. Byrne, 900 Lytton Bldg., 14 E. Jackson Street. Phone Harrison 1147.
Boston—C. L. Morton, Room 733, Old South Bldg., Telephone Main 1024.

GREAT BRITAIN—
London—The MacLean Company of Great Britain, Limited, 88 Fleet Street, E.C., E. J. Dodd, Director, Telephone Central 11960. Address: Atabek, London, England.

SUBSCRIPTION RATE

Canada, $1.00; United States, $1.50; Great Britain, Australia and other colonies, 4s. d., per year; other countries, $1.50. Advertising rates on request.

Subscribers, who are not receiving their paper regularly, will confer a favor by telling us. We should be notified at once of any change in address giving both old and new.

Vol. XI. MARCH, 1918 No. 3

PRINCIPAL CONTENTS

Notes on the Design and Testing of Air Lift Pumps I..... 57-61
General 61
Fuels of Canada.
Electricity and Hydraulics 62-64
Principles and Operation of Modern Electrical Equipment I....Readers' Queries....Street Railway Power.
General 65
Wrecking Old Masonry....Welding of Locomotive Fire-boxes.
Steam and Its Generation 66-71
Modern Condenser Practice....Setting Values on Wheelock Engines....Modern Practice in Applying Gas Firing to Steam Boilers II....Reader's Query.
Transmission 72-74
Speed Reduction Gear.
General 74-75
The Steam Gun....Ice Plant Men Are Warned to be Saving of Ammonia....Powerful Electric Passenger Locomotives for the Chicago, Milwaukee and St. Paul Railway.
Editorial 76
No Let Up in Economy....He Reads the Advertising.
Association and Personal 77
Operators' Point of View 78-83
The Status of the Engineer, Oxygen and Perpetual Motion ....Chart For Finding the Length of Coiled Pipe....Circulating Pipes....Setting Machine Tools....An Oil Filter.... The Joys of a Millwright....Alcohol as a Motor Fuel.
General 84
The Sources of Energy....Salvage of Grease and Oil.... Vocational Training Facilities Increased.
Operators' Instruction Course 85
Education Paper VI.
Selected Market Quotations 86
Trade Gossip, Catalogues (Advtg. Section) 47-58

NO LET-UP IN ECONOMY

THERE is a grave danger that the passing of severe weather and the resumption of more or less normal railroading conditions will remove much of the seriousness of the coal situation from the minds of many of us, and that, as soon as personal discomfort is forgotten, the business of burning up coal will be continued with as much lack of attention as hitherto.

No language is strong enough to condemn those who waste fuel. That any man would actually take coal and dump it in the lake or otherwise dispose of it so that no one got any benefit is not to be thought of, yet that way of wasting fuel would be cheaper and easier than by installing expensive boilers and mechanical stokers and operating them carelessly.

Condemnation is doubly deserved when the waste involves wear and tear on plant and unnecessary exertion on the part of attendants.

Just as the finest automobile goes into the ditch when deprived of a guiding hand on the steering wheel, so can the efficiency of the finest plant disappear in smoke when uncontrolled.

An exact knowledge of what takes place in a boiler furnace is essential to every fireman. A due appreciation of this can only be had by investigating the composition of the waste gases and determining their relation to the furnace efficiency. Once furnace efficiency is understood, the heat transmitting features of the boiler demand attention, and this involves such items as clean boilers, inside and out, suitable draft to give the proper velocity to the gases, and sufficient load on the boiler to enable these conditions to be maintained.

The efficient use of all the various devices and apparatus for maintaining these conditions is part of a fireman's duties and places him above the old-time handy man who cared little whether he shovelled sand or coal.

It may be that the individual saving in any one plant is so small as not to appear worth while, but our actions to-day in respect of fuel are going to affect us ten or twelve months hence just as surely as the sun will rise to-morrow. It may not be possible for many of us to save a carload of coal over last year's consumption, but one more car on a freight train during weather like the past winter may mean the difference between breakdown of a locomotive and getting the coal through.

The total coal saved when the saving is good and the securing of supplies when opportunity offers are two ways of avoiding trouble next winter. They are not so commendable, however, as those methods which economize through increased efficiency, and every employer and every fireman, engineer and millwright should feel that his duty to the country, to the industry and to those dependent on him makes it incumbent to burn less coal and get more heat out of it whenever mechanical apparatus and devices make it possible.

HE READS THE ADVERTISING

HERE'S something to think about: "I never miss a chance to read the technical papers. I read the advertising pages and all. In fact I read the ads. first."

Now, that's not a saying that was hatched in the brain of a man trying to sell advertising matter for a technical paper.

It is the opinion of a steel mill superintendent, who entered the business as an apprentice in a machine shop.

From apprentice he went to journeyman, to foreman, to assistant master mechanic, to master mechanic and on to superintendent.

And all the time he has studied and read the technical and trade papers, and studied the advertisements.

It simply goes to show that the technical and trade press is filling a place in the life of the mechanic that no other paper can reach.

It keeps him in touch with the latest developments in a field that is constantly being changed by new devices that may make the fit plant of to-day obsolete in a few years from now.

The advertising pages of the technical and trade press are as up-to-date text books to the man who is coming toward the top.

Association and Personal

C. J. Hicks has been appointed assistant superintendent of the Dodge Mfg. Co. of Toronto. Mr. Hicks came from Midland, Ont., and previously to his work there has had wide experience in manufacturing work.

Adam Cook, the senior member of the firm of Adam Cook's Sons, manufacturers of Albany Grease, died on Feb. 19, at his residence, 148 West 78th street, New York City. Adam Cook was born in Albany, N.Y., in 1867.

R. A. Gurnham, who has been connected with the John McDougall Caledonia Iron Works for the past seven years, the last two as works superintendent, has accepted a position as mechanical engineer with Darling Bros., Montreal. He will be associated with the sales department.

Loyall A. Osborne, of New York, vice-president of the Westinghouse Electric & Mfg. Co., and chairman of the executive committee of the National Industrial Conference Board, has been appointed by the Secretary of Labor a member of a committee on industrial peace during the war.

E. A. Seath, formerly with the Montreal office of the Canada Wire and Cable Co., and the Moloney Electric Co. of Canada, has been appointed manager for the Maritime Provinces of these companies, and has opened an office at 674 Barrington Street, Halifax. He is succeeded in Montreal by Harry Riley, formerly of the Toronto office of the Canada Wire and Cable Co.

SWEDISH EXHIBITION

THE Swedish Export and Industry Exhibition has arranged a display of typical Swedish inventions for the purposes of interesting the public capitalists and exporters in the many practical and useful inventions to the credit of Sweden.

The exhibition will remain open for three months, and the exhibits numbering over 250 thoroughly cover the fields of industry and science.

A particularly interesting display showing the uses to which paper is being put shows entire costumes, gauze bandages, stockings, blind cords, machinery belts, towels, etc., all of paper.

NEW REGULATIONS FOR THE OPERATION OF STEAM BOILERS

AT the last session of the legislature of the province of Saskatchewan the boiler code was amended changing the system of collecting fees for the inspection of portable and traction engine boilers.

Owners of these boilers are now required to register them with the Department and to pay an annual license fee of $5.00 for each boiler.

On receipt of the above fee the Department will issue a number license plate which must be attached to the boiler, and after the 1st of January, 1918, no portable or traction engine may be used or operated which does not display thereon the numbered license plate for the current year as prescribed by the Act, under a penalty on summary conviction of not less than $10.00 and not more than $50.00.

Where the owner of a portable or traction boiler had already paid to the Department the annual fee for the current year the inspector will not charge any fee for the inspection of such boiler.

PEAT DEPOSITS IN CANADA

DR. EUGENE HAANEL, Director of the Mines Branch, has made a valuable report on the subject of peat, which is being given consideration in formulating a policy. Dr. Haanel estimates the total area of the Dominion overlain by peat bogs as 37,000 square miles, and of this total area the known peat bogs of Ontario, Quebec and Manitoba comprise 12,000 square miles, with an average depth of six feet. He estimates the 12,000 square miles will contain about 9,300,000 tons of peat, having a fuel value equivalent to about 5,400,000 tons of coal.

Seven bogs within convenient shipping distances of Toronto are estimated to be capable of producing approximately 26,500,000 tons of fuel; and seven bogs in the vicinity of Montreal could supply that city with 23,500,000 tons of fuel.

Five bogs along the Lower St. Lawrence, conveniently situated as regards water transportation to the City of Quebec, can, it is estimated, supply 16,250,000 tons of fuel and 5,700,000 tons of peat litter.

The bogs examined in Nova Scotia can produce 6,200,000 tons of fuel and 500,000 tons of peat litter, and those of Prince Edward Island produce 1,250,000 tons of fuel and over 1,000,000 tons of peat litter.

In Manitoba the aggregate fuel content of the bogs is estimated at less than 2,000,000 tons. One bog alone, however, it has been estimated, is capable of furnishing 2,500,000 tons of peat litter.

OPERATOR ORGANIZATIONS

British Columbia Association of Stationary Engineers, Vancouver.—Subordinate Lodges at Vancouver, Victoria, New Westminster, Cumberland, Merritt, and Fernie.

North-West Association of Stationary Engineers, Edmonton, Alta.

Manitoba Association of Stationary Engineers, Winnipeg.

Canadian Association of Stationary Engineers, Hamilton, Ont.—Subordinate Lodges at Montreal, Toronto, Hamilton, Ottawa, Brantford, Guelph, Kitchener, Chatham, Ont.; St. John, N.B.; Owen Sound, London, Stratford, Belleville, Kingston, Sudbury, St. Thomas, North Bay, Port Arthur, Sarnia, and Windsor, Ont. The executive officers of the C.A.S.E. Grand Lodge are as follows:—

Past President—W. G. Forbes, Montreal, Que.
President—R. F. Gofton, Kitchener, Ont.
Vice-President—Wm. Cooke, Belleville, Ont.
Treasurer.—A. W. Heath, Hamilton, Ont.
Conductor—S. Balmfirth, Toronto, Ont.
Doorkeeper—George Moll, London, Ont.
Secretary.—John H. Hale, Hamilton, Ont.

ELECTRICAL FITTINGS IN DEMAND IN AUSTRALIA

D. H. ROSS, Canadian Trade Commissioner in Australia reports that according to an authentic publication compiled in 1915 there were in that year 165 cities and towns in Australia lighted by electricity. Of the plants in operation 87 were municipally owned and controlled and 81 were private companies. Taken by states, Victoria had 75 cities and towns electrically lighted, New South Wales 42, Queensland 10, South Australia 7, Western Australia 22, and Tasmania 9. In one or two cities there are both municipal and private concerns furnishing light, the boundaries of the former being the city proper and the latter having as their sphere of operations the suburbs.

It is anticipated that the 1918 edition of the Australasian electrical directory will show a moderate increase in the number of towns which have adopted modern methods of lighting and also in power plants for manufacturing and tramway extensions. A number of contemplated municipal enterprises, in both lighting and power, have, perforce, been held in abeyance until the difficulties of increased expense of procuring the requisite material from overseas are less pronounced than at present.

For the time being imports are to a large extent restricted to parts and fittings necessary in ordinary extensions and in the maintenance of existing plants, though the volume of such imports is still very large.

The elimination of German goods, which constituted a large portion of the Australian purchases of electrical material abroad, has necessitated dealers seeking other sources of supply to make up the deficiency. The United States and Japan have been the principal gainers by these changed conditions, hence a like opportunity now exists for Canadian manufacturers.

The Operators' Point of View

THE STATUS OF THE ENGINEER

By James E. Noble

HOW that the question of graded certificates for stationary engineers has been shelved for awhile, it may not be out of place to give a personal opinion on the subject.

It is quite possible that I will bring up some of the points already discussed among the hundreds of articles which have been written about this matter; I will, however, also bring up one or two new items. As this article deals with my personal opinion it may be permissible to state that I passed an examination and secured a first-class certificate in the days of the Ontario Association.

However there are hundreds of fine fellows as good as the best of engineers, in practical operation, who are cursed with a mind which positively will not permit them to retain a vast amount of technical information in such shape as to be available on demand. These men have the knowledge in such form that they can solve the most difficult problems by using their text books to find the rules.

Unless a man understands the technical side of engineering the use of books at an examination would be practically useless to him. What I would suggest to the men who are boosting for a graded certificate is to embody in the law permission for the candidate to use text books at an examination for first class papers.

Did anyone ever hear of any engineer being asked to give the diameter of crank shaft required on a given engine, or to make a sketch of a properly braced boiler head, or to sketch a theoretical diagram (indicator) from an automatic cut-off engine, or to show the proper size pump required to supply a certain battery of boilers, or any one of a thousand such questions by any employer, without permission to refer to his text books? In operation I do not believe it has happened very often if ever, so why make the conditions on an examination different from those liable to occur in practice?

In a bookless examination on technical subjects, it is the man of the science school who is most liable to make a high percentage, while the practical self book educated engineer may fall down because his brain is full of original thoughts and practical knowledge and somewhat shy on rules.

I venture to state that most people could give a list of questions such as the examiners use in first-class examinations and a large percentage of the examiners would fail to make good.

This actually happened some years ago in one of the American states when the examiners themselves had to pass an examination such as they had been using, incidentally keeping many capable men out of first-class plants. It is all right to demand direct answers without the use of books to many practical problems liable to occur in any plant, and most of such questions should be used in the lower grade examinations. In the higher grade ones it is my opinion it would be the acme of common sense and common justice to allow the use of text books.

Before trying the examination for first-class papers I used up some months of valuable time memorizing hundreds of rules which were not necessary for me to know at the examination and for which I have had no use during the following twelve years, although first engineer in a power plant. The questions I was asked were all technical, which any man who had considerable book knowledge and no practical experience could answer. Of course, an applicant for examination is supposed to have some years' experience in a power plant, but I am thinking that the information given by the applicant himself is usually taken at its face value, and it is seldom that any engineer is asked to send or give proof that the statements given are correct.

It has been said that no system of education is in force that does not compel a man to learn a lot of things which will probably never be of any value to him. In engineers' examination for high-grade papers this rule need not be carried out. If the engineer reads his trade journal and text books, even casually, he will have, with the help of an index, a fair idea where to look for any information wanted. Information so found will be much more reliable than if the memory alone were depended upon.

A cipher placed in the wrong place may do a world of harm. With the memory this is quite possible; with the use of the best of the text books it is highly improbable. Therefore, why not allow the use of text books to answer purely technical questions at examinations?

Another idea is this: If a man has had a certain number of years' practical experience in full charge of a high pressure steam plant, and has a diploma from any good school (residential or correspondence) showing that he has completed a course of study in engineering, give this man a first-class certificate without further examination; he pays the regular fees, of course.

There are many of these men who have expended considerable sums of money educating themselves along engineering lines who possibly could not satisfy some pernickety examiner that they were qualified because their memory or mind is not a mass of useless rules and figures, but who are probably better engineers and safer men in a power plant than the examiner would be, and who could perhaps work out problems with the use of text books that would puzzle the examiner to answer with the use of the same books.

Call stationary engineering a profession if it suits you, but it will never be a profession so long as it is worked along the present lines.

Look at the civil or consulting engineer. He has no Government certificate. His college diploma and perhaps some practical experience is all he has, but he is considered as ranking in the professional class by the public at large. The power plant chief suffers very much by comparison in the eyes of the dear public.

Look at the places where compulsory examinations are in force. Is the engineer considered any more favorably by the public than in other places? No. In order to better the condition of the stationary engineer we must persuade the Government to pass a law making it compulsory for first-grade engineers to have a certain amount of practical experience and a college or correspondence school diploma for a course in steam engineering, and see how soon the stationary engineer will rank with the civil engineers.

We must get some modern thought into the system; never mind the old chestnut of compulsory examination by the memory test. Get permission from the Government to allow such first-class engineers only to use the letters S.E. after the name, and see how soon the public will sit up and take notice. The stationary engineers will then have a place in the sun. How many people outside of the engineers themselves and a few of their employees know that there is such a thing as a Government examination? The employers who were notified about the matter have now forgotten it. As the Government is beginning to enforce the law, some more employers will hear about it, but they will soon forget it again.

If it is better remuneration the engineers want, the scheme outlined above will help out. If it is glory, it also holds good. If it is for love of the public only and the desire to supply good men to good plants, the scheme is a top-notcher.

OXYGEN AND PERPETUAL MOTION

IN the February issue of POWER HOUSE, on page 46, there is an article telling of an invention of a Mr. Gallagher for obtaining oxygen from the air with no other expense than the first cost. So far so good, but your correspondent goes on to say that the inventor is perfecting (I believe that is the term used) the invention, and is experimenting on an internal combustion engine, in which the oxygen obtained from the air is to take the place of oil, gas, or gasoline.

Mr. Editor, that would surely be some engine, if your correspondent is right.

As far as my memory serves me I learned that oxygen is incombustible, after the manner of some of this winter's coal; that is the only fault I have to find with the invention as reported.

If oxygen can be manufactured free of cost (practically speaking) the inventor will have conferred a boon upon all long suffering engineers. Perfect combustion without excess air, just what all engineers, and incidentally owners, have been looking for.

In an internal combustion engine, too, it would certainly help wonderfully. About 4 or 5 times the power could be developed in an engine of the same size, as one in which air is used to support combustion.

But as for taking the place of oil, etc., I 'hae my doots'.

I am afraid it looks too much like a perpetual motion machine. There have been so many revolutionary machines and engines that somehow failed to revolute. However, I await confirmation of the report with great interest.

S. BALMFIRTH.

Toronto.

A CHART FOR FINDING THE LENGTH OF COILED PIPE, ETC.

By N. G. Near.

WITH the aid of the acompanying chart it is a simple matter to determine the length of a coil of rope, the length of a pipe so familiar to the plumber, the length fo a coil of rope, the length of a coil of wire, or a coil of almost anything as a matter of fact. This chart, however, was made primarily for pipe. The size limits of this chart, it will be noted, range from 4 to 30 inches in diameter (column A) and from one to 60 turns (column C). This limits the charts to a bit over 400 feet.

To use the chart, measure the "average" diameter of the coils as indicated by the sketch on the chart itself. That is, measure from the "mid-point" of one side to the mid-point of the other side in inches. Then count the number of coils. Then connect the diameter (column A) with the number of turns (column C) and the intersection with column B immediately gives the total length in feet.

For example. What is the approximate length in feet where the diameter is 15 inches and the number of turns is 20?

Connect the 15 (column A) with the 20 (column C), as indicated by means of the dotted line drawn across the chart and the intersection with column B immediately shows the length of the coil of lead pipe or whatever else it might be as very close to 79 feet.

It is evident that it is much quicker to use this chart than to unroll the pipe and measure it, or even to compute it, knowing that to compute one must divide the diameter in inches by 12 and multiply by 3.1416 and then by the number of turns in arriving at the result. Besides, this method is just as accurate anyway because of the judgment that must be used in measuring the diameter.

This method is much quicker and easier than to unroll a long coil and measure it with infinite care and then roll it up again. The method is not "absolutely accurate" but for most rough purposes it will do very well indeed. If it is desired to determine the "exact" length within an inch or even a foot (provided the coils are large) there is no surer method than unrolling and measuring in the longhand way. But if the answer is wanted only approximately, why do it the hard way?

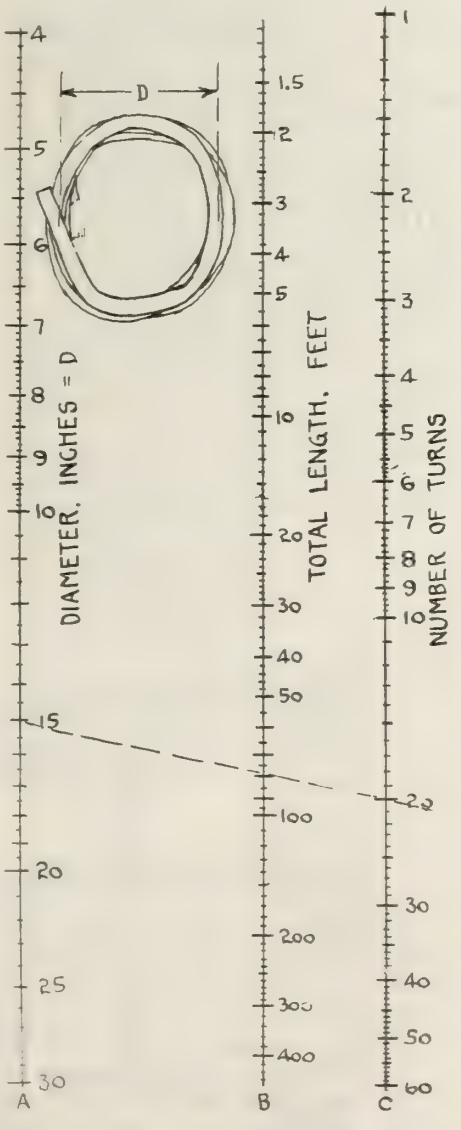


CHART FOR DETERMINING THE LENGTH OF COILED PIPE, ETC.

SETTING MACHINE TOOLS

By D. S. Mann

WHERE machine tools are placed on concrete floors as they are ,in the greater number of cases, it is quite a job to put

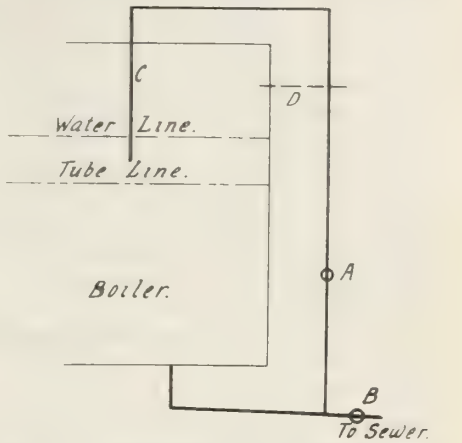


FIG. 2. ALTERNATING ARRANGEMENT OF BLOW-OFF PIPES

in the foundation bolts for holding same. Of course, for the larger and more weighty machine no fastening is necessary, and especially so if motor-driven. However, the average machine tool will finally work its way out of position either from the belt pull or by being struck with trucks or heavy castings. Several years ago the writer installed the machines in a manufacturing shop and, not being quite certain as to their ultimate positions, adopted the following plan:—The machines were levelled up by means of iron wedges and raised about three-quarters of an inch off the floor. A good strong mixture of sand and cement was mixed up with a generous supply of fine iron chips. This was worked wel under the edge of the machine so as to have a good wide bearing and was extended out about one inch, giving a bevelled edge entirely around the machine. When this hardened it seemed impossible for the machine to move and, to the writer's recollection, none ever did move. Adding the iron chips formed a very hard cement, and even where castings were rolled against this edge it seemed almost impossible to crack it. If it were desired to move the machine it could, of course, be ervy easily raised and the cement band then broken up.

ASKED as to the occupations of national importance which were available for discharged disabled men, Sir A. Geddes said, on the 31st ult., that they were: Shipbuilding, ship repairing, marine engineering, munitions, agriculture, agricultural implement making, food production, railways, tramways, iron ore mines, gas, water and electric undertakings.

CIRCULATING PIPES

By James E. Noble

MANY blow-off pipes are connected to steam boilers with no circulating or equalizing pipe; this is a serious mistake as it is quite possible for steam to form in a pipe so connected, with the result that the water is forced out of the blow-off pipe into the boiler, allowing the pipe to become overheated, and, if the water rushes back into the overheated pipe, it is quite possible that a fracture may occur, caused by rapid contraction. Some engineers advocate connecting a circulating pipe at the water line of the boiler; the main objection to this is that the circulating water will act as a surface skimmer, to some extent depositing the impurities inside the boiler near the blow-off. If the blow-off is used often no harm would develop, even if the water was pretty dirty, but the objection can be overcome by using a double connection as shown in Fig. 1. To use the surface blow-off close valves A and C and open B and D. When not using the surface blow-off close B and D and open the other two. The funnel piece G should be made from sheet copper; a pipe coupling is soldered on to the end and this in turn is screwed loosely on to the end of the 1¼ inch pipe coming through the tube end of the boiler.

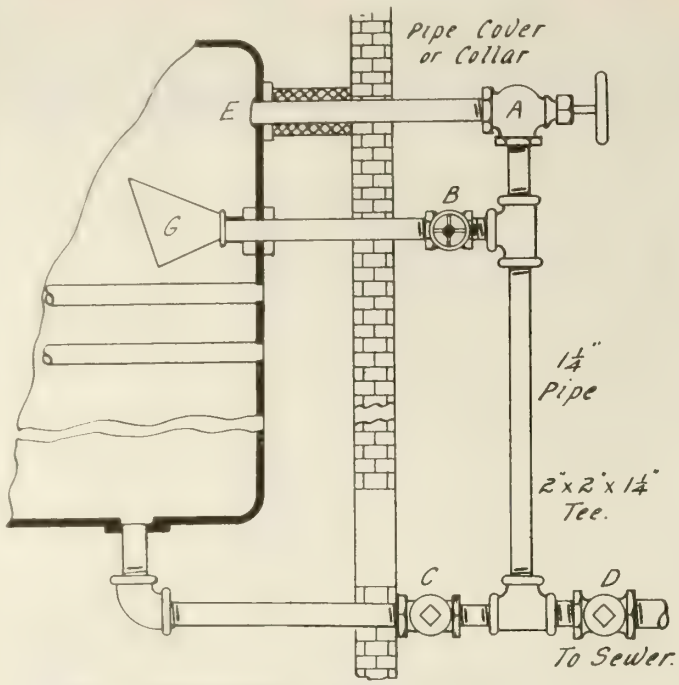


FIG. 1. ARRANGEMENT OF CIRCULATING BLOW-OFF CONNECTIONS.

When cleaning scale from the back head, the funnel can be unscrewed by hand and placed aside out of the way until ready to close up the boiler, when it can be replaced. Objection may be made that there are too many valves to operate in this outfit. Eliminating the skimmer, the circulating pipe can be installed as indicated in the diagram, Fig. 2, page 79. To blow-off close valve A and open B. When not using the blow-off, B is closed and A left open. The circulating pipe will work even if the pipe C does not go below the water line, although experiment seems to prove that connected as shown in the diagram, better results have been attained. Unless the pipe is connected below the water line it is better to run it up outside the brickwork and connect it into the top of the boiler as shown in Fig. 2. If it enters the head of the boiler, at the steam space, it is liable to get burned at part shown by the dotted line D, Fig. 2.

AN OIL FILTER

By John Port

SO many oil filters have been described that I hesitate to describe another. The one here shown has proved very satisfactory in operation and has many advantages over a number of home-made filters in operation to-day.

The tanks made from galvanized iron can be obtained from any tinsmith for a few dollars and the taps and pipes can be installed by any operating engineer. The filter can be made any size according to the size of the plant. So far as cleaning dynamo or engine oil is concerned the filter will work like a charm just as shown.

If it is desired to filter lard oil, cylinder oil or any other heavy oil it will be necessary to instal a steam pipe in the compartment B, below the waste, to keep the oil thinned.

One feature should be noted in the design of this filter, all pipe-work in the various sections should preferably be of the same size and ½ in. galvanized iron pipe has been found satisfactory in this respect.

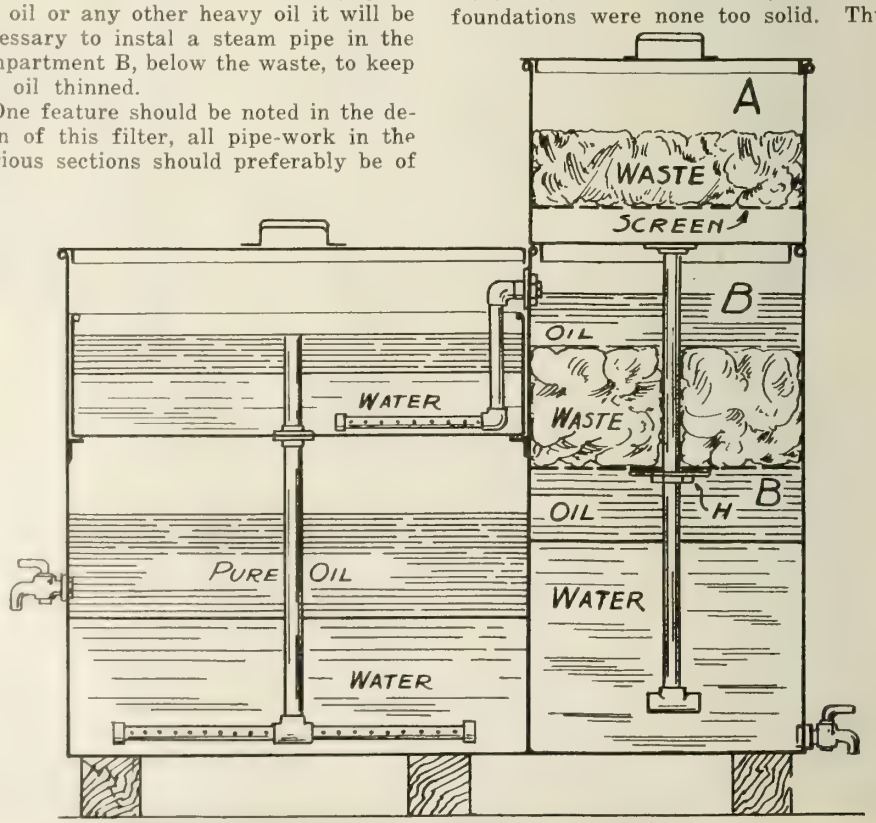
The oil to be filtered is put into tank A, passes to the bottom of tank B, up through the waste and into tank C, and from there through the water to tank D, where it passes out of the tap E.

There is a coupling and a large iron washer at H; this holds up the perforated iron screen. Tank A acts as a cover for B and lifts out, taking the screen pipe and waste from B when cleaning is required. By removing the locknut at K the pipe can be removed and the tank C lifted out for cleaning tank D.

When cleaning out the tanks any oil therein should be saved and refiltered.

It is quite safe to use oil filtered with this machine as very little oil will get past tanks A and B. These two last-named tanks will require cleaning more frequently than C and D.

This filter will do as good work as many manufactured at four times its cost.



SECTION THROUGH FILTER SHOWING ARRANGEMENT.

THE JOYS OF A MILLWRIGHT

By D. Middleton

THE Milo mill of the United Paper and Pulp Co. was a sort of dumping ground for the machinery that had outlived its usefulness in the company's other plants. And yet they were supposed to, and did, turn out the finest grade of tissue paper —which was a silent tribute to the men who would put up with such conditions and made a go of things discouraging.

Machinery of this class is heavy and is subjected to all sorts of sudden strains and unfavorable conditions in the way of location and dampness. The buildings of this plant were all of wood, the floors were wet most of the time, and the foundations were none too solid. Thus

it was that shafting got out of line about every so often, and if it wasn't discovered in time the word would come that "the 4½ in. shaft in the beater room just broke close up to the hanger by the driving pulley." That being the only piece of that size on hand, and the orders being to get no new material where old could be used, it was up to the shop crew to shift the remaining length of 4½ in. along and splice out the gap with a piece of 4 in. or 5 in., whichever could be found out in the yard. Often this meant changing a couple of old-fashioned hangers that seemed to weigh a ton to the boys working up against the damp ceiling, and always it meant filling up one or more of the numerous keyseats in the shaft so they could run in the hangers at that spot. And then new keyways had to be cut by hand. The job had to be done at once, and there was no rest for the crew until it was finished.

Fitting Keys

The showing that the plant made was due in no slight measure to Frank Maclay, the machinist, who would have done even better if there hadn't always been three months' work ahead of him which he had "to keep him busy," and to work on when something wasn't actually breaking. Maclay was the best man on fitting up keys that the writer has ever known, and it is from the experience gained while working with him that the writer has always since been able to guarantee a job of this kind that had been done according to instructions. Surely Maclay was right, for I never knew a pulley or gear in that plant to come loose—and the drives were of the hardest—and it gave one a sick feeling to be told to take a pulley or gear off a shaft that he had once keyed up. Some of Maclay's key maxims were: "I never expect to see a gear stay tight if it doesn't fit the shaft; if you want me to put it up, I'm going to bore it out and put in a sleeve that will fit.

"I don't want any key put in that doesn't bear all around, top and bottom and sides; if it's going to drive more than two dog power, it won't last if fitted any other way. Make a long enough head on your keys so the driving don't swell the key proper.

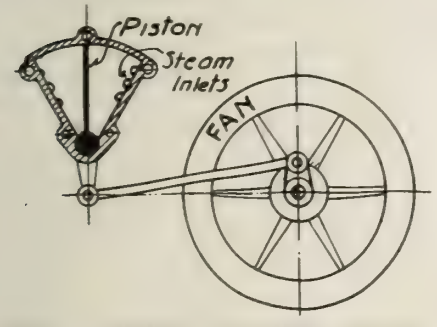


FIG. 1. PRINCIPLE OF NOVEL ENGINE.

"Your hammer ought to weigh about two pounds to the inch (that is, a 2 lb. hammer on a 1 in. shaft, a 4 lb. hammer on a 2 in. shaft, etc).

"If you're going to expect a key to stay in a shaft or hub. you've got to drive it home with something besides a chipping hammer. If the hub is too light to stand that without cracking it is going to give you trouble sooner or later anyway.

"I don't want any keys with a taper on them of more than a thirty-second in four inches—give a man a taper key and he depends on that for a fit every time—thinks because he drives the key till it stops it is fitted; if he makes that kind of a job tight he splits the hub at the top of the keyseat. When you are fitting keys by driving and trying and filing, use twice as heavy a hammer for driving out as for driving in—if you do that you won't get the point end all swelled up. A heavy hammer drives, it does not swell locally. Put oil, just a little, all over a key every time you drive it in a hole, and you won't have stuck keys.

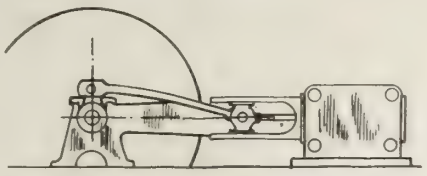


FIG. 2. BENT CONNECTING ROD ON CORLISS ENGINE.

"The smoother your keyway faces are the tighter you key will be; a rough side on a keyway will impress its roughness in the key and may go so far as to loosen up the fit. Take time enough to fit your key all over for the full length—do that, get a tight fit, and you won't have to be doing the job over again every second Sunday. Make your key long enough so that you can drive it in further and tighter in about a week if the key is subject to a pull both ways or from light to full load and the strain is a heavy one."

Unique Steam Engine

Supplementing the water power at this paper mill were several engines, rejected at other plants but doing fair service at Milo. One of these, Fig. 1, was a curiosity, to me at least. It had a "cylinder" of triangular shape, apex down. In this cylinder a piston-like fan oscillated on the shaft at the bottom. The valve admitted steam alternately on the sides of this piston, and the movement was transmitted by an arm outside the cylinder, through a connecting rod to the crank. They had shut down this engine at the time I was there—said it wasted too much steam. Another of the antiques had the cross-head guides made of wood; they were worn just as smooth as glass, and certainly presented a fine surface.

The best engine of the bunch was the 300 h.p. Corliss, on which a never-to-be-forgotten job was done. In shutting down for supper one night the engineer forgot to open the cocks—a fatal mistake, as the steam came a hundred and fifty feet through uncovered pipes. The back stroke caught the water and the connecting rod—of wrought iron—buckled, Fig. 2. On the forward stroke the rod failed to straighten out entirely when the cylinder head was reached, and the momentum of the flywheel crushed the key in the crank and everything stopped dead, for the key did not shear off. That was some key, and it was my job to get it out.

After two days of drilling with a ratchet, we were able to drive the key loose and get the crank off. The latter was sent to a shop in the nearest town to have the keyseat squared out and a key made. I started with hammer and chisel to re-cut the shaft end. By the time the crushed portions had been dressed up, a 2 in. x 3 in. key was needed—originally it had been about an inch less each way. Every inch of the fifteen-inch length of the shaft meant another blister for the fortunate chipper, and on top of that "old Moran," the superintendent, insisted on having a 1½ in. key put in at right angles to the other one to make the job doubly secure. And one afternoon he brought in a friend who said he could show us a way to cut the keyways in a jiffy. He suggested using a dentist's drill and boring the metal away. I told him steel was tougher than teeth, and old Moran looked at the 3 x 15 of steel and the husky pile of chips on the floor and suddenly thought of something in the office he needed, leaving me and dragging the dentist with him.

The forge was out in the barn, up the lane, and it was necessary to wade through the snow to go there and draw out the chisels. A diamond point was used to cut the path at the edge, then the center was readily cut out with a flat chisel without breaking the corners. A cape chisel and files were used to straighten up the sides and the bottom.

When the new keys came from the shop, they were found to be two inches too long. We had no power saw, so they were chucked in the lathe and reduced with a cutting-off tool. The keys were fitted in good shape and finally driven home with a twenty pound sledge. We left a half inch—all that would clear the rod—projecting, and the Sunday following the starting up we managed to drive that all the way in. That was fifteen years ago, Maclay and old Moran are both dead, but the keys go driving on, and have never needed attention.

That lathe was a 20 in. affair that served the plant as lathe, shaper and drill press. An extension had been added at one time that allowed it to take 15 feet between centers. Somehow they managed to do a job on it that would pass, but when it came to turning the work that was over the extension, the lathe hand had to feed by hand for the screw had not been lengthened. A sharp watch had to kept of the size, too, when using the extension, to offset the persistent taper produced by the sagging back end. In the spring when the brook was high, the legs were awash, and the lathe man had to wear boots. In spite of these handicaps, all the lathe work of the shop was done here; it had to be, in fact, for Moran wouldn't give an order for any outside work "with a good machine out there standing idle."

ALCOHOL AS A MOTOR FUEL

By J. E. MacCormick

THE appearance in these columns recently of articles dealing with the subject of industrial alcohol has caused the writer to investigate the subject at some length, and the following remarks and statements are submitted for the approval or otherwise of readers. I have noticed that some periodicals have recently inserted articles intimating that distillery men should now turn their attention to the production of a grade of alcohol suitable for motor fuel. It looks to me as though if encouraged this could develop into another alcohol versus gasoline agitation such as swept over America about a dozen years ago, and became so marked that during 1906-1907 the United States Congress passed certain acts intended to especially favor "distillers producing alcohol from any substance whatever for denaturation only, and having a daily spirit producing capacity not exceeding 100 proof gallons."

How this worked out is intimated in Chemical Bulletin No. 130. Bureau of Chemistry, U. S. Department of Agriculture. I quote from page 9:

"Therefore, in 1907 it was provided, by an amendment to the original Act, that especial encouragement might be given by the Commission of Internal Revenue to distilleries producing industrial alcohol in amounts less than 100 proof gallons daily by the removal of many of the restrictions which are imposed on larger distilleries and on those in which potable alcohol is produced.

"It was believed that as a result of this action it would be possible for farmers to make crude alcohol at so low a cost that they could utilize it advantageously upon their farms as a source of power, light, and heat; and it was expected that many communities would establish such agricultural distilleries as were contemplated in the Act. Over a year passed, however, without any attempts to make alcohol upon this plan, to the serious disappointment of all who were interested in the matter, and it became apparent that further encouragement was needed.

"By numerous misleading publications a great many people had been led to believe that any waste vegetable material, though of the most worthless character, can profitably be used in making alcohol. Evidently it was necessary to teach the community which types of material can be so used and which can not. They had also been led to believe that the apparatus of a small distillery can be built very inexpensively, and that the manufacturing process is very simple. Evidently it was necessary to furnish accurate information regarding the cost and construction of small plants and regarding the processes of mashing, fermenting, and distilling."

From the "letter of transmittal" on page 3 of the above bulletin I quote: "Although now almost three years have elapsed since the passage of the Act permitting the use of industrial alcohol free of tax, not a single agricultural distillery has yet been successfully established." This letter was dated August 7, 1909.

In those times one of my hobbies was that the gasoline motor was the proper automobile power plant; another was that the gasoline tractor was the coming farm power. Then the above-mentioned gasoline versus alcohol agitation led me to believe that the alcohol engine would finally supersede the gasoline engine. Then the chance remark of a friend that "one could not use the refuse from an auto for fertilizing purposes as could be done with that of the horse" influenced me. I believed the thing could be done, for I remembered the story of the farmers of "ye olde times" who found distillery refuse an excellent fertilizer. My interest in the alcohol problem being thus intensified, I procured reliable literature on the subject and spent my evenings reading up on the matter. The result was that I abandoned the alcohol as a motor fuel proposition as being so expensive as to render it commercially impracticable. I will now try to give a brief sketch involving some outstanding features.

Cost not considered, the alcohol is more pleasant to use, and as regards fire and explosions, it is less dangerous than gasoline. As to efficiency and fuel consumption, when alcohol was used in engines designed for gasoline and the engine operated on each fuel separately for a time the proportion of alcohol used to gasoline used for equal power obtained varied from 1.3 to 1.8 gallons of alcohol as compared with 1 gallon of gasoline. The average was 1.6 to 1. With the alcohol burned in an especially designed engine (having a compression of 180 lbs. above atmosphere) the proportion was reduced to 1.2 to 1, and it was believed possible to improve the design to a point where, when each fuel was used in its own type of engine, the h.p. hrs. obtained per gallon from each of these fuels would be about equal. Changing a gasoline engine over (to use alcohol) by merely boring out the carbureter need not affect the consumption of gasoline, but the consumption of alcohol would be 1½ to 2 times that of gasoline for the same power. Victor W. Page in his book, "The Modern Gasoline Automobile," 1913 edition, page 235. says: "An engine designed for gasoline will use twice as much alcohol as it does gasoline to develop the same amount of energy, though in a special motor the same amount of power will be obtained as when equal quantities of gasoline are burned in the conventional engine. One of the disadvantages of alcohol that is shared in common with kerosene is that it is difficult to start an engine when cold, as alcohol is not very volatile unless heated." On page 236 he tells how to start an alcohol engine by passing the vapor through calcium carbide, the water present in the alcohol thus forming acetylene gas which, being very inflammable, increases the explosive value of the alcohol vapor.

Bulletin 93 of the Iowa State College of Agriculture, in its summary says:—

4. Alcohol of 94 per cent. purity must be sold for from 11 to 17 cents per gallon to compete with gasoline for lighting purposes at 20 cents per gallon (the present retail price of gasoline in Ames). (July, 1907.)

8. To compete with gasoline at 20 cents per gallon for use in gasoline engines 94 per cent. alcohol must be sold for from 13 to 17 cents per gallon, and 90 per cent. alcohol from 11 to 15 cents per gallon.

9. None of the engines could be started readily with alcohol, although a few could be started with less difficulty than others.

13. Gasoline can not be used readily in a special designed alcohol engine using high compression on account of preignition.

United States Department of Agriculture Bulletin No. 277 in its "conclusions" says:

18. By reason of its greater safety and its adaptability to the work alcohol should immediately supplant gasoline for use in boats.

20. In most localities it is unlikely that alcohol power will be as cheap as gasoline power for some time to come.

With regard to the use of alcohol as a source of heat, Bulletin 429, page 31, says: "Such data as are at hand indicate that the coal consumption—per gallon of 180° alcohol produced—may vary from 11 pounds under the most favorable conditions to 38 pounds in a poorly equipped and poorly managed plant. As 11 pounds of coal as a distillery fuel yield almost 159,000 heat units and a gallon of alcohol gives about 75,000, it is apparent that the use of alcohol so produced for heating would involve a great waste and he altogether unprofitable."

In connection with the economic phase of the use of alcohol as a motor fuel the above statement is very significant.

On page 32 the above bulletin says: "The alluring statements sometimes made regarding large financial returns to be obtained by making industrial alcohole with waste raw material, unskilled labor, and a 'cheap' distillery outfit, are misleading, and can only result in loss if followed."

It will be noticed that this is speaking of alcohol production from waste materials. Most of these rules also hold good in production from materials of more or less market value.

With regard to alcohol production, Bulletin 410, page 6, says: "One per cent. of sugar or starch in a product will produce approximately one-half of 1 per cent. of alcohol. It is not practicable to distil a fermented solution containing less than 2 or 3 per cent. alcohol. It is, therefore, evident that materials containing less than 6 per cent. of sugar or starch cannot be considered suitable for the profitable manufacture of alcohol. . . . The next point to be considered after it is decided that the raw material to be used contains sufficient sugar or starch is the supply of this material and the cost of its delivery to the distillery. Further, there must be available a good supply of water for the condensing apparatus and cheap fuel for the boilers. All of these considerations must be carefully weighed before any attempt is

made to establish a distillery. The detailed discussion which is to follow regarding the location, equipment, and operation of a potato distillery is applicable, in a general way, to the handling of other waste materials of the farm, and will be valuable as indicating the conditions under which such materials may be successfully used."

McPherson and Hendersons' course in general chemistry tells how dextrose may be obtained from starch, and, speaking of ethyl (grain) alcohol, says: "It is prepared by the action of ordinary brewers' yeast upon certain sugars, especially maltrose and dextrose. With dextrose the reaction is shown by the following equation:—$C_6 H_{12} O_6 = 2 C_2 H_5 O H + 2 CO_2$."

Bulletin 429, pages 21, 22, says:—"The chemical composition of dextrose, which is the form of sugar occurring in most ripe fruits, is represented by the formula $C_6 H_{12} O_6$, which signifies that one molecule or unit of the compound substance dextrose is made up of six atoms or units of the element carbon, twelve of the element hydrogen, and six of the element oxygen. When fermentation takes place the molecule of dextrose breaks up substantially, as is indicated by the following equation:—$C_6 H_{12} O_6 = 2 C_2 H_5 O H + 2 C O_2$.

This signifies that after fermentation is over the dextrose will have disappeared, and in its place will be found an amount of alcohol containing all of the hydrogen, two-thirds of the carbon, and one-third of the oxygen of the sugar, and an amount of carbon dioxide containing one-third of its carbon and two-thirds of its oxygen. Theoretically the total weights of the alcohol and carbon dioxide which are produced in the fermentation should equal exactly the weight of dextrose which is decomposed, and 100 pounds of the sugar should yield 51.11 pounds of alcohol and 48.89 pounds of carbon dioxide.

In practice, however, the decomposition is never complete, nor is it ever so simple as is indicated by the foregoing equation. Only in carefully conducted laboratory work is it ever possible to ferment any sugar completely, and even then, as a result of life processes of the yeast which are not yet understood by chemists or biologists, small and varying proportions of the sugar escape transformation into alcohol, and are converted instead into other substances. According to the investigations of Pastuer, 100 pounds of dextrose, instead of yielding the theoretical weights of alcohol and carbonic acid indicated by the equation, will produce in laboratory practice the following amounts of fermentation products:

Alcohol	48.55	pounds.
Carbon dioxide	46.74	„
Glycerine	3.23	„
Organic acids	.62	„
Miscellaneous	1.23	„
Total	100.37	„

The fact that the total weight of the fermentation products exceeds slightly the weight of sugar fermented is explained on the ground that the formation of certain of the by-products is accompanied by the absorption and fixation of slight amounts of water.

In manufacturing work such completeness of fermentation may be taken as an ideal toward which one is to strive. According to the skill of the distiller, the character of his mechanical equipment, and the quality of his water, yeast, and fermentable materials, his yields of alcohol may approximate those indicated, or may, on the other hand, fall far below it.

The above-mentioned facts in regard to there being evolved nearly as much weight of carbon dioxide as of alcohol is significant. It is for the purpose of allowing this dioxide to escape that, except where other means are provided, three-inch or four-inch holes are sometimes cut in the distillery vat room floor. In fact, during the process of manufacturing a gallon of alcohol we actually throw away—allow to go entirely to waste—at least one-half as much carbon as the resultant alcohol itself contains, and not only that, but in proportion to the efficiency of our plant we burn from 11 to 38 pounds of coal in the attempt. (See above extract from Bulletin 429 with regard to fuel required.) This looks very like an unwarranted wastefulness when it comes to manufacturing alcohol for fuel purposes, especially in instances when the escaping carbon dioxide is the result of the decomposition of dextrose obtained from a substance which could otherwise have been profitably used for foood purposes; and the coal is not really too plentiful either.

TABLE No. 1.

Name of Material—	Pounds required
Shelled maize	20
Barley	21
Wheat	22
Rye	24
Oats	29
Sweet potatoes	53
Potatoes	69
Sugar beets	84
Corn stalks (theoretically)	285

I have made calculations on a number of raw materials with a view to ascertaining how many pounds of raw material were required to produce a gallon of 90 per cent. alcohol. The data on which I based my calculations were obtained from different sources, and did not always mutually agree. When authorities differed I chose the one allowing a gallon from the smallest number of pounds of raw material. By this means I obtained the following tabulation, the figures being the number of pounds of raw material required to obtain one gallone of 90 per cent. (180° proof) alcohol. It must be remembered that the authorities being American, the alcohol will be in American gallons (231 cu. in. per gal.).

From a record of engine tests made in the Iowa Agricultural College at Ames I calculated that the eight horse-power engine designated as No. 1 and developing 8.6 b.h.p. (which was more economical than the lighter load) would in 2,100 hours (approximately ten hours a day for eight months) consume 3,864.8 (practically 3,900) gallons of alcohol. With motors especially designed for alcohol this amount would about nicely suffice for one of the twelve horse-power size operating for a similar length of time. From tabulation No. 1 I calculated that the amount of raw material required to provide the 3,900 gallons are approximately:

TABLE No. 2.

Either	Maize	1,393	bush. of	56	lbs. per bu.
or	Barley	1,706	" "	48	" "
or	Wheat	1,430	" "	60	" "
or	Oats	3,326	" "	34	" "
or	Potatoes	1,483	" "	60	" "
or	Sugar beets...	164	tons		

To this must be added at least this minimum of $3,900 \times 11 = 42,900$ pounds of coal, together with a share in the overhead charges of the plant.

The result of this expenditure is the obtaining of a supply of alcohol sufficient to operate an alcohol engine of about 12 b.h.p. ten hours a day for eight months. Economical do you think? Of course, if I had taken the less favorable data the above quantities of raw material would have been materially increased, but even these figures point out that to secure appreciable quantities of alcohol for motor fuel would entail the cultivation of extensive areas of farm land for this purpose alone. In fact, with the exception of artichokes and sugar beets, the prospect looks discouraging, does it not? The reason for favoring artichokes rather than potatoes is that they are reported to give a much larger yield per acre

EFFICIENCY OF PAINTED RADIATORS

THE practice of painting radiators with various metallic paints is not conducive to economy according to recent tests carried out at the University of Michigan. In comparing the heating effects of radiators not painted and those painted with bronze, aluminum, lead paint, Japan and enamel, it was found that radiators not painted and those painted with lead paint, Japan and enamel had about the same heating effect but the radiators covered with the bronze and the aluminum paints had about twenty-five per cent. less heating effect. That is, the aluminum and the bronze paint reduced the amount of heat that the radiator could give off. It was also found that it is the last coat of paint that increases the radiation, so that if bronze paint is put on over the other paint the heating effect is reduced one-fourth, while if bronze paint is covered with the other paint then the heating effect of the radiator is brought up to normal.

If a radiator covered with bronze paint is not heating a room sufficiently, covering with lead paint, Japan or enamel will increase its heating effect one-fourth to one-third, or will be equivalent to increasing the heating surface one-third to one-fourth, or it will make three radiators give off about as much heat as four radiators covered with bronze or aluminum.

THE SOURCE OF ENERGY

By Paul Raiko

JUST open any good newspaper on any old morning and you will see that the most poignant question about and most imperative need is of coal, wood or gasoline, any kind of fuel wherefrom a good amount of energy could be produced.

The energy is badly wanted to keep the wheels of the factories in motion, the trains running, the bread baked, the streets and houses lighted and, above all, the dwellings heated. Most rigid economy of fuel, mainly that of coal, is painfully enforced.

Much of coal is burnt to generate compressed air. Ask the railway authority, how many tons of coal is burned daily to have sufficient amount of proper pressure of compressed air to run all their turn-tables, pneumatic hammers, forges, furnaces, etc. Compressed air is decidedly a good form of motive-power, as good as steam and many mechanical engineers are of opinion that compressed air is even better than steam for quite a number of reasons: Firstly, it is healthier for all parts of machinery—the cylinders, the pistons, the stays, etc., because the temperature of compressed air is even, free from contrast of extreme heat and extreme cold, which causes the machinery to expand and contract and some parts of machinery to burst and break. Compressed air is practically free from such an accusation.

If a certain amount of compressed air is wanted, is it really so necessary to burn coal for it? Decidedly no. Why not try to find another sourec of energy to generate and store compressed air? Is there not another source? Look around; better, What is the wind?

To construct so many standardized windmills that would keep in motion as many standardized air-compressors would undoubtedly supply a city, or a community, or even country with a considerably good energy and it would undoubtedly pay.

A box-car full of good soft coal at $4 a ton costs about $100. How much will an old-fashioned Dutch windmill of four wings cost? How much costs an air compressor of the size and capacity of a standard air compressor which is attached to a standard railway locomotive? The price of these two features will not much exceed the cost of a carload of of coal.

But four wings and an air compressor can serve and work very long, practically permanently, and will require few repairs. Now, suppose a number of air compressors compress air into a tank, or a battery of tanks. This compressed air will turn an air-engine and a dynamo and produce electricity free from expenses on fuel. If such a plant is provided with reserve tanks and a storage battery, then the supply of power can be uninterrupted. The light as well as power would be supplied at a cheaper rate, and it would pay.

It may seem to some persons a dream. But well, most of the inventors were considered dreamers at one time or another. Yet I do not claim this my idea an invention. Just a wit, forced, perhaps, by the shortage of coal and suffering from cold.

If there was a sufficient supply of electricity, this wonderful energy could be used for cooking and heating purposes. It is not absolutely necessary to ask a big professor for the advice. Ask a machinist, a railway engineer or fireman, or a machine-shop help.

Once I asked a good fellow, a school teacher, how much motive-power could be produced from wind alone.

And the power which can be derived from the wind alone my friend has defined with a single word: **Limitless.**

SALVAGE OF GREASE AND OILS FROM BRITISH MOTOR VEHICLES

THE grease removed in the cleaning of wheels, axles, and other parts of motor omnibuses, trucks, and other motor vehicles, is now utilized by the London General Omnibus Co., London, England. The process of reclaiming the oil is thus described in the *Commercial Motor*.

Before the war kerosene was largely employed for the cleansing of engines and other parts of vehicles, but now its consumption is restricted to the barest minimum, the net effect being the saving of five-sixths of the former consumption. Kerosene, as a matter of fact, is now only employed on certain parts of the mechanism for the cleaning of which there is no practical substitute. For the cleaning of wheels, axle casings, and front axles, a weak solution of hot caustic soda is employed.

When engines, gear boxes, back axles, or any other parts are stripped for overhaul, a very great saving is effected over former practice.

Process of Reclaiming

The unit is dismantled and the parts are placed in a cradle and dumped into a tank of water into which a jet of steam is turned so as to bring the water to boiling point. Caustic soda is added to the water until a solution of about 3 per cent. strength is obtained. The whole of the grease is removed from the parts in the process of boiling and comes to the top of the water. Before the contents are removed the grease is drawn off the top. This is done through an overflow pipe which leads into a barrel.

The cradle of parts is then transferred to a second tank of clean, boiling water, which finishes the cleansing and, as the parts are drawn out quite hot, they drain perfectly dry and absolutely clean.

The result, so far as cleanliness of parts is concerned, is considerably better than if kerosene had been used. All minute parts of metal, dirt, and grit go to the bottom of the first cleansing tank.

Oil Put Through Process

The London General Omnibus Co. has a central depot for reclaiming oil and washing rags, and to this depot the barrels of waste oil, as they are obtained from the various garages, and the rags are sent.

At this depot there is a battery of three tanks erected over a furnace, each of which is filled to about two-thirds with water, which is brought up to the boiling point. The barrels of oil as they come in are drawn off into the first boiling tank, a little being added at a time. The oil is thoroughly boiled, and when it overflows into the second tank it has become almost fit for use again, (by the adding of more oil to the first) but it passes into the second tank and is given a second boiling, and then on to the third tank, where it goes through its final stage of cleansing, and from the last tank it is drawn off and run into barrels.

Salvage of Rags

As to rags, their price to-day is much higher than before the war, when they were thrown away after being used. At present every rag is collected in each garage and sent once a week to the central cleaning depot.

VOCATIONAL TRAINING FACILITIES INCREASED

ADDITIONAL machinery is being added by the Military Hospitals Commission to the equipment in the Calgary Institute of Technology and Art for the purpose of affording more returned men the opportunity to take up electrical and mechanical engineering.

The constantly increasing number of men returning from the front makes it imperative for the vocational training centres to be ready to receive them and grant them at once the training necessary to fit them to return to civil life.

In British Columbia, the vocational training facilities at the Shaughnessy Convalescent Hospital in Vancouver are being increased by the addition of twelve extra class rooms, while at Fairmont the equipment is to be supplemented by the addition of a big machine shop and drafting room. Accommodation will also be made for a large shoe repairing department.

Re-educational Centres

Provision for a centre of vocational re-education in Fredericton, N.B., is also being made in the fine vocational building now under construction there.

In carrying out its vocational re-education powers the Military Hospitals Commission has provided as wide a variety of courses as possible at all centres. The policy has been adopted, however, of developing centres of re-education with special equipment at important points as follows, Halifax, Montreal, Toronto, Guelph, Winnipeg, Calgary and Saskatoon.

Centres of re-education for agriculture are being developed at Guelph, Winnipeg, Saskatoon and at Olds, Alta., where the Provincial Department of Agriculture placed one of its agricultural high schools at the disposal of the Commission.

Operators' Instruction Course

EDUCATION PAPER VI.

A boiler carrying 90 lbs. pressure and having feed water at 100 deg. Fahr. evaporated 2987 lbs. of water per hour. What is the horsepower?

A boiler horsepower is equivalent to the evaporation of 34.5 lbs. of water from and at 212° Fahr. per hour. It will be necessary to reduce the above quantity of water to the equivalent evaporation from and at 212°. This quantity is given by the equation We=(H—h)÷ 970.4 in which,

We=the equivalent evaporation.

H=total heat of steam above 32° Fahr., whether wet, dry or superheated.

h=heat of liquid corresponding to the temperature of the feed water.

Substituting in the above equation we have (1187.0—68)÷970.4=1.15.

Since 2987 lbs. of water have been evaporated in one hour, the equivalent evaporation will be 2987×1.15=3435 lbs. and the horse power of the boiler will be 3435÷34.5=100 horsepower nearly.

* * *

What is the equivalent evaporation from and at 212 degrees Fahr. of the evaporation just given? If a boiler evaporates 30 lbs. in one hour from 100° Fahr. to steam at 70 lbs. pressure, how many lbs. water will it evaporate from feed water at 212° Fahr. into steam at atmospheric pressure in the same time?

The equivalent evaporation calculated for the preceding question is 3435 lbs.

When 30 lbs. of water are raised from 100° Fahr. and converted into steam at 70 lbs. pressure heat is required and the amount necessary may be divided into two parts, that necessary to raise the water from 100° up to the temperature of the steam, and that necessary to convert this water into steam.

Steam tables give the total heat content of steam at any required pressure, and quality or superheat. This quantity is figured from 32° Fahr. They also give the total heat of water at any required temperature also figured from 32° Fahr.

And so if we subtract the heat of the liquid from that of the steam we will obtain the total heat imparted to the water. Thus at 70 lbs. pressure dry steam will have a total heat content of 1183.1 B. T. U., and the feed water entering the boiler at 100° Fahr. will have a heat content of 68, and substratcing, we have 1115.1 B.T.U. as the amount of heat imparted to one lb. of the water.

To evaporate water from and at 212° Fahr. requires only the heat necessary to evaporate the water, and none is required for raising its temperature. The latent heat of water at 212° Fahr. is 970.4 and the equivalent number of lbs. of water evaporated under these conditions will be,

1115.1÷970.4×30=34.5 lbs., or one boiler horsepower.

* * *

A boiler has two safety valves, each being 3½ inches in diameter. The size of the wire spring is ⅝ inch square. Required, the allowable pressure on the boiler, the grate surface in square feet and the outside diameter and length of spring.

The area of a safety valve measured at the inside point of contact between the valve and the seat is proportioned to the size of the firegrate according to the following formula

$$A = \frac{37.5 \times G}{B + 15}$$

Where—

A=area of valve in square inches at the point of contact between valve and seat.

G=area of fire grate in square feet.

B=working pressure in pounds per square inch.

It will be necessary in the above formula to assume some definite working pressure and 125 lbs. will be taken. The area of two 3½ inch valves is 22 square inches nearly, and substituting these valves in the above equaton we have

$$22 = \frac{37.5 \times G}{125 + 15} \text{ or } G = 82 \text{ sq. ft. approx.}$$

The diameter of the spring coil may be obtained from the following formula:

$$R = 12{,}500d^3 \div 1.2S$$

where

R=mean radius of coil.

d=side of square=⅝ inch.

S=load on spring in pounds=1375.

Substituting it will be found that R=2" and the diameter will be 4+⅝=4⅝ inches outside.

The springs should have a sufficient number of coils to allow a compression under the working load of one-eighth the diameter of the valve. This will work out to ⅛ of 3½ or about ½ inch. The deflection of a helical coiled spring is found as follows:

$$F = \frac{64 \ P \ R^3 \times .59}{G \ d^4}$$

Where

F=extension or compression of one coil.

P=load in pounds upon spring=1375 pounds.

R=mean radius of coil=2 inches.

G=modulus of torsional elasticity=12,000,000.

d=side of square=⅝ inch.

Substituting we find F will equal .16 inch for one coil. Therefore the number of coils will be .5÷.16=4 free and two end ones, which will be about 5 inches long.

DIMENSION CONVERSION

IN order to conform to the practice of certain shops it is often necessary for the mechanics to convert fractional dimensions to their decimal equivalents, or decimal measurements to the corresponding fractional value, generally in thirty-seconds or sixty-fourths. Various tables have been compiled for this purpose, but it is not always that these are available when desired. To convert a fraction to a decimal equivalent all that is necessary is to divide the numerator (the upper term of the fraction) by the denominator or lower term. Hence to find the value of 7/64 in the form of a decimal, divide 7 by 64 = .109375.

Suppose it is desired to find how many 64ths are contained in the fraction 63/96. This can be calculated in two ways: by converting the fraction to a decimal and then multiplying by 64, thus 63 divided by 96 equals 0.65625 and multiplying by 64 gives 42 or 42/64; or by multiplying the fraction directly by 64 we get the same result. To convert a decimal to an equivalent fraction multiply the decimal by the denominator of the desired fraction. Thus, to change .3215 to the nearest 28th, we get 9.002, which is just 2/1000 over 9/28. To find the number of 64ths contained in the decimal 0.203125, multiply by 64 and the integer of the product will be the desired number of 64ths; thus, 0.203125 x 64 equals 13: therefore the equivalent of the decimal is 13/64.

ONE-AND-SEVEN-TENTHS of the total number of railroad fatalities for the year 1916 were due to the negligence of passengers and 21.4 per cent. to negligence of employees in falling from or getting on or off trains and in walking on track; 5.6 per cent. were due to collisions and derailment of trains. Finally, 5.3 per cent. of the fatalities occurred in shops and were in nowise due to the operation of trains.

SELECTED MARKET QUOTATIONS

A Record of Prices Current on Raw, Semi-finished, and Finished Materials Entering Into the Manufacture and Operation of Power Plant Equipment

BOILER TUBES

Size	Seamless	Lap-welded
1 in.	$36 00	$.....
1¼ in.	40 00	.....
1½ in.	43 00	36 00
1¾ in.	43 00	36 00
2 in.	50 00	36 00
2¼ in.	53 00	38 00
2½ in.	55 00	42 00
3 in.	64 00	50 00
3¼ in.	.....	58 00
3½ in.	77 00	60 00
4 in.	90 00	75 00

Prices per 100 feet, Montreal and Toronto.

PLATES

	Montreal	Toronto
Plates, ¼ to ½	$13 00	$12 00
Heads	13 30	12 30
Tank plates, 3-16 in.	13 65	12 10

WROUGHT PIPE

Effective Jan. 7, 1918.
Standard Buttweld.

Size.	Black Per 100 feet	Galvanized Per 100 feet
⅛ in.	$ 6 00	$ 8 00
¼ in.	5 10	7 23
⅜ in.	5 10	7 23
½ in.	6 46	8 03
¾ in.	8 17	10 29
1 in.	12 07	15 22
1¼ in.	16 33	20 59
1½ in.	19 53	24 61
2 in.	26 27	33 12
2½ in.	42 12	52 94
3 in.	55 08	69 23
3½ in.	69 92	86 94
4 in.	82 84	103 00
Standard Lapweld.		
2 in.	29 43	35 71
2½ in.	43 88	54 11
3 in.	57 38	70 76
3½ in.	71 76	89 70
4 in.	85 02	106 28
4½ in.	96 52	121 29
5 in.	112 50	141 34
6 in.	145 90	183 36
7 in.	190 40	238 00
8 L in.	200 00	250 00
8 in.	230 40	288 00
9 in.	276 00	345 00
10 L in.	256 00	320 00
10 in.	329 60	412 00

Prices—Ontario, Quebec and Maritime Provinces

WROUGHT NIPPLES

4" and under, 45%.
4½" and larger, 40%.
4" and under, running thread, 25%.
Standard couplings, 4" and under, 35%.
4½" and larger, 15%.

IRON PIPE FITTINGS

Malleable fittings, class A, 20% on list; class B and C, net list. Cast iron fittings, 25% off list. Malleable bushings, 25 and 7½%; [illegible] prices, 45%; plugs, 20% off list. Net prices malleable fittings: Class B black, 24½c lb.; Class C black, 15¾c lb.; galvanized, Class B, 34c lb.; Class C, 24½c lb. F.O.B. Toronto.

COLD ROLLED SHAFTING.

At mill ..... list plus 40%
At warehouse ..... list plus [illegible]%
Discounts off new list. Warehouse price at Montreal and Toronto.

FINISHED IRON AND STEEL

Per lb. to large dealers. Cents

Iron bars, base, Toronto	$5 25
Steel bars, base, Toronto	5 50
Steel bars, 2" to 4" base	6 00
Iron bars, base, Montreal	5 25
Steel bars, base, Montreal	5 50
Reinforcing bars, base	5 50
Steel plates	5 75

SHEETS

	Montreal	Toronto
Sheets, Black, No. 28.	$ 8 50	$ 8 50
Sheets, Black, No. 10.	12 00	12 00
Canada plates, dull, 52 sheets	9 00	9 00
Canada plates, all bright	10 50	10 50
Apollo brand, 10¾ oz. galvanized	....	....
Queen's Head, 28 B.W.G.	....	....
Fleur-de-Lis, 28 B.W.G.		
Gorbal"s Best, No. 28.		
Colborne Crown, No. 28	....	....
Premier, No. 28 U.S.	9 45	9 45
Premier, 10¾ oz.	9 75	9 75

PROOF COIL CHAIN B

¼ in.	$12 00
5-16 in.	11 50
⅜ in.	11 15
7-16 in.	10 90
½ in.	10 70
9-16 in.	10 70
⅝ in.	10 50
¾ in.	10 40
⅞ in.	10 25
1 in.	10 10
Extra for B.B. Chain	1 20
Extra for B.B.B. Chain	1 80

ELECTRIC WELD COIL CHAIN B.B.

⅛ in.	$15 50
3-16 in.	11 70
¼ in.	8 40
5-16 in.	7 40
⅜ in.	6 35
7-16 in.	6 35
½ in.	6 35
⅝ in.	6 35
¾ in.	6 35

Prices per 100 lbs.

FILES AND RASPS

	Per Cent.
Great Western, American	50
Kearney & Foot, Arcade	50
J. Barton Smith, Eagle	50
McClelland, Globe	50
Whitman & Barnes	50
Black Diamond	37½
Delta Files	37½
Nicholson	37½
Globe	50
Vulcan	50
Disston	50
P.H. and Imperial	50

OILS AND COMPOUNDS

Castor oil, per lb.	52
Royalite, per gal., bulk	17
Palacine	20
Machine oil, per gal.	26½
Black oil, per gal.	13
Cylinder oil, Capital	45½
Cylinder oil, Acme	36½
Standard cutting compound, per lb.	06
Lard oil, per gal.	2 50
Union thread cutting oil antiseptic	88
Acme cutting oil, antiseptic	37½
[illegible] quenching oil	39½
Petroleum fuel oil	13½

BELTING—No. 1 OAK TANNED.

Extra heavy, single and double	30-5%
Standard	40%
Cut leather lacing, No. 1	$1 95
Leather in sides	1 75

COAL AND COKE.

Solvay Foundry Coke	.....
Connelsville Foundry Coke	.....
Steam Lump Coal	.....
Best Slack	.....

Net ton f.o.b. Toronto.

BOLTS, NUTS AND SCREWS

	Per Cent.
Coach and lag screws	25
Stove bolts	55
Plate washers....list plus	20
Machine bolts, 7-16 and over	net
Machine bolts, ⅜ and less	10
Blank bolts	net
Bolt ends	net
Machine screws, fl. and rd. hd., steel	27½
Machine screws, o. and fil. hd., steel	10
Machine screws, fl. and rd. hd., brass ....add	20
Machine screws, o. and fil. hd., brass ....add	25
Nuts, square blank ....add	$1 50
Nuts, square, tapped....add	1 75
Nuts, hex. blank ....add	1 75
Nuts, hex. tapped ....add	2 00
Copper rivets and burrs, list plus	30
Burrs only list plus	50
Iron rivets and burrs	15
Boiler rivets, base ¾" and larger $8	50
Structural rivets, as above	8 40
Wood screws, flat, bright	72½
Wood screws, O. & R., bright	67½
Wood screws, flat, brass	37½
Wood screws, O. & R., brass	32½
Wood screws, flat, bronze	27½
Wood screws, O. & R., bronze	25

MISCELLANEOUS.

Solder, strictly	0 39
Solder, guaranteed	0 43
Babbitt metals ....18 to	70
Soldering coppers, 3 to 6 lbs.	0 64
Putty, 100-lb. drums	4 55
White lead, pure, cwt.	15 20
Red dry lead, 100-lb kegs, per cwt. 15	50
Glue, English	0 35
Gasoline, per gal., bulk	0 31½
Benzine, per gal., bulk	0 30½
Pure turpentine, single bbls., gal.	0 74
Linseed oil, raw, single bbls.	1 36
Linseed oil, boiled, single bbls.	1 39
Lead wool, per lb.	0 15
Plumbers' oakum, per cwt.	9 00
Sandpaper, B. & A....list plus	20
Emery Cloth....list plus	20
Sal Soda	0 03½
Sulphur, rolls	0 05
Sulphur, commercial	0 04½
Rosin "D," per lb.	0 03
Rosin "G," per lb.	0 03½
Borax crystal and granula.	0 13
Wood alcohol, per gallon	1 80
Whiting, plain, per 100 lbs.	2 20

COPPER PRODUCTS

	Montreal	Toronto
Bars, ½ to 2 in.	$55 00	$48 00
Plain sheets, base 16 oz. and heavier	56 00	48 00
Copper sheet, tinned, 14x60 in., 14 oz.	60 00	60 00
Copper sheet, planished, base 16 oz. and heavier	64 00	49 00
Braziers' in. sheets, 6x4 base	55 00	48 00
Tubing T.P.S., base ¾ in. up to 3 in.	60 00	60 00

Above prices are full sheets and bars. Cut sheets and bars are 5c per lb. higher.

BRASS PRODUCTS.

Brass rods, base ½" to 1" rd.	$0 43
Sheets 24 oz. and heavier base	0 48
Brass tubing, seamless	0 55
Tubin, I.P.S., 1" base	0 55

POLISHED DRILL ROD.

Discount off list, Montreal and Toronto	Net

RUBBER BELTING

Standard	10%
Best grades	15%

WASTE

White.	Cents per lb.
XXX Extra	21
Peerless	21
Grand	19¾
Superior	19¾
X L C R	18½
Atlas	18½
X Empire	17¼
Ideal	17¼
X press	16
Colored.	
Lion	15
Standard	13½
No. 1	13½
Popular	12
Keen	10½
Wool Packing	
Arrow	25
Axle	20
Anvil	15
Anchor	11
Washed Wipers	
Select White	11
Mixed colored	10
Dark colored	09

This list subject to trade discount for quantity

MILLED PRODUCTS

	Per Cent.
Set screws	25
Sq. & Hex., Head Cap Screws	20
Rd. & Fil Head Cap Screws	Net
Flat & But. Hd. Cap Screws plus	Net
Fin. & Semi-fin. nuts up to 1 in.	25
Fin. and semi-fin. nuts, over 1 in., up to 1½ in.	20
Fin. and semi-fin. nuts, over 1½ in., up to 2 in., list plus	10
Studs	20
Taper pins	40
Coupling bolts, pins	10
Planer head bolts, without fillets ....list plus	10
Planer head bolts, with fillet list plus 10 and	10
Planer head bolt nuts, same as finished nuts.	
Planer bolt washers	net
Hollow set screws..list plus	20
Collar screws...list plus 30,	10
Thumb screws	20
Thumb nuts	65
Patch bolts ....add 40,	10
Cold pressed nuts to 1½ in.	add $4 50
Cold pressed nuts over 1½ in. ....add	$7 00

METALS

	Montreal	Toronto
Lake copper	$31 00	$32 00
Electro copper	31 00	32 00
Castings, copper	30 00	31 00
Tin	77 00	80 00
Spelter	10 50	10 50
Lead	9 75	9 00
Antimony	18 00	18 00
Aluminum	65 00	62 00

Prices per 100 lbs...

ROPES AND PACKING

Packing, square braided	0 34
Packing, No. 1 Italian	0 40
Packing, No. 2 Italian	0 32
Pure Manila rope	0 39
Transmission rope, Manila	0 45
Drilling cables, Manila	0 41

LEAD SHEETS

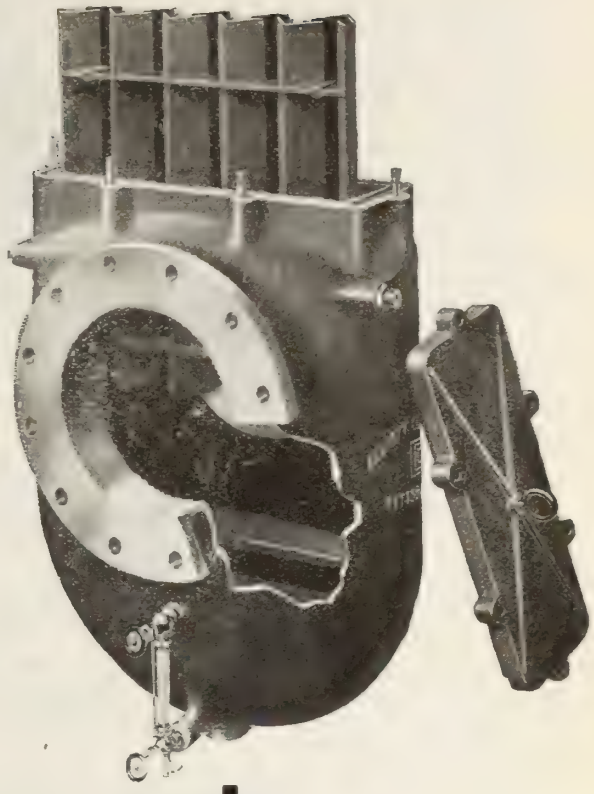
	Montreal	Toronto
Sheets, 3 lbs. sq. ft. lb.	$12 00	$13 25
Sheets, 3½ lbs.	12 00	13 25
Sheets, 4 to 6 lbs.	13 00	12 50

Cut sheets, ¾c per lb. extra.
Cuts sheets to size, 1c per lb. extra.

ELLIOTT
Oil Separators

Have baffle plates that can be removed from the Separator and cleaned when they become gummed with oil.

The double row of V-shaped baffle plates in Elliott Oil Separators, Type "P," collect the particles of oil and conduct them out of the path of the steam.



Type "P" Oil Separator showing how the baffles may be removed for cleaning.

In some types of Oil Separators a flat or corrugated baffle plate is interposed in the path of the steam—the idea being that the particles of oil which are traveling at an enormous velocity will hit it head-on and in some manner or other be so broken up that they will cease to exist. The impact or collision may serve to break up the particles of oil into still smaller particles, but little is accomplished toward getting the oil out of the steam as the particles of oil will rebound back where they can be picked up again and carried on with the steam.

A similar action will be observed if you direct a stream of water under pressure against a wall at right angles to the flow of water. The impact breaks up the stream into hundreds of small drops, which rebound back in all directions. If the stream of water were directed against the wall at an angle, practically all of the water would be deflected in the same direction.

This is the principle of the V-shaped baffle plates in the Type "P" Oil Separators. The first row merely directs the stream at the proper angle against the second row of baffles which in turn throws the particles of oil back into the recess angles of the first row so that the oil is completely out of the path of the steam.

The baffle plates are kept moistened with jets of water from a spray pipe (see spray pipe connection at side of accompanying cut.) With the baffle plates in a moist condition the particles of oil readily form into globules or large drops and run down into the reservoir.

The first step in learning more of the Elliott Oil Separators is sending for bulletin "E." It is yours on request.

ELLIOTT COMPANY

6902 Susquehanna Street **Pittsburgh, Penna.**

If any advertisement interests you, tear it out now and place with letters to be answered.

TRADE GOSSIP

Chatham, Ont.—The city council contemplate undertaking extensive improvement to the waterworks system.

Fredericton, N.B.—The city council are considering calling for tenders for pumps for the waterworks.

Calgary, Alta.—The City Commissioners are in the market for a motor generator set.

North Bay, Ont.—The town council has decided to purchase a steam pump for the waterworks department.

North Vancouver, B.C.—City Council contemplate the erection of a $50,000 filtration plant.

Fredericton, N.B.—The city council are considering calling for tenders for pumps for the waterworks.

Chatham, Ont.—The city council contemplate undertaking extensive improvements to the waterworks system.

Verdun, Que.—Tenders will be called this year for repairs and reinforcements to waterworks and electric plants at a cost of $50,000 for the town council.

Bassano, Alta.—The Canadian Allis-Chalmers, Ltd., have been awarded the contract for a pump and 75 h.p. motor for the town council.

Verdun, Que.—Tenders will be called this year for repairs and reinforcements to waterworks and electric plants at a cost of $50,000 for the town council.

Three Rivers, Que.—The city council is in the market for a centrifugal pump of 3,000 gallons capacity and a 200 h.p. oil engine.

Brantford, Ont.—The Canadian Westinghouse Co., Hamilton, has secured the contract for motor and electrical equipment for the sewage pumping station here.

Lethbridge, Alta.—The Canadian General Electric Co., of Toronto, has been awarded the contract for the new 1,200 kilowatt turbo-generator for the civic power house.

Melfort, Sask.—Town Council contemplates the purchase of a Diesel oil engine.

Port Dover, Ont.—The gas franchise by-law was carried here by 210 for and 10 against.

Alliston, Ont.—The Town Council has decided to purchase a 20 h.p. triplex plunger pump and electric motor at a cost of $2,800. W. J. Cunningham is chairman of the committee which has the matter in hand.

Toronto, Ont.—The Provincial Government contemplates purchasing a cold storage building in Toronto for the purpose of saving the fish caught in the summer and fall for use in winter.

Shelburne, N.S.—Frank J. Carter, of Dartmouth, it is announced, will build and operate a cold storage warehouse at Shelburne, building and equipment to cost not less than $40,000.

Redonda Island, B.C.—The Redonda Canning & Cold Storage Co. are having their fish freezing plant equipped with a 12-ton refrigerating machine furnished by the Armstrong Machinery Co., Spokane, Wash.

Green's Economiser Ltd. has been incorporated at Ottawa with a capital of $50,000 to manufacture all kinds of machinery, plant, mechanical appliances, etc., with head office at Toronto. The incorporators are W. Gilchrist, J. Stewart and H. J. Stuart, all of Toronto.

Picton, Ont.—The Town Council contemplates installing a pump of 1,000 gal. per min. capacity in its waterworks.

Strathroy, Ont.—The Public Utilities Commission is calling for tenders for a pump house. F. R. Smithrin, sec-treasurer.

Montreal, Que.—The Southern Canada Power Co. is contemplating the construction of about 100 miles of high tension transmission line and has called for tenders on poles, cross arms, insulators, cross arm braces, wire and other materials.

Chatham, Ont.—The Dominion Sugar Co. has asked the Hydro Commission for 2,900 h.p. for the operation of a part of their plant using what is known as the Barium process, by which it is now possible to manufacture sugar from refuse formerly regarded as almost impossible.

The Dominion Bridge Co., Lachine, Que., has obtained a large contract for machinery for the British America Nickel Corporation, Toronto. This company is equipping an extensive plant near Sudbury, Ont. The contract includes turbines, turbine blowers, and turbo alternators.

Toronto, Ont.—The Ontario Legislature has voted over $9,000,000 for Hydro-Electric extensions, of which $4,175,000 is for carrying on work on the great Chippawa development at Niagara Falls, from which the province will ultimately secure a minimum of 250,000 additional horse-power.

Kingston, Ont.—The Utilities' Commission has decided to buy four 40 k.w. transformers for the hosiery mill, and a meter for the Campbell power line. A transformer for the street railway will also be purchased from the Canadian General Electric Co., in place of one ordered but not delivered from a firm in the States.

Montreal, Que.—In order to obtain more factory space for their increasing activities, the Mason Regulator and Engineering Co. of Montreal are vacating their present factory for more commodious quarters at 135-153 Dagenais Street. The head office of the company will still be maintained at 380 St. James Street.

London, Ont.—The ice pressure of last month has forced a hole 20 feet wide in the foundations of the waterworks dam at Springbank, which prevents further development of power from this source. Five hundred horse-power was developed there and used for power-load correction and during the present shortage. It will be months before the necessary repairs can be made.

Kingston, Ont.—Manager Folger, of the Utilities' Commission, will report at the next meeting as to the cost of rearranging the smoke stack and some other machinery which was in use when the electric generators were driven by steam, which it is proposed to change over to the gas plant now. It was expected that the work would cost about $1,000 and it was thought better to get a closer estimate of the cost.

Weston, Ont.—Building operations on the new factory of the K. and S. Canadian Tires, Ltd., at Weston, have recently been completed and the installation of the plant equipment is also nearing completion. The heating system is now working and there remains but little machinery to be set up before the plant is finished. Manufacturing operations will commence about the middle of March.

Toronto, Ont.—H. C. Anderson and C. G. Sheldon, representing the Northern Coal Operators' Association, have arrived in the city to impress upon the people of Ontario that the lignite coal mined in Alberta can be brought into this province in case of emergency. They have come here to arrange, if possible, an Eastern movement from the Western mines. Shipments by rail, Mr. Anderson claims, would be the rule, and the freight charges would be about $5 per ton.

Tillsonburg, Ont.—Fire on March 6 almost completely destroyed the main building of the Huntley Manufacturing Co. Its origin is a mystery, and the amount of the loss will probably amount to at least $50,000 on the building, exclusive of machinery, tools and new machines ready for shipment. The main factory of the Huntley Co., which is engaged in the manufacture of elevator machinery, is situated in Silver Creek, N.Y. The Canadian company purchased the plant of the Tillsonburg Electric Car Co. a year ago.

Sudbury, Ont.—The Town Council has petitioned the Provincial Legislature asking for confirmation of certain money by-laws passed by the town. These by-laws are for the issuing of debentures to obtain sums of money to purchase a library site, to get lands for park purposes, for the construction of sewers and water works, for the extension of the present waterworks system and sewers, and for the cost of concrete sidewalks. The money to be raised amounts to about $134,000.

Hydro Commission Gets Extra Power.—The Ontario Hydro-Electric Commission has secured from the Canadian Niagara Power Co. 20,000 horse-power which they have been deprived of for a month or two as a result of the breaking down of two generators at the Canadian Niagara plant. When the machines went out of commission the Hydro asked the Canadian Niagara Co. to supply the power by cutting down on exportations to Buffalo. The company refused, and the Hydro, in spite of appeals to the Power Controller, was unable to get its way.

THE CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED

Oneida Steel Split Pulleys

To Reduce Running Expense and To Save Coal

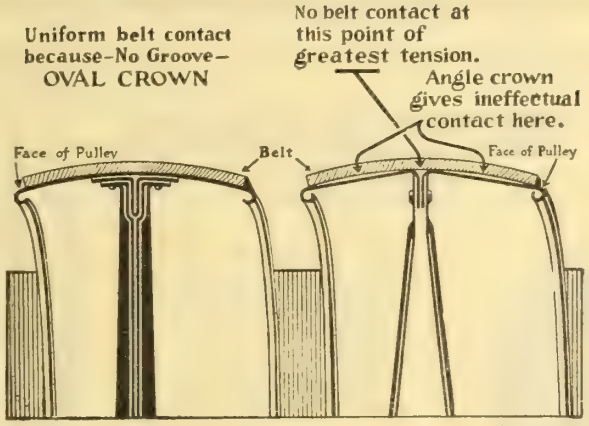
Look to your Transmission

The Oneida Steel Split Pulley is not only right for ordinary line shaft work but it is also successfully built without a change of design, in sizes capable of transmitting 750 H.P.—and more if necessary.

They are furnished as large as 144-inch diameter by 40-inch face.

We carry a large stock of transmission material

For anything mechanical address our nearest house


Uniform belt contact because–No Groove–
OVAL CROWN
No belt contact at this point of greatest tension.
Angle crown gives ineffectual contact here.
Face of Pulley
Belt
Face of Pulley

The economical pulley has a face which insures efficient belt contact.
The Oneida Steel Split Pulley has a one-piece, perfect oval crown, with no groove running through the center. The belt hugs the crown uniformly—thus the greatest amount of belt adhesion is obtained with the least belt tension. Lowering the belt tension means lessening bearing friction.

THE CANADIAN FAIRBANKS-MORSE CO., Limited

St. John Montreal Quebec Ottawa Hamilton Toronto Windsor Winnipeg Calgary Saskatoon Vancouver Victoria

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

METLSKIN

BOILER PRESERVATIVE

IT IS NEITHER "COMPOUND" NOR "CURE-ALL"

By arrangement with the manufacturer we are able to make a

60 Day Trial Offer

to any owner or operator of a Steam Plant, whose boilers are Troubled with SCALE. One-sixteenth of an inch of scale means at least 10% more consumption of fuel.

METLSKIN will gradually take out scale and keep it out permanently. It will prevent the common boiler-ills, pitting and corrosion. It will make any boiler a better "Steamer" and save money on coal bills.

METLSKIN is strongly guaranteed **not** to work injury to any part of the boiler system. Nor will it contaminate the steam. For this reason METLSKIN has been standardized in many Paper Mills, Textile Mills, Canning Factories, and other industries where live steam is used in the process of manufacture.

A postal to our nearest branch will bring a GUARANTEE BOND, details of the 60-day Trial Offer, and prices.

The Canadian Fairbanks-Morse Co., LIMITED

St. John Quebec Montreal Ottawa Hamilton Toronto Windsor Winnipeg
Saskatoon Calgary Vancouver Victoria

Sole Manufacturers—METLSKIN COMPANY, INC., 63 Elizabeth Street, Rochester, N.Y.

III IMPORTANT THINGS

TO CONSIDER ABOUT A SEPARATOR.

I. THE PLAN—Is it sensible, will it work, no matter how large the Separator or how well made?

II. THE SIZE—Is it big enough regardless of plan, will it hold a good dose of water?

III. THE CONSTRUCTION—Is it strong enough, are flanges heavy, how will it look by the side of a nicely finished engine? Send for catalog and note these points in

Sweet's Separators

DIRECT SEPARATOR COMPANY

820 Geddes Street - SYRACUSE, N.Y.

General Sales Agents:

Canadian Fairbanks Morse Company, Limited

St. John, Montreal, Quebec, Ottawa, Toronto, Hamilton, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria

PRATT & CADY

P&C CO

Valves and Asbestos Packed Cocks

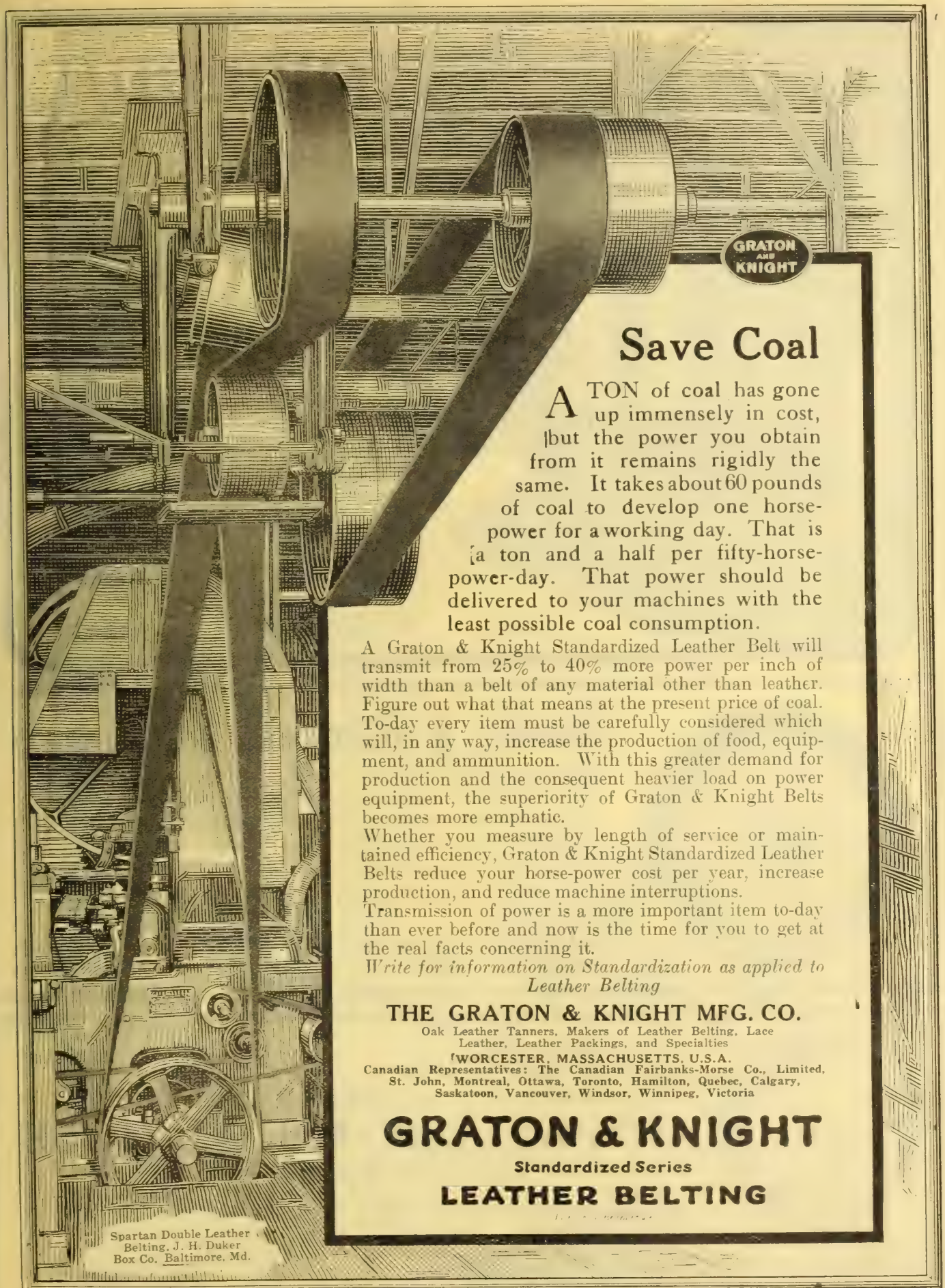
for All Purposes and Pressures

Pratt and Cady valves remain leak-proof under the most trying conditions. They meet with every modern condition and promote economy and greater efficiency. They "make good" where other valves and cocks fail.

PRATT & CADY CO., Inc.
Hartford, Conn.

General Sales Agents
THE CANADIAN FAIRBANKS-MORSE CO., Limited
St. John, Quebec, Montreal, Ottawa, Toronto, Hamilton, Winnipeg, Saskatoon, Calgary, Windsor, Vancouver, Victoria.

THE CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED



GRATON AND KNIGHT

Save Coal

A TON of coal has gone up immensely in cost, but the power you obtain from it remains rigidly the same. It takes about 60 pounds of coal to develop one horse-power for a working day. That is a ton and a half per fifty-horse-power-day. That power should be delivered to your machines with the least possible coal consumption.

A Graton & Knight Standardized Leather Belt will transmit from 25% to 40% more power per inch of width than a belt of any material other than leather. Figure out what that means at the present price of coal. To-day every item must be carefully considered which will, in any way, increase the production of food, equipment, and ammunition. With this greater demand for production and the consequent heavier load on power equipment, the superiority of Graton & Knight Belts becomes more emphatic.

Whether you measure by length of service or maintained efficiency, Graton & Knight Standardized Leather Belts reduce your horse-power cost per year, increase production, and reduce machine interruptions.

Transmission of power is a more important item to-day than ever before and now is the time for you to get at the real facts concerning it.

Write for information on Standardization as applied to Leather Belting

THE GRATON & KNIGHT MFG. CO.

Oak Leather Tanners, Makers of Leather Belting, Lace Leather, Leather Packings, and Specialties

WORCESTER, MASSACHUSETTS, U.S.A.

Canadian Representatives: The Canadian Fairbanks-Morse Co., Limited, St. John, Montreal, Ottawa, Toronto, Hamilton, Quebec, Calgary, Saskatoon, Vancouver, Windsor, Winnipeg, Victoria

GRATON & KNIGHT

Standardized Series

LEATHER BELTING

Spartan Double Leather Belting, J. H. Duker Box Co. Baltimore, Md.

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

DURABLA

DURABLA
TRADE MARK REGISTERED

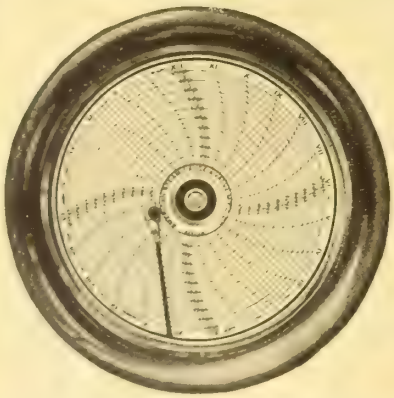
Durabla is a Giant in Strength

Many of the largest industries have adopted Durabla Gasket Material as a Standard for all new Construction Work and Repairs, using it on Steam, Air, Oil, Ammonia, Benzol and Alkalies at various temperatures and pressures, on All Flanges where a Permanently Tight Joint is required.

Claims of Superiority are easily made—comparative tests establish facts.

Durabla Manufacturing Company
NEW YORK

Distributors for Canada:
The Canadian Fairbanks-Morse Co., Limited



Make a Record to Prove

that the proper pressure has been carefully maintained and in this way help the Production Department to trace and locate the exact cause of any irregularity in output.

USE THE AMERICAN PRESSURE RECORDER
Descriptive matter on request.

Canadian Agents: CANADIAN FAIRBANKS-MORSE CO., Limited
Montreal, Quebec, Toronto, St. John

AMERICAN STEAM GAUGE AND VALVE MFG. CO.
New York Chicago BOSTON Atlanta Pittsburgh

FOR Steam or Air Drill, Pneumatic Tools, Boiler Flue Cleaning, Syphon Connections, Suction Lines.
For all kinds of Oil, Gasoline, Paints, Hydraulics, Gas.

"PENFLEX" METAL HOSE

INTERLOCKING

An all Metal Flexible Hose. Manufactured in Bronze or Galvanized Steel. Will withstand highest pressures. Is unsurpassed for durability and pressure resisting qualities.

Large Stock Carried in Canada
Pennsylvania Flexible Metallic Tubing Company - - Philadelphia, Pa.

Canadian Agents: The Canadian Fairbanks-Morse Co., Ltd., St. John, Quebec, Montreal, Ottawa, Toronto, Hamilton, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria.

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

COAL

A GREAT SOURCE OF POWER

HARD TO GET AND HIGH IN PRICE

Then why waste power by letting steam leak through poor packing in the stuffing box?

When the production of power costs as much as it does at present you should use

TRADE MARK

"PALMETTO"

because it is a packing that can be depended upon to give the longest service under the hardest conditions known to packings--and

Because of the unusually high grade of the materials used and the superior methods of manufacture

Free working samples to prove quality.

GREENE, TWEED & CO.,

Sole Manufacturers,

109 Duane St., New York

Representatives in Canada: The Canadian Fairbanks-Morse Co., Limited, Toronto, Montreal.

THE CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

Clip this Cut! Show it to an Expert Heating Engineer

Even though he does not know the Alberger Heater—which is improbable—the "floating" head feature will win him at once. "This allows for unequal expansion of hot and cold tubes," he will tell you. "Evidently it positively, permanently eliminates expansion strains. A splendid idea! For in most heaters, expansion strains cause endless trouble."

Next he will note the *pure copper tubes.*

"These tubes are corrugated," he will say. "They will transmit 50% more heat than a straight tube of the same size. Make sure they aren't brass, however, for materials segregate in brass tubes and splitting of the tubes, unless they are pure copper, will be frequent."

Alberger Multi-Head Heaters keep up with heaviest hot water demands. They heat water as quickly as it can be drawn—and at a lower cost than any other heater. Both Horizontal and Vertical Types of adequate capacities for every service.

Write for Bulletin 201.

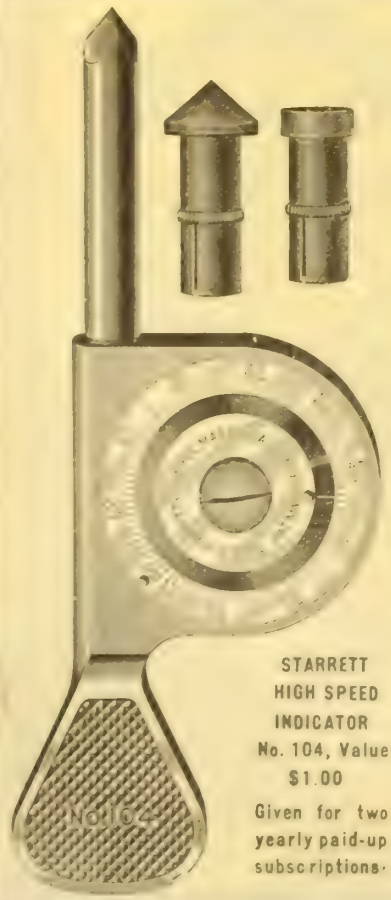
Alberger Heater Company

Buffalo, N.Y.

GENERAL SALES AGENTS:

The Canadian Fairbanks-Morse Co., Limited

St. John, Montreal, Quebec, Ottawa, Toronto, Hamilton, Windsor, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria.



STARRETT
HIGH SPEED
INDICATOR
No. 104, Value
$1.00
Given for two
yearly paid-up
subscriptions.

You May Have This Speed Indicator without Spending a Cent

if you are a subscriber to "POWER HOUSE." If you are not a subscriber, send in your own subscription together with two others, and the indicator you are entitled to will be mailed to you immediately.

To subscribers who send us two NEW yearly paid-up subscriptions we will send this $1.00 indicator.

"POWER HOUSE" is designed to give Canadian Engineers, Superintendents and Power Users all the latest and best information in the engineering field. A little work among your engineer friends and acquaintances will earn for you this handy indicator without any trouble. Try it and see how easy it will be.

PUBLISHED MONTHLY AT $1.00 PER YEAR
Start in TO-DAY to earn one of these Handy Tools

POWER HOUSE 143 University Ave., **Toronto**

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

SKF

BALL BEARING HANGERS

SKF BALL BEARINGS USED THE WORLD OVER

THE fundamental merits of S K F Self-Aligning Ball Bearings have been testified to by many of the largest industrial plants.

If you are interested, ask us to substantiate these claims.

Canadian SKF Co., Limited
TORONTO, ONTARIO

Sales Agents for SKF Transmission Bearings:
The Canadian Fairbanks-Morse Co. Limited

St. John, Quebec, Montreal, Ottawa, Toronto, Hamilton, Windsor, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria.

Lloyd George
and the War

COL. JOHN BAYNE MACLEAN contributes to the March issue of MACLEAN'S MAGAZINE a strong article dealing with the need for efficiency in the Lloyd George Government and giving interesting information with reference to the young man who is rapidly coming to the front in Imperial affairs—Sir Eric Geddes, the head of the Admiralty. This contribution is one of a notable series.

"SIXTEEN MONTHS IN GERMANY."

What a Canadian Prisoner saw and heard there—and how he escaped," By John Evans

This article presents a picture of conditions in Germany and gives many new facts with reference to what is going on in that country. The writer worked for sixteen months in the mines of Westphalia and came in close contact at all times with the miners. The story of his escape is a thrilling one.

"CANADIANS IN MESOPOTAMIA."

By a Canadian Medical Officer.

Little has been known heretofore of the campaign in Mesopotamia. This article gives details of the campaign and of the part which Canadians are taking in it. It shows how the inefficiency of the first campaign has been done away with and how splendidly organized the British army now is. The article contains many interesting anecdotes of adventure on that front.

"LABOR THE DOMINANT FACTOR."

By Agnes C. Laut.

This is an article on the war situation as it is developing on this side of the Atlantic, showing that labor is becoming a dominant factor. In the United States the antagonistic attitude of the labor union is dying out and being replaced by a strong desire to assist in war measures.

"CANADA'S NEW BOSS."

By H. F. Gadsby.

A political article, dealing with the "man behind" Union Government. It gives interesting and exclusive information with reference to the political situation at Ottawa as it is developing since the election.

"A CASUALTY."

By Robert W. Service.

A war poem which tells of an experience which actually happened to Service while driving a motor ambulance on the Western Front. It will be illustrated by C. W. Jefferys.

Fiction in the March Number

"BY THE TIP OF AN EYELASH," by A. C. Allenson, illustrated by R. M. Brinkerhoff. A bright story combining business, love and horse racing.

"THE GARDEN OF SPICES," by L. M. Montgomery, illustrated by F. Weston Taylor. This is a most unusual and charming love story.

Two long instalments of the two serials **"THE PAWNS COUNT,"** by E. Phillips Oppenheim, and **"THE MAGIC MAKERS,"** by Alan Sullivan.

"THE GIRL ON THE VERANDAH," by Arthur Beverly Baxter, who wrote **"The Man Who Scoffed,"** and **"Mam'selle Butterfly."**

Regular Departments and Features

There are the regular features and departments: Review of Reviews; Business Outlook; The Investment Situation; The Nation's Business; Books; Women and Their Work. A food article by Miss Chapman is a feature, and a new Spring Department on Seeds and Garden Culture starts in this number.

MacLean's Magazine
At all News Stands—20c.

Toronto, Ont.—Permit was granted last Thursday to the Dominion Shipbuilding Co. to construct a one or two-storey main building at the foot of Bathurst street on the Harbor Commission property at a cost of $175,000. The building will be of steel throughout and faced with hollow tile. The site leased by the company covers about 16 acres, and five shipbuilding berths will be laid down.

London, Ont.—The Public Utilities' Commission has directed to the Dominion Natural Gas Co. a request for full particulars concerning the strike of gas in a well near Port Talbot, thirty miles from London. The company is reported to have found gas there 70 miles from any other known field. The strike was made at a depth of 1,506 feet, and the yield is now estimated at from 5,000,000 to 7,000,000 feet a day. London will ask for a supply in order to be able to meet the coal shortage next winter.

Fuel From Garbage.—The City Council of Guelph has closed a contract with L. R. Long, of the Ontario Oakoal Co., for the construction of a plant in that city. The garbage of the place, with the exception of such non-combustible matter as crockery, glassware, etc., is to provide the raw material, and the plant is to turn out a fuel in briquette form to retail at $7 a ton. The city provides a free site, water and exemption from taxes, excepting for local improvement and patriotic purposes. Mr. Long guarantees to have a capacity of 50 tons per day of his new product.

Montreal, Que.—J. M. Hutcheson, general manager of Montreal Tramways Co., states that the second auxiliary steam plant at Hochelaga, consisting of a steam turbine with a capacity of 12,500 k.w.h., or about 17,000 h.p., will be installed towards the end of April or at the beginning of May. Asked as to how the first auxiliary plant was working out, Mr. Hutcheson replied that it was doing very well, being used in rush hours, such as in the morning and evening, when requirements for electric current are far above normal, besides which it can be used in case of any failure of transmission of hydraulic power.

Plan Big Outlay on Hydro System.—Estimated expenditures of over $9,000,000 for Hydro-Electric extensions, of which $4,175,000 is to pay for work on the Chippawa Creek development, are included in the Ontario Provincial estimates totalling $9,741,662. For Niagara system extension the sum of $2,865,000 is being voted, for the Central Ontario system extensions $588,000, for the Severn system $405,000, Eugenia Falls system $233,000, Port Arthur system $150,000, St. Lawrence system $251,000, Rideau system $117,000, Nipissing system $60,000, and for service buildings and miscellaneous, the sum of $100,000 is asked.

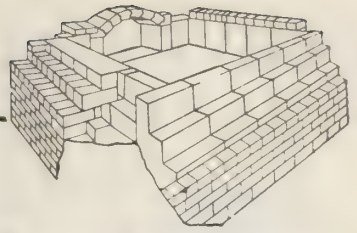
Boiler Inspection Act Amendment is Proposed.—Consideration was promised by Hon. F. G. Macdiarmid, Ontario Minister of Public Works, to a deputation headed by J. Leonard, of London, Ont., recently, asking that the Boiler Inspection Act be amended. The act now provides for the inspection of all boilers from the time the plans and specifications are submitted, but unless the boiler requires repairing it is never inspected in the interim, except by insurance companies. The inspection is made by stationary engineers. This is objected to by the manufacturers, as they claim that the stationary engineers are not competent to judge, because of his employment by a company owning the boiler.

Quebec, Que.—With the exception of the closing of some temporary sluices, the great dam at the head of the St. Maurice River is now finished, giving this province the largest artificial water storage in the world. The reservoir has an area of not less than 300 square miles. It is the completion of a work which has involved more than five years of investigation and construction, and an expenditure not far short of $3,000,000. On July 25, 1915, the contract was finally awarded to the St. Maurice Construction Co., who made an arrangement under which the supervision and organization of the contract work was placed in the hands of Messrs. Fraser, Brace & Co. of Montreal.

Engineers Will Discuss Fuel Problem.—Because of the great public interest in fuel and power, the Canadian Society of Civil Engineers has called a public session for March 26 and 27 at the University of Toronto, Physics Building, to discuss coal, wood, peat, gas and electricity, as related to coal and kindred problems. Arthur Hewitt will speak on "Gas," B. F. Haanel on "Peat and Natural Resources," Prof. Zavitz on "Wood," and Sir Geo. Bury on "Transportation," John Murphy on "Railway Electrification," P. H. Mitchell on "Electric Heat." Premier Hearst has been asked to preside, and invitations have been sent to the Provincial Government, the City Council, the Board of Trade, and the Canadian Manufacturers' Association

Ammonia Shortage Feared for Artificial Ice Making.—The United States Food Administration issues the following statement: The attention of the Food Administration has been called to articles appearing in various New York papers by which it is indicated that plenty of ammonia will be available to make ice next summer; that there will be no commandeering of ammonia in New York; and that there will be a sufficient supply of the commodity to permit the manufacture of the customary amount of artificial ice. The Government can not give assurance that there will be a sufficient supply of ammonia, nor that the manufacture of the customary amount of artificial ice will be possible. There is danger of a serious shortage of ammonia, and steps are being taken to have as large as possible a harvest of natural ice to meet any possible shortage of artificial ice.

Sarnia, Ont.—A number of factories here have been affected by the order issued by the Ontario Railway Board, cutting off the supply of natural gas for manufacturing purposes. The firms in



Gates Boiler Furnace

Patented 1916

Will last three times as long as ordinary good grade Fire Brick. These blocks are inter-locking, and made so that any handy man or fireman can renew them without disturbing any of the other brick work.

WRITE FOR PARTICULARS.

John W. Gates 2 St. James St., MONTREAL, QUE.

Attention, Water Power Users

FOR SALE

Four standard 55-inch Crocker Turbine Water Wheels, fitted with graduating gates, complete with shafting, gears, etc. Wheels were manufactured by Jenckes Machine Company, and guaranteed to develop 150 H.P. when horizontal shaft is running at 150 R.P.M. when working under an effective head of four feet. Have never been used and are as good as new.

H. Corby Distillery Co., Limited
CORBYVILLE, ONTARIO (p3b)

Are you allowing money to slip through your fingers?

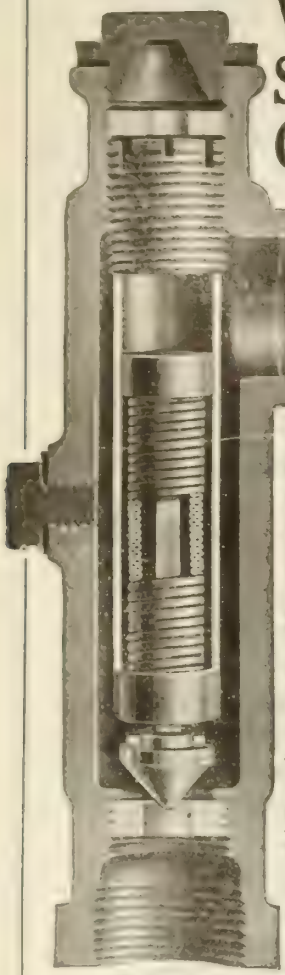
Examine your coal bills and think this over.

Why not let us show you how to return condensation back to your boiler, at such a high temperature that you can't help but show a saving?

At least send for literature.

Geo. W. Cole, Limited
2002-4 Dundas St. W., Toronto, Ont.

INDIVIDUAL TRAPPING WILL SAVE COAL



Because you stop the flow of Steam at every point where a trap is installed and pass only condensation to your receiving well.

Any method of carrying live steam with the condensation to some distant point to a large, cumbersome type of trap, which also requires steam pressure to make it discharge, is not only old-fashioned but wastes a large quantity of steam by useless radiation, requiring heavier coaling at boiler to keep steam pressure at required point.

Steam Trap SARCO

can be installed at five different places for the price of one float or bucket type of trap, and allow nothing but condensation to pass, saving you that much coal in operation.

The Sarco principle of construction is basically sound, it uses hydraulic pressure: the expansion of a liquid by heat and the contraction of the same liquid when cooled. There is only one moving part, and none to get out of order.

They are small in size and large in capacity.

COAL IS SCARCE

and individual trapping is a way to save

We will demonstrate on a 30 days' free trial basis.

If you want to save at five points in your plant instead of one

Write for Bulletin J-9.

Sarco Company Inc.

Woolworth Building, New York

Buffalo Detroit
Philadelphia Chicago

Representatives in all Principal Cities

Sarnia affected by the order are not using the gas for fuel, but for power-generating. The gas engines are in such plants as the Lougheed Machine Co., Sarnia Fence Co., Cleveland-Sarnia Saw-mills Co., Doherty Stove Co., Canadian Printing Co. and others. These firms will have to close unless they can either obtain special permits to use gas or the order is rescinded. The firms cannot secure hydro equipment owing to the conditions prevailing. No gas has been supplied any local firms for fuel since last November. The big plant of the Imperial Oil Co. is not affected. Its gas supply for fuel was cut off with others last November, and since that time oil and coal have been used.

Ottawa, Ont.—Tenders will be received until March 18, 1918, for heating and ventilating equipment required in the reconstruction of the Parliament Buildings. All tenders to be based on the execution, erection, and completion, together with the furnishing of all materials, tools, appliances, scaffolding, apparatus and labor required for the installation of the heating and ventilating equipment as called for in the plans and specifications. All information can be obtained at the office of the general contractors, P. Lyall & Sons Construction Co., Ottawa. A set of plans and specifications may be had by depositing an accepted bank cheque for twenty-five ($25.00) dollars, made payable to the Honorable the Minister of Public Works, which will be returned if the intending bidder submits a regular bid.

Quebec Railway to Stimulate Manufacturing.—At a meeting of the Quebec Railway, Light, Heat & Power Co., plans were discussed in connection with a propaganda to advertise the company's capacities, with a view to inducing Western capital into the Province of Quebec, particularly on the company's lands in and around the City of Quebec, the purpose in view being the furnishing of electric power to the industries backed by the capital induced. The company has water powers at Montmorency Falls, the Natural Steps just above the falls, at the Chaudiere Falls, and on the Jacques Cartier and Ste. Anne rivers. The total amount developed is 48,000 h.p., and there is further power, as yet unharnessed, of 25,000 h.p., with an additional 3,000 when the proposed dam on the Jacques Cartier river is completed. The company is placing before the Government at Ottawa a proposal asking that the company electrify the new Quebec Bridge, and take all trains across by means of electric engines.

WILL RELIEVE GAS SITUATION

THE Ontario Legislature has unanimously passed the Natural Gas Act, giving the Ontario Railway and Municipal Board wide powers to control and regulate the production and transmission, distribution and sale, disposition and consumption of all the natural gas produced in Ontario.

This was an emergency measure taken to relieve within the next twenty-four hours the serious situation existing in various parts of the province which depend on natural gas for heating purposes, but especially the city of Windsor and district.

The Ontario Railway and Municipal Board is now in complete control of the situation, and has power to brush aside all private corporations, and the Minister of Lands, Forests and Mines, who introduced the measure, made it clear that the people of the province are to have first call on the gas supply for the purpose of heating their homes,and that important industries engaged in the manufacture of war supplies and the production of food supplies are to come second.

"Belmont" 1903 Special Hydraulic Packing. For Hot or Cold Water Boiler Feed Pumps (Inside or Outside Packed) and for Hydraulic Work It Has No Equal.

Pressures up to 10,000 lbs.

Cannot Split, Swell or Pinch

We guarantee Belmont Special Hydraulic Packing to give absolute satisfaction under the heaviest pressures, and when exposed to acid or alkaline waters. We know that it is made right, and from the best material, and that "Belmont" is absolutely the "last word" in packing arguments.

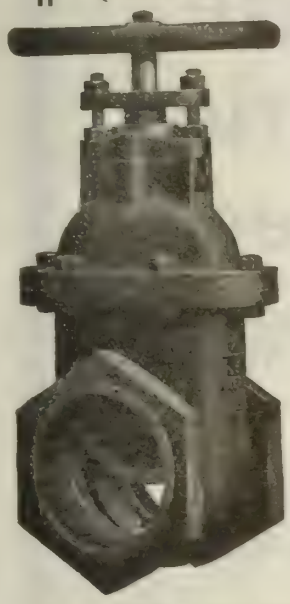
William C. Wilson & Co.
21 Camden St. TORONTO

MONCRIEFF'S "UNIFIC" WATER GAUGE GLASSES

Stand in a Class by Themselves for Quality, Efficiency and Economy
A trial will convince you. Write for Catalog

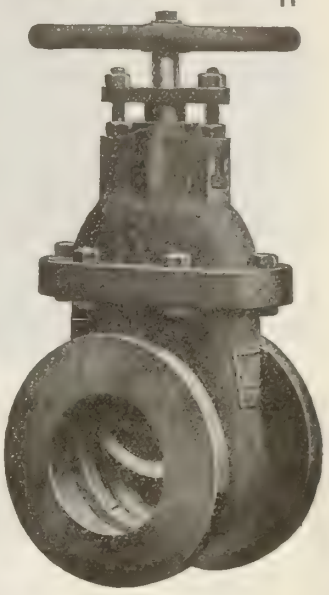
W. J. WALL, 134-136 BLEURY ST., MONTREAL
(Canadian Representative)

KERR
("New KEYSTONE" Pattern) GATE VALVES



If you have not used any of these New Pattern Valves, specify "KERR" in your next order. We want you to get acquainted with the most reliable valve on the market.

If you have been using them, we are confident that our satisfaction will bring us your repeat orders. These valves will never cause you or your customer the slightest trouble. Their high quality is consistent.



When you buy a "KERR" Valve you get a guaranteed article that is backed by a reliable firm. Many of the largest distributers of valves in Canada have sold "KERR" Valves for over 25 years, and are still recommending them as the "Best Valve." Write us for particulars.

Kerr Engine Co., Ltd., Valve Specialists **Walkerville, Ont.**

The function of lubricating oil is to give the greatest ease of motion to all parts of the engine, so that every possible atom of power may be transmitted to the machines. An oil that will do this will have effect on other divisions. Ease of operation would mean elimination of friction, no wear on the bearings, less oiling. Pure oil would be a decided labor-saving, cost-reducing, efficiency-promoting factor in the engine room. A great many Canadian manufacturers have pronounced our "Non-Corrosive Cylinder Oil" pure. We, who know its construction, pronounce it pure. Get in touch with us.

NON-CORROSIVE CYLINDER OIL
MANUFACTURED ONLY BY
E. H. KELLOGG & CO.
NOS. 242 TO 244 SOUTH ST. NEW YORK, U.S.A.

WALTER J. FRANCIS, C.E. M. Can. Soc. C.E. M. Am. Soc. C.E. M. Inst. C.E.
FREDERICK B. BROWN, M.Sc. M. Can. Soc. C.E. Mem. Am. Soc. M.E. Mem. A.I.E.E.

WALTER J. FRANCIS & COMPANY
CONSULTING ENGINEERS
Head Office, 232 St. James St., Montreal
Cable Address, "Walfran, Montreal"—W.U. Code.
Long Distance Telephone, Main 5643.

MacKINNON, HOLMES & Co.
Limited
MacKinnon Steel Co., Ltd.
SHERBROOKE QUEBEC

Engineers, Manufacturers and Erectors of Steel Structures

We Specialize in

Bridges, Buildings, Towers, Tanks, Penstocks, Roof Trusses, Columns, Smoke Flues and Stacks, Coal Bins, Ore Bins, Buckets, Refuse Burners, Stills, Air Receivers, etc.

WRITE FOR PRICES.

Use Graphite for Cylinder Lubrication and Cut the Cost.

Dixon's Flake Graphite forms a wonderfully smooth, anti-friction veneer over the interior of the cylinder.

It furnishes better lubrication than can possibly be obtained by oil alone.

DIXON'S Ticonderoga Flake Graphite

will restore cut and scored cylinders and valves to perfect smoothness. Sticking and groaning valves disappear entirely. Rod packings last indefinitely.

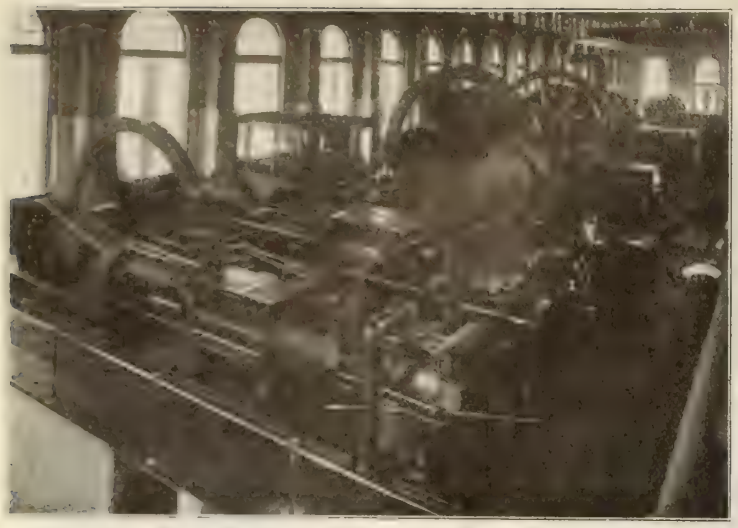
Write for booklet No. C, showing some of the types of engines on which Dixon's Flake Graphite is being used, and explaining method of successfully introducing it into the cylinder.

Made in Jersey City, N.J., by the

JOSEPH DIXON CRUCIBLE COMPANY

ESTABLISHED 1827

Sole Canadian Representative:
CANADIAN ASBESTOS CO.
Montreal, Que.



Positive Lubrication Assured

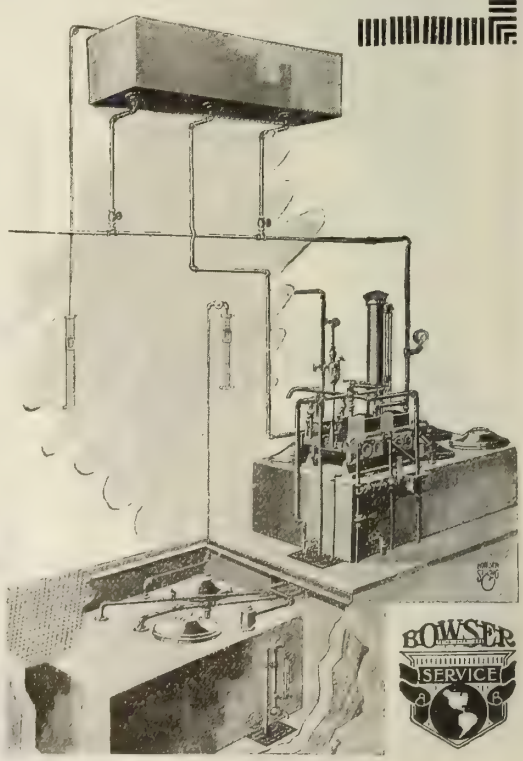
WHEN YOUR PLANT IS UNDER THE CARE OF THE

BOWSER ESTABLISHED 1885 **Lubricating Oil Circulating Filtering** **SYSTEMS** THE STANDARD ALWAYS

It is an everyday occurrence for some factories to have shut-downs once or twice a day, and the cause of this, many times, is improper lubrication. Dirt and grit gets into the oil during use. When such oil comes in contact with the bearings there is at once an unnecessary friction and "hot boxes" result—then shut-downs follow.

With the Bowser Filtration Systems shut-downs are avoided. More power is obtained from the engine and less wear and tear on the parts is assured. The dirty oil is taken by the system into its filtering compartment, where all the impurities are extracted. From this compartment the oil is returned to the clean oil tank ready for use again—as good as new. This system not only saves machinery, but it saves oil, as well. The refuse and dirty oil can be drawn from the chamber used to collect it and many uses can be found for it. This saving alone amounts to a sum worth considering.

Bowser Systems are built for any sized plant, to fulfill any requirement. The 6F shown below is especially adapted to plants whose engines are on ground floor instead of in basement, and where large volumes of water return with the dirty oil. Let us be your advisors in lubricant and power problems. Write to-day, explaining your requirements—no obligations on your part.



S. F. Bowser & Co.

INCORPORATED

Toronto, Canada

Sales Offices in All Centres

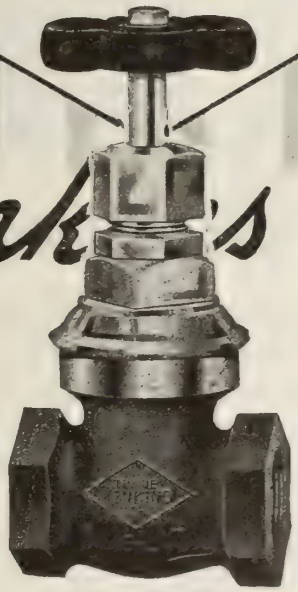
Representatives Everywhere

WRITE FOR BOOKLET

TRADE

JENKINS

MARK



Jenkins Bros

TYPE "K" BRASS Gate Valves

It Pays to Use the Best

Installing good valves at the start saves repair and replacement charges as well as labor cost of reinstallations later.

JENKINS BROS.' TYPE "K" Brass Gate Valves are representative of the highest type of Gate Valves made. Improved in design and constructed from carefully selected materials by first-class workmen. They are thoroughly tested under working conditions by both steam and hydraulic pressure previous to shipment, thus we are able to send out a genuine guarantee of good service with every Type "K" Valve.

You will know a JENKINS BROS.' VALVE by the Diamond Trade Mark which is cast on the body of all Genuine—Look for it.

There's a JENKINS BROS.' VALVE for every purpose. Catalogue No. 8 free on request.

TRADE JENKINS MARK Jenkins Bros

Jenkins Bros. LIMITED

TRADE JENKINS MARK Jenkins Bros

Head Office and Works: 103 St. Remi Street, Montreal, Canada

Agencies in all Principal Countries of the World

European Branch: 95 Queen Victoria Street, London, E.C. 4, England

Success and Your Associates

ALWAYS associate with men who are earning more money than you are. Such is the advice given by a man whose name is known the world over for his own success and the business which he created. It is good advice of a certainty, but we are not urging that it is the best advice. At the same time it is wise to associate with better or bigger men than you are yourself. because you are likely to be lifted up to their levels.

Most of us would probably like to be the intimates of J. P. Morgan, or of John D, or of Charlie Schwab, or Canny Andrew. If we had a speaking acquaintance with John Wanamaker, or Lord Beaverbrook, or Lord Shaughnessy, and with other distinguished and successful men, we would take comfort from the fact.

And most of us would feel rather small and uncomfortable if we were placed beside President Woodrow Wilson at a dinner table, or beside Sir Robt. Borden, Sir Herbert Holt or Thomas Findley. And the reason would probably be that we know so little of the knowledge that really counts. If these great men engaged us in conversation we would probably find ourselves knowing very little about the things that matter.

This will illustrate the point:

Here's a true story. A Toronto manufacturer found himself on a train going to Albany in company with a number of distinguished Americans about to attend the inaugural ceremonies of a State Governor. A washout led to a delay, and the Canadian was thrown into close association with senators and congressmen and prominent lawyers. They bantered the little Canadian about Canada. He had the pluck of a bigger man. He had been a constant reader of THE FINANCIAL POST, and had absorbed many facts about Canada. He surprised his American traveling companions with his positive, well-informed and wide knowledge of Canada. When the company reached Albany, the Canadian was persuaded to attend the ceremonies, and was introduced as the man who knew all about Canada. The Governor was interested in Canada, and said so, and the little Canadian found himself telling the story of Canada very ardently to a very attentive listener, much to the amusement of his friends who introduced him.

This man made a hit on that journey, and many friends. One of the company gave him a stock market tip worth a fortune.

The point of this story is: You, as a Canadian, can make yourself informed very fully and intelligently if you become a regular reader of THE FINANCIAL POST. You can make yourself a worthy companion and intimate of presidents and magnates. The world likes to listen to men who know something well, and who can talk interestingly and informingly on the subject of their study.

You can become worth listening to if you know your Canada well. And you can get the kind and amount of knowledge concerning Canada which will make you interesting to others if you will read THE FINANCIAL POST regularly each week.

IF you read THE FINANCIAL POST REGULARLY you will find yourself keeping company with the highest paid staff of editors engaged on any publication in Canada—trained men who know how to make others know what they know and learn.

You will find yourself living in a most interesting world—the great, throbbing world of business. You will have your thoughts tremendously stimulated and helpfully directed. You will find yourself becoming a fit table companion for big men — this because you will have knowledge of a quality that will keep you from shame.

What is it that keeps you and THE POST separated? It cannot be its subscription price of $3. Probably it is because you are not very well acquainted with this paper.

We are going to put it to you this way: If you have the desire to be worthy of association with big men, then prepare yourself for such association by reading THE POST, and to make acquaintance easy, we provide the coupon below. It offers you THE POST for four months for a dollar bill.

— —

The MacLean Publishing Company, Limited.

143-153 University Avenue, Toronto.

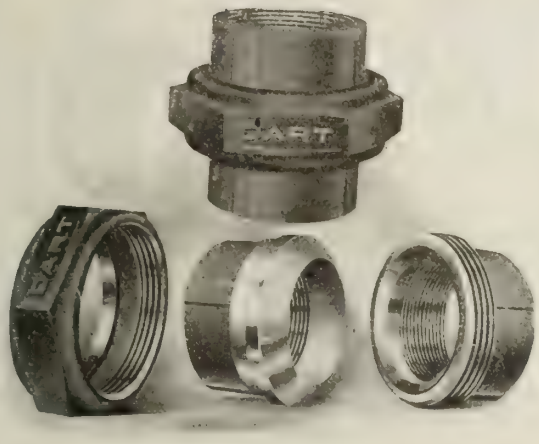
Send me/us THE FINANCIAL POST for four months for One Dollar. Money enclosed / to be remitted

(Signed)

.....

P.H. .....

Look at Your Floor Is it Wet?



If it is, discard that leaky pipe coupling for a Union we guarantee will never leak—a

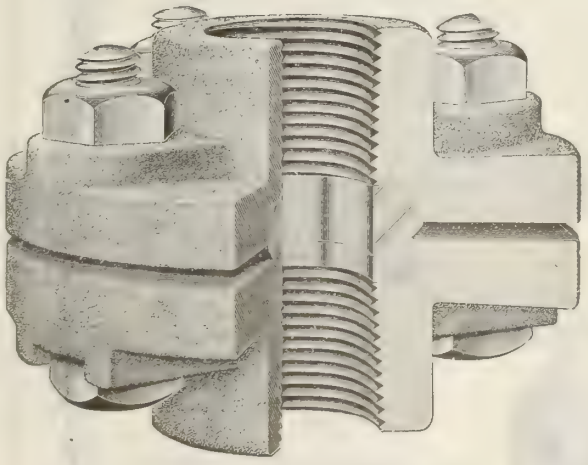
DART UNION

Bronze to Bronze

at the Joint

Once installed, Dart Unions never need attention. Their cost for upkeep is absolutely nothing, because non-corroding bronze against bronze at the joint positively prevents leakage, and the force of extraordinary strain cannot separate the parts of heavy iron.

Furthermore, the ball-shaped seats of Dart Unions enable anyone to make connections permanently tight with ease, *even though the pipes are out of alignment.*



FLANGE UNION

For a Dart Union imperfect—Two New Ones FREE.

Order from any Supply House.

Order from any Supply House.

MADE IN CANADA BY

DART UNION COMPANY, LIMITED

TORONTO, CANADA

For a Dart Union imperfect– Two new ones FREE.

If any advertisement interests you, tear it out now and place with letters to be answered.

—it's the disc and self-cleansing seat in

LUNKENHEIMER "DURO" BLOW-OFF VALVES

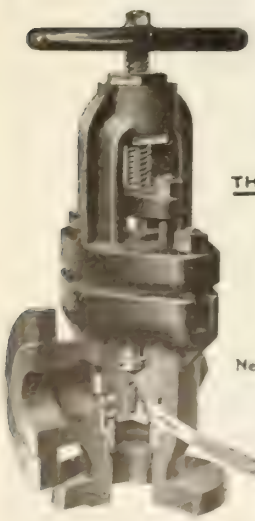
that insure tightness under all service conditions.

The disc has a soft alloy face which readily accommodates itself to any irregularity of the seat; and the seat is automatically cleansed when valve is closing, by the action of the disc which cuts off the inlet and allows only a thin film of water, free from sediment, to pass and remove foreign matter that may have lodged on the seating surface during the blow-off.

The disc is reversible, having two seating faces, and these faces can easily be replaced when worn. All parts including the seat-ring and reversible disc are renewable.

All sizes; Screw or Flanged Ends; for working steam pressures up to 250 pounds.

Your local dealer can furnish them; if not, write us. Write for descriptive booklet No. 515-DC.



THE LUNKENHEIMER CO.
—"QUALITY"—

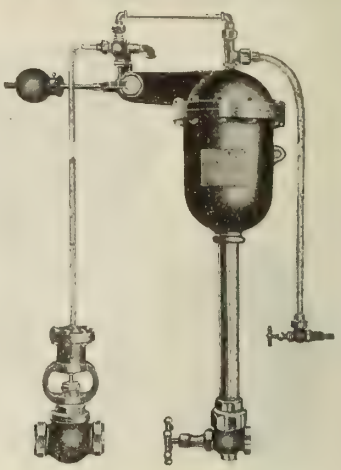
Largest Manufacturers of High-Grade Engineering Specialties in the World

CINCINNATI

New York
Chicago Boston
London

The Vigilant Feed Water Regulator

Saves a Lot of Fuel



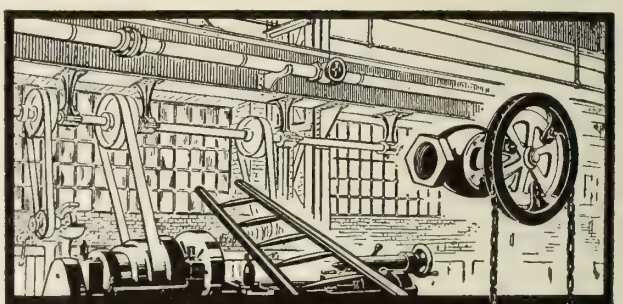
Aside from the ability of the "Vigilant" to give you safe and certain protection against too high or too low water in your boiler, **it will save 3 to 17% in fuel.**

This is an important factor in these days of fuel scarcity and high prices—a saving that soon pays for the regulator.

The "Vigilant" is guaranteed to keep water level within ¼" of middle gauge. High or low pressure accidents are unknown where the "Vigilant" is on the job. It is ever watchful, day and night.

Pleased to go into the ability of the "Vigilant" further with you. Send for Engineers' Data Cards and catalog. Write now.

The Chaplin-Fulton Manufacturing Company
28 Penn Avenue - - Pittsburgh, Pa.



"BUT IT ISN'T NECESSARY FOR THE WORKMAN TO CLIMB THE LADDER,"

argued the Compensation Adjuster after the accident. Enough said.

Many factory owners are paying for accidents that might have been prevented with the

Babbitt
—Adjustable—
SPROCKET RIM

ATTACH THEM TO YOUR VALVE WHEEL

INTERN THE LADDER FOR KEEPS

Made to fit any valve anywhere

At Your Dealer's, or write for Pamphlet

BABBITT STEAM SPECIALTY COMPANY
NEW BEDFORD, MASS.

Manufactured in Canada, under Canadian Patents, exclusively by the Engineering Specialties Company, Limited, 1080 King Street West, Toronto, Ont. 93-9

MUELLER

Globe and Angle Valves

BUILT from actual, practical experience. Made of the famous *MUELLER* steam metal and fully guaranteed against all defects in design and construction. Not a Valve, but *the* Valve.

¶ *MUELLER* globe and angle Valves can be repacked under pressure. The disc is so designed as to adjust itself to any position and still receive the thrust of the spindle on the center line; thus preventing any distortion to the seat or diaphragm. The pipe threads are full length, and are tapered to conform to I. P. Threads, insuring perfect joints.

¶ Full sized and unobstructed passages guarantee full service. The large Hexagons allow an excellent wrench grip and our design puts the strain where it belongs, so that there is no danger of distorting either the body or the bonnet. Furnished with enameled, Malleable iron wheel handles. Every *MUELLER* Valve tested to beyond unusual service conditions. Write for prices.

MUELLER gate and check valves, steam cocks, etc. rank highest in every branch of exacting service.

H. Mueller Mfg. Co., Limited

SARNIA, CANADA

This is one view of the manufacturing plant of

Canuck Supply Co., Limited

AND

This is where

Anchor Steam and Hydraulic Packings

U.S. Metallic Locomotive and Marine Packings

and

Other Mechanical Devices and Supplies

are

MADE IN CANADA

Canuck Supply Co., Limited

Toronto Montreal Winnipeg

All Down the Line—

You'll find sizes and types of

Jefferson Unions

for every union need—why not standardize them and put an end to pipe line troubles throughout your plant?

The Jefferson feature of forcing the brass seat ring into a recess just back from the runway and contents of the pipe makes it corrosion-proof and at the same time much more durable than a bronze or brass seated union handled in any other way. Then the weight of a Jefferson is greater than any other union of similar class—another logical "reason why" they are most successful.

If your jobber can't supply Jeffersons, a line direct to us will bring you the name of our nearest dealer and the Jefferson Book "Unions"—a treatise on pipe line connections which you'll enjoy reading.

Jefferson Union Features

Ground ball brass-to-iron or iron-to-iron joint, ground with mate and never separated.

Sloping shoulder and large play in the ball end, which is of assistance in connecting piping out of line.

Standard pipe threads tapered to fit the pipe. Coarse nut threads for quick adjustment.

Heaviest of its class made and sold at reasonable prices.

The Jefferson Union Company

Lexington, Mass. **U.S.A.**

MAIL THIS HANDY COUPON FOR THE JEFFERSON BOOK "UNIONS"

Jefferson Union Co.,
Lexington, Mass.
Please send me a copy of your New Catalog.

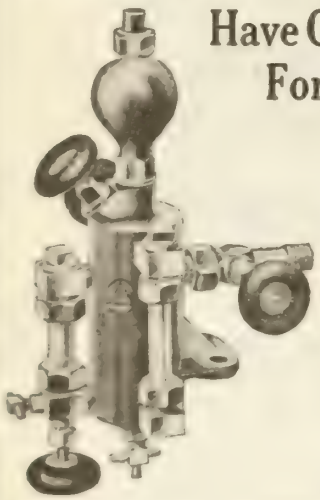
Name .....
Firm Name .....
Address .....

If any advertisement interests you, tear it out now and place with letters to be answered.

IF you have sickness in your home, you immediately send for a specialist—usually the best you can get. It's only logical, then, when sickness appears in your Power House, to send for US.

Detroit Lubricators

Have Given Satisfaction For Forty Years.



Built in a sufficient variety of styles to lubricate properly every type of steam engine, pump, gas engine, air compressor, etc.

Send to-day for catalog L 1. The information on lubricating devices contained in it will be valuable to you.

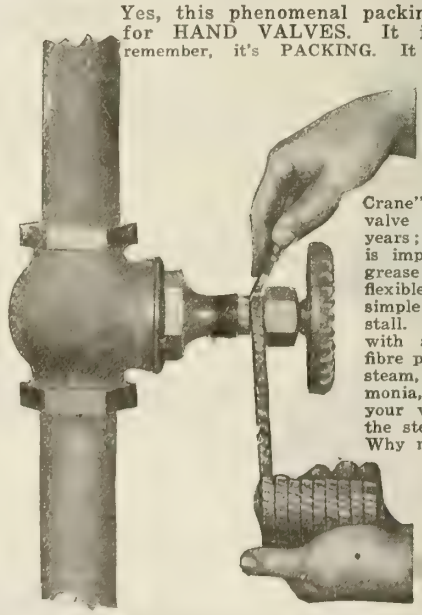
THEIR efficiency holds over half the world's trade.

Makers of Stewart Carburetors.

CANADIAN DETROIT LUBRICATOR COMPANY, LTD.
WALKERVILLE, ONT.

Don't Stuff Your Stuffing Boxes With Mere "Stuff"

PACK Them With "John Crane" FLEXIBLE METALLIC PACKING



Yes, this phenomenal packing is also good for HAND VALVES. It isn't "stuffing," remember, it's PACKING. It necessarily costs more because it is made of smooth babbitt metal throughout, spirally wound from the very center "John Crane" does not injure valve stems; lasts for years; does not harden; is impregnated with oil, grease and graphite; is flexible, compressible, simple and easy to install. You can cut it with a knife just like fibre packings. Good for steam, air, water, ammonia, or oil lines. Pack your valves NOW while the stems are still good. Why not learn all about "John Crane" packing? It is the most economical packing in the long run for EVERY purpose. Give it one fair trial and you will bid all other packings good-bye.

CRANE PACKING COMPANY
Box 241, Windsor, Ont.
General Office and Factory, Chicago, Ill.

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

JOHNS-MANVILLE
Power Plant Service

JOHNS-MANVILLE SERVICE
COVERS THE CONTINENT

IT HAPPENS every day to hundreds of you engineers—you mention your problems to a Johns-Manville salesman who drops in and that's his cue to get together with you and help. The next minute finds you working together over a piping design, to kill off wet steam that's laming the pump or whatever the bother happens to be.

We are not competing with the consulting engineer. But call it service, salesmanship, or common sense—the fact remains that no Johns-Manville man is contented with mere order taking. For back of every product he sells is a Johns-Manville branch, home office, factory and technical staff, whose primary aim is to make "*Johns-Manville*" a tradename in the power field for all around service.

View above: Nashville Railway & Light Co., Nashville, Tenn. High Temperature Cement used.

The Canadian H. W. Johns-Manville Co., Inc.
MONTREAL TORONTO VANCOUVER WINNIPEG

Canadian Association of Stationary Engineers

Incorporated May, 1887 — Incorporated at Ottawa, June, 1917

An organization having as its aims and objects:—

To promote the knowledge of its members in the art and science of Steam Engineering.

The dissemination of information beneficial to the members of the association in the discharge of their calling.

To further and protect the interests of competent engineers, and receive such as members of this organization.

To secure, through proper legislation, the greatest security in operation of steam plants.

To assist unemployed members to secure positions.

To maintain freedom of action between employer and employee.

The members of the Association subscribe to the above in the full belief that ability and knowledge of one's profession are necessary to insure the highest degree of success.

Labor Study Energy

These three essentials have been responsible for the success of the world's greatest men. They are no less essential for yours. We cannot all become great, but this fact does not lessen the necessity for the exercise of these essentials in our individual occupations. Cool, calm, calculating judgment characterizes the successful power house operator of to-day. The demands on the engineer of to-day are many, and the obstacles in his path are great. To assist in the overcoming of these and help the accomplishment of great works, material, moral and educational, is the desire of all our members.

The benefits accruing from association with members of his fraternity, the opportunity to benefit by their experience, and the inspiration to greater effort by reason of their success render membership in this association indispensable to all progressive engineers.

If you are interested in such an organization and live where less than fifteen engineers are located, send for a copy of our constitution and application blanks for admission to nearest branch lodge. If there are more than fifteen engineers in your community, get together and send for particulars regarding formation of a branch lodge.

J. H. HALE, General Secretary, C.A.S.E.

230 Caroline Street — Hamilton, Ont.

---The Oak Leaf---
Is the Sign To Go By

D. K. McLAREN'S LEATHER BELTING

Keep the OAK LEAF in mind the next time you are buying belting—it will serve you as a guide to the better belting service in your plant.

The use of this belting reduces slip to a minimum, thereby saving a considerable amount of power. It also saves a remarkable amount of time, labor and attention, because there is hardly any stretch to it.

Genuine British-Oak Tanned

Therein lies the secret of the toughness and durability of D. K. McLaren's famous Leather Belting. The British Oak Tanning Process is the best method known for treating leather for belts, and this, coupled with the expert choice of flawless back leather makes these D. K. McLaren products as serviceable as a leather belt can possibly be.

We would like you to know what others think of it—write for list of users, then ask them.

GENUINE OAK

D·K·McLAREN
LIMITED

GENUINE OAK

HEAD OFFICE AND FACTORY:
351 ST. JAMES STREET, MONTREAL, P.Q., CANADA

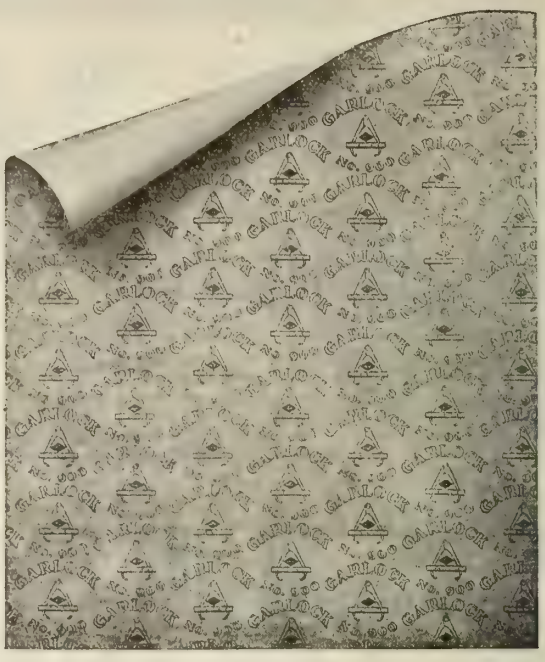
VANCOUVER, B.C.
849 Beatty St.

TORONTO, ONT.
194 King St., West

ST. JOHN, N.B.
90 Germain St.

If any advertisement interests you, tear it out now and place with letters to be answered.

GARLOCK
NINE HUNDRED SHEET



Is unsurpassed for superheated steam joints.

It is equally well adapted to air, acids, ammonia,

Or any severe condition where sheet packing is required.

It is made of the highest quality of long fibre asbestos,

And is built up into sheet form under tremendous pressure,

Thus securing great toughness, flexibility and tensile strength.

It is not affected by extremely high pressures and temperatures,

And does not require following up after gaskets have been applied.

Joints can be opened as often as desired without injury to gaskets.

This sheet is furnished in all thicknesses from 1-64 to ¼ inch.

Gaskets of all shapes and sizes can be cut by us from Nine Hundred Sheet.

The Garlock Packing Company - Hamilton, Ontario

BRANCHES:

Montreal, Quebec.....409 Shaughnessy Bldg.
Toronto, Ontario.....404 Continental Life Building
Winnipeg, Manitoba.....Galt Building

If what you want is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

A HALF CENTURY

of useful work is celebrated by Albany Grease. During the past 50 years Albany Grease has always given perfect lubrication service on engines, pumps, motors, generators and gears in power and industrial plants.

ALBANY GREASE

has proven in many instances to be very efficient and most economical. It will keep bearings running cool and easy at all times. Should you not be using Albany Grease send for samples and try it.

Albany Lubricating Co.
708-10 Washington St.
NEW YORK, U.S.A.
Established 1868

The Gripping Power of a Giant

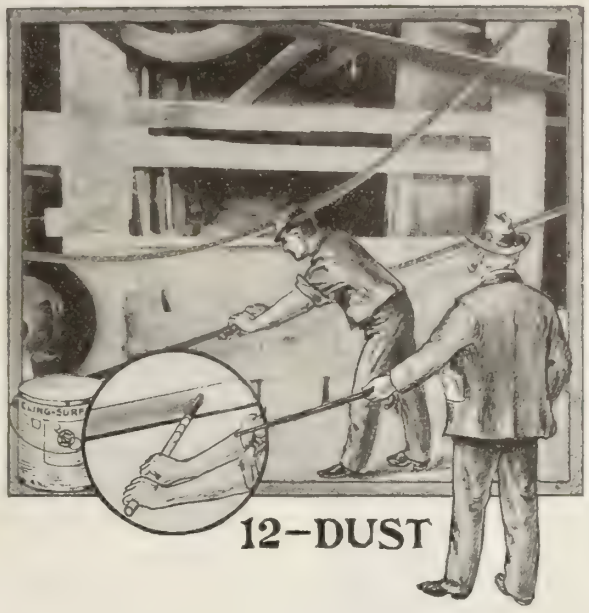
is the gripping power of "Spiro" couplings; in fact, they have a 50% greater gripping force than any other compression coupling. The tighter the pull on the two halves of the coupling the tighter the grip on the entire length and circumference of the sleeve on the shaft.

A spiral slot in the sleeve is a patented Bond feature that allows tremendous gripping force to be applied. There are no keys to break or work loose and cause time and labor to be wasted in fixing it.

"SPIRO" Couplings Cannot Slip

Write for our catalog on Power Transmission Machinery to-day.

Canadian Bond Hanger & Coupling Co., Ltd.
ALEXANDRIA, ONTARIO



Dont Claim Exemption

—because the air is filled with dust,
—because this dust settles on the belts,
—because it makes a belt dressing "ball up"
are no reasons at all why your belts can't have the benefit of

CLING-SURFACE Belt Preservative

Just wipe the dust off first.

Then with the swab (as shown) treat the face of the belts a little at a time.

Your belts will absorb CLING-SURFACE very quickly, leaving a clean, not sticky, surface.

It will be smooth, velvety, and will not slip.

Nor will it hold the dust.

Your drives will last longer, do more work, cause no trouble, and can be run easy or slack under full loads.

They will never again have static electricity.

* * *

Results like these PAY.

Are you willing to try this treatment if such trial **costs you nothing?**

Then write to-day for the 25-pound can we have waiting for you.

Use it sixty days.

If you're satisfied, pay us for it. If not, we will take back what you have left, charge you nothing for what you've used, and pay the freight both ways.

ALL CHEERFULLY—no hard feelings!

Remember, use CLING-SURFACE and you won't need belt dressings.

Cling-Surface Co
1057 Niagara Street
Buffalo New York
U S A

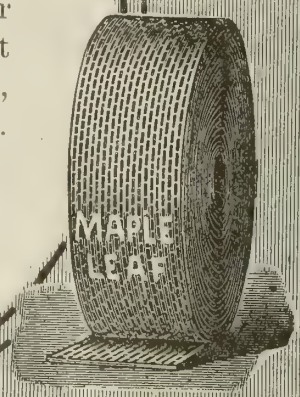
"Maple Leaf" Brand

Stitched Cotton Duck Belting

THE BEST FOR ALL KINDS OF BELTS

Is strong, durable, economical and true running. Being thoroughly waterproof, it is equally good for running in wet or dry places. As a main drive belt "MAPLE LEAF" cannot be excelled, and for conveyors is in great demand. A trial belt will convince you.

Write for prices and samples.



Dominion Belting Co., Ltd.,

HAMILTON, CANADA

PACKING

FOR

CENTRIFUGAL PUMPS

Our style No. 270 is made specially for this work.

A braided cotton, lubricated and graphited.

Sample on Request.

Thomson-Gordon Limited

Hamilton, Ont.

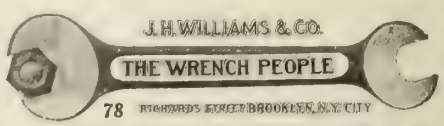
Packings *Belting* *Engineer Supplies*

Vulcan-ize Pipe Work

Only the "penny-wise" begrudge the price of "VULCAN" sufficiency. Experienced buyers will take nothing else.

Double life, proof-tested chains and knowledge of security are worth all they cost—and more—TO THE MAN WHO KNOWS THE "VULCAN."

Seven sizes, accommodate 1/8-inch to 12-inch pipe and hold all records for service.



Chicago Office and Warehouse: 78 South Clinton Street.
A. G. Low Co., Ltd., Saskatoon, Sask., agents for Manitoba, Saskatchewan, Alberta and British Columbia

Morse Rocker-Joint Silent Chains

IN USE BY THE LARGEST POWER TRANSMISSION IN THE WORLD.

IN THE LEADING MINES, MILLS, POWER PLANTS, FACTORIES, for EVERY SORT AND CONDITION OF DRIVE.

The Rocker Joint is the exclusive patented feature. There is no sliding friction. Depends on construction, not lubrication, for its life and durability.

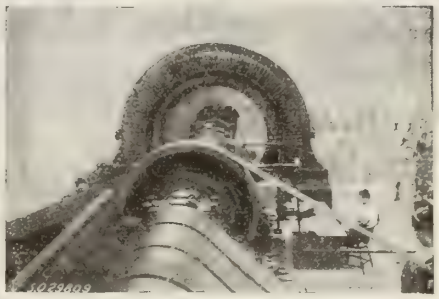
WHY?

ASK THE BUYER & USER

about

99% EFFICIENCY EVENNESS
DURABILITY CLEANNESS
ECONOMY MAINTENANCE

Let MORSE Engineers Design Your New Drives.



Ox-bow, largest drive in the world

POWER

TRANSMISSION MUST BE FIGURED

In Terms of DOLLARS

- Power Costs
- Replacement Costs
- Shut-Down Costs
- Repair Costs
- Time Lost Costs
- Production Costs
- Damaged Goods Losses
- Shipping Losses

FIGURE IT OUT

Would you like to know.

WRITE

MORSE CHAIN COMPANY GENERAL OFFICE AND WORKS ITHACA, N.Y., U.S.A.

Boston	141 Milk St.
Chicago	Merchants' L. & T. Bldg.
Cleveland	421 Engineers' Bldg.
Detroit	1003 Woodward Ave.
Greensboro, N.C.	805 Ashboro St.
New York	50 Church St.
Pittsburgh	Westinghouse Bldg.
San Francisco	Monadnock Bldg.

REPRESENTATIVES

ATLANTA	Earl F. Scott, M.E., 702 Chandler Bldg.
KANSAS CITY, MO.	Morse Engineering Co. Chemical Bldg.
MINNEAPOLIS	Strong & Scott Mfg. Co., 413 Third St. S.
MONTREAL	Jones & Glassco, St. Nicholas Bldg.
TORONTO	Jones & Glassco, Traders Bank Bldg.
ST. LOUIS	Morse Engineering Co., Chemical Bldg.

If any advertisement interests you, tear it out now and place with letters to be answered.

HINTS TO BUYERS

DOMINION COAL COMPANY LIMITED

"Dominion" and "Springhill" BITUMINOUS STEAM and GAS COALS

GENERAL SALES OFFICE

112 St. James St. Montreal

NOTICE

TO

Stationary and Hoisting Engineers

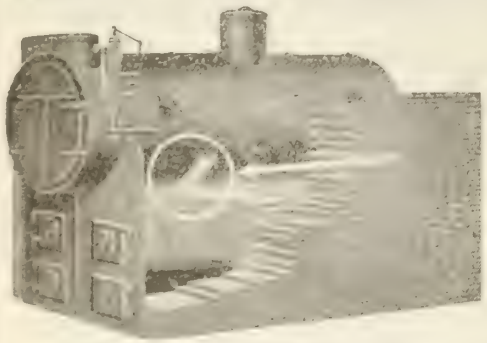
Everyone operating a STATIONARY steam plant of 50 h.p. or over in the Province of Ontario must hold a Stationary Engineer's Certificate from the Board of Stationary and Hoisting Engineers. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary and Hoisting Engineers' Act.

Everyone operating a HOISTING steam plant working at a pressure of 20 pounds or over, irrespective of horse power, and used for hoisting in structural operations or excavating purposes, in the Province of Ontario, must hold a Hoisting Engineer's Certificate from the Board of Stationary and Hoisting Engineers. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary and Hoisting Engineers' Act.

Application forms for obtaining STATIONARY or HOISTING Engineers' Certificates, may be had upon applying to the Chairman.

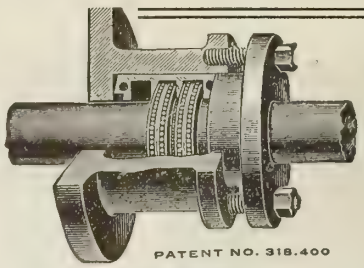
HON. F. G. MACDIARMID, Minister of Public Works and Highways.
W. C. McGHIE, Chairman of Board.
W. A. RIDDELL, M. A. PH. D., Superintendent, Trades & Labour Branch.

PREVENT FIRE CRACKS and LEAKS



by installing the National Boiler Seam Protector. Attached by anyone in 30 minutes. Endorsed by Engineers, Boiler Inspectors and Insurance Companies. 3,500 installations made in last two years. Write for list of Canadian and U. S. A. users.

NATIONAL BOILER SEAM PROTECTOR CO. OF CANADA
Head Office: 910 New Birks Bldg., Montreal
Toronto Office: 568 Manning Ave., Toronto



PATENT NO. 318,400

PAT. NO.	500,899	PAT. NO.	829,116
" "	534,104	" "	830,530
" "	602,328	" "	856,103
" "	654,541	" "	878,238
" "	654,542	" "	894,537
" "	725,368	" "	895,791
" "	774,490	" "	898,066
" "	775,193	" "	905,103
" "	775,194	" "	934,629
" "	791,300	" "	979,208
" "	805,669	" "	1000,75

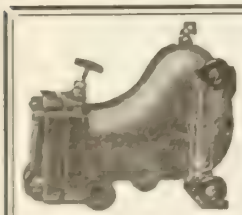
Why not Buy the Best, when in market for Packing?

HOLMES' Metallic Packing

Is Guaranteed 3 Years

Lasts many times longer. 30 days' trial. Less oil. No cutting. Easily applied to any Steam Engine, Air Compressor or Gas Engine. Satisfaction or no pay. Write us.

HOLMES METALLIC PACKING CO.,
Wilkes-Barre, Pa.
Incorporated 1897



McDANIEL IMPROVED STEAM TRAP

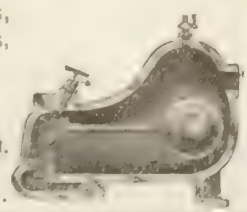
FOR HIGH OR LOW PRESSURE.

Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

MAY WE SEND ONE FOR TRIAL?

Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators.

SEND FOR CATALOGUE.



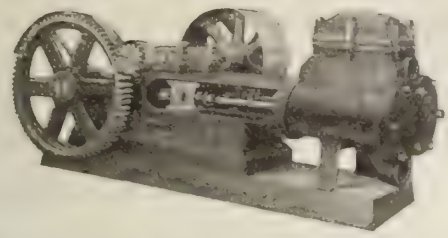
THE GARTH COMPANY
26 Craig Street MONTREAL, CAN.
WATSON & McDANIEL CO.
No. 146 N. 7th Street, PHILADELPHIA, Pa.

Water Turbines, Hydraulic Governors, Centrifugal Pumps

OUR LINDSAY WORKS

Boving Hydraulic & Engineering Co., Limited
LINDSAY, ONTARIO

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

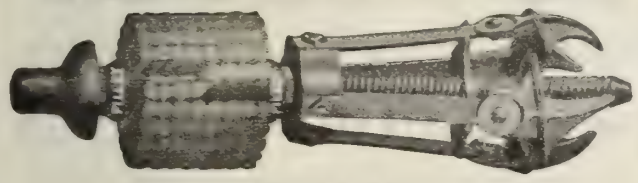


THE BEST IN PUMPING MACHINERY

The Smart-Turner Machine Co., Limited

HAMILTON, CANADA

The Simplest and Best Cleaner on the market is



PILLEY'S

Combination Flue Brush and Scraper

Guaranteed not to break or the wires to pull out or lay over. A simple turn of the hand adjusts it to the tube, and the brush removes what the scraper loosens.

For sale by leading Canadian jobbers

Manufactured by

PILLEY PACKING & FLUE BRUSH MFG. CO.

623 South Third Street ST. LOUIS, MO.

Eastern Office: 71 Fulton St., New York.

BOILER INSPECTION

The Steam Boiler Act, Chapter 252 R.S.O., 1914 With Amendments Chapter 58—6, George V.

STEAM BOILERS.

All Steam boilers constructed for use in Ontario must be built from designs which have been approved and allotted a registration number by the Steam Boiler Branch.

Used boilers, boilers sold or exchanged, and unregistered boilers brought into the Province must be inspected prior to being put into operation.

Notice of repairs to steam boilers, stating the nature and extent of same, must be sent to the Steam Boiler Branch, and should such repairs be considered extensive by the Chief Boiler Inspector, the boilers will require to be inspected.

In each and every case the inspections must be made by Inspectors authorized to inspect boilers under the Steam Boilers Act, who are employed only by the Steam Boiler Branch of the Department of Public Works. Official certificates with the maximum working pressure stated thereon are issued to the owners of the boilers so inspected.

STEAM PIPING.

Drawings and Specifications of all high pressure steam piping must be approved and registered by the Steam Boiler Branch before any work of installation is commenced. The drawings submitted should show clearly the dimensions and layout of the main steam lines. Full particulars should be given as to the material used in the construction of the piping, and all valves and other fittings used in connection therewith must be of approved make.

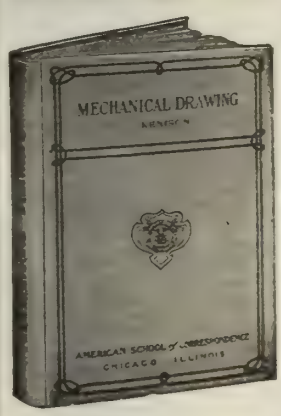
Any deviation from the above requirements shall be deemed a violation of the Steam Boilers Act.

All communications in this respect should be addressed to the Steam Boiler Branch, Department of Public Works, Parliament Buildings, Toronto.

HON. F. G MACDIARMID, Minister of Public Works and Highways

W. A. RIDDELL, M.A. Ph.D., Supt. Trades & Labour Branch

D. M. MEDCALF,
Chief Inspector of Steam Boilers.



Mechanical Drawing

By Ervin Kenison, S.B.

Instructor in Mechanical Drawing, Massachusetts Institute of Technology

176 pp., 140 illus. Cloth binding. Gives a course of practical instruction in the art of Mechanical Drawing, based on methods that have stood the test of years of experience. Includes orthographic, isometric and oblique projections, shade lines, intersections and developments, lettering, etc., with abundant exercises and plates.

Price, $1.00

MacLean Publishing Co.

Technical Book Dept.

143-153 University Ave., Toronto

THE LADD VERTICAL WATER TUBE BOILER

The Goldie-McCulloch Co., Ltd.

Galt, Ontario

Canadian licencees under patents 162401 and 162402 dated May 4, 1915.

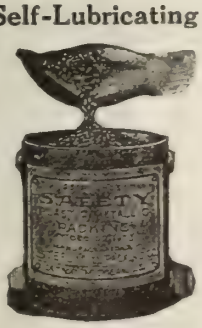
The George T. Ladd Company,

Pittsburgh, Pa.

Owners and manufacturers for the United States.

Write for new Catalogue No. 17.

Self-Lubricating



In Bulk

SAFETY PLASTIC

METALLIC PACKING

FOR STEAM, WATER, AIR, GAS, ETC.

Pat. Dec. 22, 1903 Highest Award World's Fair, St. Louis, 1904

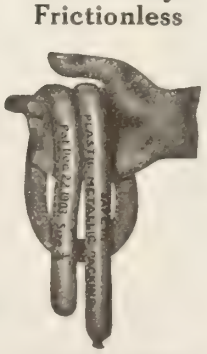
GUARANTEED TO LAST THREE YEARS

WITHOUT RENEWAL

Drop us a line and let us tell you all about this Remarkable Packing.

STEEL MILL PACKING CO., WINDSOR, ONT. Established 1899

Practically Frictionless



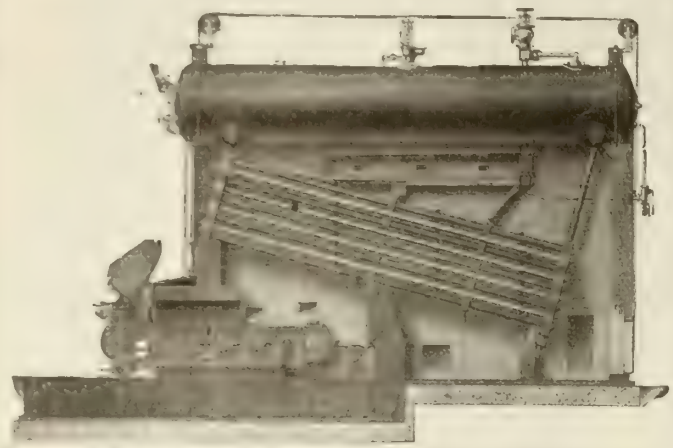
In Cotton Tubes

If any advertisement interests you, tear it out now and place with letters to be answered.

"ALL BRITISH"

"B.&W." PATENT WATER TUBE STEAM BOILERS

HIGHEST ECONOMY, SAFETY, DURABILITY. OVER 17,000,000 H.P. IN USE.



Babcock & Wilcox Patent Water Tube Steam Boiler, Superheater and Mechanical Stoker.

ALSO

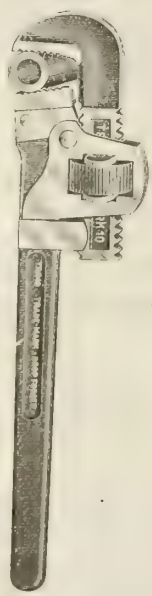
Steam Superheaters
Mechanical Stokers
Coal-Handling Machinery
Piping, Feed Water Heaters
Water Softeners and Purifiers
and **ELECTRIC CRANES**

BABCOCK & WILCOX, Limited

HEAD OFFICE FOR CANADA - COLLEGE ST. (ST. HENRY), MONTREAL
TORONTO OFFICE, TRADERS BANK BUILDING

The Wrench of 25% Greater Efficiency

TRIMO PIPE WRENCH



Two new features have been recently added to the Trimo Pipe Wrench, namely Nut-Guards, in all sizes, and unbreakable steel frames, in leading sizes.

The Nut-Guards prevent the accidental rotation of the nut while in use.

These improvements add 25% to the usefulness of the tool.

The Trimo Pipe Wrench is made with wood handles in 4 sizes, 6-in., 8-in., 10-in., 14-in. and in steel handles in all sizes, 6-in. to 48-in. inclusive.

All Trimo Pipe Wrench parts are interchangeable.

The inserted jaw in the handle can be readily replaced when worn, thus adding to the life of the tool.

Nut with Nut-Guards

Inquiries from Importers and Dealers Solicited. Send for Catalogue No. 55.

TRIMONT MANUFACTURING CO.

CableAddress: Triwrench
Code: Western Union

Roxbury (Boston) Mass., U.S.A.

POWER HOUSE BUYERS' DIRECTORY

If what you want is not listed here write us, and we will tell you where to get it. Let us suggest that you consult also the advertisers' index facing the inside back cover, after having secured advertisers' names from this directory. The information you desire may be found in the advertising pages. This department is maintained for the benefit and convenience of our readers. The insertion of our advertisers' names under proper headings is gladly undertaken, but does not become part of an advertising contract.

AIR COCKS
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

AIR VALVES
Mueller Mfg. Co., H., Sarnia, Ont.

AMMETERS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. H. W. Johns-Manville Co., Toronto, Ont.

AMMONIA VALVES AND FITTINGS
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Frick Co., Waynesboro, Franklin Co., Pa.
Homestead Valve Mfg. Co., Pittsburgh, Pa.
York Mfg. Co., York, Pa.

AMMONIA PURIFIERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Mfg. Co., York, Pa.

AMMONIA TANKS
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford, Ont.

ARCHES, COMBUSTION CHAMBER
Canadian Fairbanks-Morse Co., Ltd. Montreal.

ASH CARRYING SYSTEMS
Babcock & Wilcox, Ltd. Montreal.
Waterous Engine Works Co., Brantford, Ont.

ASBESTOS SPECIALTIES
Durabla Mfg. Co., New York, N.Y.
Garlock Packing Co., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

AUTOMATIC ICE RECORDING DOORS AND CHUTES
James[illegible] Cold Storage Door Co., Hagerstown, Md.

BABBITT AND ANTI-FRICTION METAL
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Hoyt Metal Co., Toronto.
Magnolia Metal Co., Montreal
Wm. C. Wilson & Co., Toronto.

BALL BEARINGS
Can. S K F Co., Toronto, Ont.

BALLCOCKS
D'Este Co., Julian, Boston, Mass.

BATTERIES AND ACCESSORIES
Can. H. W. Johns-Manville Co., Toronto, Ont.

BELT CEMENT
Graton & Knight Mfg. Co., Montreal.

BELT DRESSING
Cling Surface Co., Buffalo.
Jos. Dixon Crucible Co., Jersey City.
Dominion Belting Co., Hamilton, Ont.
Graton & Knight Mfg. Co., Montreal.

BELT LACING, LEATHER
Graton & Knight Mfg. Co., Montreal.

BELT TIGHTENERS
Waterous Engine Works Co., Brantford, Ont.

BELT PULLEYS
American Pulley Co., Philadelphia, Pa.
Waterous Engine Works Co., Brantford, Ont.

BELTING, BALATA
Federal Engineering Co., Toronto, Ont.

BELTING, LINK
Graton & Knight Mfg. Co., Montreal.
Waterous Engine Works Co., Brantford, Ont.

BELTING, STITCHED COTTON DUCK
Dominion Belting Co., Hamilton, Ont.

BELTING, LEATHER
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Garlock Packing Co., Hamilton, Ont.
Goodyear Tire & Rubber Co., Toronto.
Graton & Knight Mfg. Co., Montreal.
D. K. McLaren Ltd., Montreal.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

BELTING, RUBBER
Can. H. W. Johns-Manville Co., Toronto, Ont.
Goodyear Tire & Rubber Co., Toronto.
Jeffrey Manufacturing Co., Montreal.
Peerless Mfg. Co., New York, N.Y.
Thomson-Gordon, Ltd., Hamilton, Ont.

BELTING, WOVEN COTTON
Federal Engineering Co., Toronto, Ont.

BINS, COAL, COKE AND ORE
Jeffrey Manufacturing Co., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que
Waterous Engine Works Co., Brantford, Ont.

BLOWERS
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Can. Sirocco Co., Windsor, Ont.
C. T. Coe Co., 10 Johnston St., Newark, N.J
Coppus Eng. & Equip. Co., Worcester, Mass.
Sturtevant Co. of Canada, Ltd., B. F., Galt, Ont

BOILER COMPOUNDS
Beveridge Paper Co., Ltd., Montreal, Que.
Can. Economic Lubricant Co., Montreal, Que.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Shell-Bar. Boico Supply, Ltd., Toronto, Ont
Wm. C. Wilson & Co., Toronto.

BOILER COMPOUND FEEDERS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Morehead Mfg. Co., Woodstock.
Lunkenheimer Co., Cincinnati, O.

BOILER FEED PUMPS
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Ltd., Montreal, Que.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Laurie & Lamb, Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

BOILER FEED REGULATORS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Mason Regulator & Engineering Co., Montreal.

BOILER GRAPHITE
Joseph Dixon Crucible Co., Jersey City, N.J.

BOILER MOUNTINGS
Babcock & Wilcox, Ltd. Montreal.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Ltd., Montreal, Que.
Inglis Co., The John, Toronto, Ont.
Lunkenheimer Co., Cincinnati, O.
Mason Regulator & Engineering Co., Montreal.

BOILER PRESERVATIVES
Johns-Pratt Co., The, Hartford, Conn.

BOILER HOUSE ACCESSORIES
Babcock & Wilcox, Ltd., Montreal.
Canadian Griscom-Russell Co., Ltd., Montreal.
Cole, Ltd., Geo. W., Toronto.
Mason Regulator & Engineering Co., Montreal.

BOILER SEAM PROTECTOR
National Boiler Seam Protector Co., Montreal.

BOILER SETTINGS
Beveridge Paper Co., Montreal.
Gates, John W., St. James St., Montreal.

BOILER TUBE CLEANERS
Babcock & Wilcox, Ltd. Montreal.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Cole, Ltd., Geo. W., Toronto.
Garlock Packing Co., Hamilton, Ont.
Liberty Mfg. Co., Pittsburg.
Laurie & Lamb, Montreal.
Pilley Packing and Flue Brush Mfg. Co., St. Louis, Mo.

BOILERS, HORIZONTAL, RETURN, TUBULAR AND WATERTUBE
Babcock & Wilcox, Ltd. Montreal.
Cole, Ltd., Geo. W., Toronto.
Goldie & McCulloch Co., Galt.
Frick Co., Waynesboro, Franklin Co., Pa.
Inglis Co., The John, Toronto, Ont.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Jones Underfeed Stoker Co., Toronto.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Ladd, The Geo. T., Co., Pittsburgh, Pa.
McAvity, T., & Sons, Ltd., St. John, N.B.
Waterous Engine Works Co., Brantford, Ont.

BOILERS, MARINE, LOCOMOTIVE AND VERTICAL
Babcock & Wilcox, Ltd. Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Goldie & McCulloch Co., Galt.
Inglis Co., The John, Toronto, Ont.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
John McDougall Caledonian Iron Works, Montreal.
Waterous Engine Works Co., Brantford, Ont.

BOOKS
Audel & Co., Theo, New York, N.Y.
MacLean Publishing Co., Toronto.

BOXES, FUSE AND METER
Johns-Pratt Co., The, Hartford, Conn.

BRASS FOUNDERS
McAvity, T., & Sons, Ltd., St. John, N.B.
D'Este Co., Julian, Boston, Mass.
Mueller Mfg. Co., H., Sarnia, Ont.

BRINE COOLERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

BRINE TANKS
Frick Co., Waynesboro, Franklin Co., Pa.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford, Ont.
York Manufacturing Co., York, Pa.

BUSHINGS
Steel Mill Packing Co., Windsor, Ont.

CABLE
Wm. C. Wilson & Co., Toronto.

CALORIMETERS
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Taylor Instrument Co., Rochester, N.Y.

CANS, OILY WASTE
Jas. Morrison Brass Mfg. Co., Toronto.

CAST IRON FITTINGS
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.

CASTINGS, BRASS AND IRON
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Lunkenheimer Co., Cincinnati, O.
John McDougall Caledonian Iron Works Co., Ltd., Montreal.
McAvity, T., & Sons, Ltd., St. John, N.B.
Mueller Mfg. Co., H., Sarnia, Ont.
Waterous Engine Works Co., Brantford, Ont.

CELLAR DRAINERS
Mueller Mfg. Co., H., Sarnia, Ont.

CEMENT, HIGH TEMPERATURE
Beveridge Paper Co., Montreal.
Gates, John W., St. James St., Montreal.

CEMENT, PIPE JOINT
Wm. C. Wilson & Co., Toronto.

CEMENT MACHINERY
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Waterous Engine Works Co., Brantford, Ont.

CHAIN DRIVES
Morse Chain Co., Ithaca, N.Y.

CHAIN WHEELS
Babbitt Steam Specialty Co., New Bedford, Mass.

CHIMNEYS, STEEL
Babcock & Wilcox, Ltd. Montreal
MacKinnon, Holmes & Co., Sherbrooke, Que.

CHUTES, COAL
Can. Allis-Chalmers, Ltd., Toronto, Ont
MacKinnon, Holmes & Co., Sherbrooke, Que.

CLOCKS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Foxboro Co., The, Foxboro, Mass.

CLOSETS
Mueller Mfg. Co., H., Sarnia, Ont.

CLUTCHES
Waterous Engine Works Co., Brantford, Ont.

COAL
Dom. Coal Co., Montreal

COAL AND ASH CONVEYORS
Babcock & Wilcox, Ltd. Montreal.
Jeffrey Manufacturing Co., Montreal.
Waterous Engine Works Co., Brantford, Ont.

COAL HANDLING MACHINERY
Babcock & Wilcox, Ltd. Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Jeffrey Manufacturing Co., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford, Ont.

COAL HOLE COVERS
Can. Allis-Chalmers, Ltd., Toronto, Ont.

COILS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

COLD STORAGE INSULATION
Armstrong Cork & Insulation Co., Montreal, Que.
Beveridge Paper Co., Ltd., Montreal, Que.

COMMUTATOR TRUING DEVICES
Jordan Bros., Inc., New York, N.Y.

CONDENSERS
Alberger Heater Co., Buffalo, N.Y.
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Toronto.
Belliss & Morcom, Birmingham, Eng.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Darling Bros., Ltd., Montreal, Que.
Goldie & McCulloch Co., Galt.
Laurie & Lamb, Montreal.
John McDougall Caledonian Iron Wks., Montreal.
Waterous Engine Works Co., Brantford.

CONDENSERS, AMMONIA AND STEAM
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

COLLECTORS, PNEUMATIC
Sturtevant Co. of Canada, B. F., Galt, Ont.

CONSULTING ENGINEERS
Walter J. Francis, Montreal.
Laurie & Lamb, Montreal.

COLD STORAGE DOORS AND WINDOWS
Jamison Cold Storage Door Co., Hagerstown, Md.

COMPRESSORS, AIR
American Steam Pump Co., Battle Creek, Mich.
Belliss & Morcom, Birmingham, Eng.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Darling Bros., Ltd., Montreal, Que.
Inglis Co., The John, Toronto, Ont.
Laurie & Lamb, Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Smart-Turner Machine Co., Ltd., Hamilton.
Taylor Instrument Co., Rochester, N.Y.

COMPRESSORS, GAS
Can. Allis-Chalmers, Ltd., Toronto, Ont.

CONDUITS
Can. H. W. Johns-Manville Co., Toronto, Ont.

CONDENSATION RECEIVER
Cole, Ltd., Geo. W., Toronto.
G. M. Davis Regulator Co., Chicago.

CONNECTIONS, FLANGED
Jefferson Union Co., Lexington, Mass.
Dart Union Co., Ltd., Toronto, Ont.

CONCRETE HARDENER
Beveridge Paper Co., Montreal.

CONTRACTORS' STRUCTURAL STEEL
Can. Fairbanks-Morse Co., Ltd. Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.

CONVEYOR MACHINERY
Babcock & Wilcox, Ltd. Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Jeffrey Manufacturing Co., Montreal.
Waterous Engine Works Co., Brantford.

COOLER, DOORS
Jamison Cold Storage Door Co., Hagerstown, Md.

CORK INSULATION
Armstrong Cork & Insulation Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.

COTTON HOSE
Hamilton Packing Co., Hamilton, Ont.

COUNTERS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Foxboro Co., The, Foxboro, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

COUNTERSHAFTS
Can. Bond Hanger & Coupling Co., Alexandria, Ont.

COUPLINGS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Jeffrey Manufacturing Co., Montreal.
McAvity & Sons, T., St. John, N.B.

COUPLINGS, BOILER, FLANGED PIPE, JOINT PIPE, UNION, STEAM PIPE
Jefferson Union Co., Lexington, Mass.
Dart Union Co., Ltd., Toronto, Ont.

COUPLINGS, SHAFT
Can. Bond Hanger & Coupling Co., Alexandria, Ont.

CRANES, ALL KINDS
Babcock & Wilcox, Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

CRANES, ELECTRIC
Babcock & Wilcox, Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

CRANES, HAND POWER
Babcock & Wilcox, Ltd., Montreal.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Smart-Turner Machine Co., Ltd., Hamilton.

CRANES, OVERHEAD TRAVELLING
Babcock & Wilcox, Ltd., Montreal.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Smart-Turner Machine Co., Ltd., Hamilton.

CRANES, POST JIB
Babcock & Wilcox, Ltd., Montreal.

CRANES, SWING JIB
Babcock & Wilcox, Ltd., Montreal.

CRANES, WALL
Babcock & Wilcox, Ltd., Montreal.

CRANK AND CROSSHEAD PIN OILERS
Lunkenheimer Co., Cincinnati, O.

CRIMPS, LEATHER
Graton & Knight Mfg. Co., Montreal.

CRUSHING MACHINERY
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Jeffrey Mfg. Co., Columbus, Ohio.

CYLINDER OIL
E. H. Kellogg & Co., New York.

DAMPER REGULATORS
Babcock & Wilcox, Ltd., Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Darling Bros., Ltd., Montreal, Que.
G. M. Davis Regulator Co., Chicago.
D'Este Co., Julian, Boston, Mass.
Leslie Co., Pittsburgh, Pa.
Mason Regulator Co., Boston, Mass.
Jas. Morrison Brass Mfg. Co., Toronto.

DISCS, FIBRE
Beveridge Paper Co., Ltd., Montreal, Que.
Johns-Pratt Co., The, Hartford, Conn.

DISCS, LEATHER
Graton & Knight Mfg. Co., Montreal.

DISTILLING APPARATUS
Canadian Griscom-Russell Co., Ltd., Montreal.
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

DOORS, COLD STORAGE AND FREEZER
Jamison Cold Storage Door Co., Hagerstown, Md.

DOUBLE PIPE CONDENSERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

DRYING MACHINERY
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Sirocco Co., Windsor, Ont.

DUST SEPARATORS
Sturtevant Co. of Canada, B. F., Galt, Ont.

DYNAMOS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Sturtevant Co. of Canada, B. F., Galt, Ont.

ECONOMIZERS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Green Fuel Economizer Co., New York, N.Y.

EJECTORS
Jas. Morrison Brass Mfg. Co., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.

ELECTRICAL ACCESSORIES AND MACHINERY
Can. H. W. Johns-Manville Co., Toronto, Ont.

ELECTRICAL SUPPLIES
Can. H. W. Johns-Manville Co., Toronto, Ont.

ELEVATORS
MacKinnon, Holmes & Co., Sherbrooke, Ont.

ELEVATING MACHINERY
Canadian Fairbanks-Morse Co., Ltd., Montreal.

Jeffrey Manufacturing Co., Montreal.
Waterous Engine Works Co., Brantford.

ENAMELWARE
H. Mueller Mfg. Co., Sarnia, Ont.

ENGINEERS' SUPPLIES
Beveridge Paper Co., Ltd., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Ltd., Montreal, Que.
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.
Jas. Morrison Brass Mfg. Co., Toronto.

ENGINES, AUTOMATIC AND DROP VALVE
Frick Co., Waynesboro, Franklin Co., Pa.
Waterous Engine Works Co., Brantford.

ENGINES, CORLISS AND ROCKING VALVE
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Waterous Engine Works Co., Brantford.

ENGINES, DIESEL
Can. Allis-Chalmers, Ltd., Toronto, Ont.

ENGINES, GAS AND GASOLINE
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Laurie & Lamb, Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

ENGINES, STEAM
Belliss & Morcom, Birmingham, Eng.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Can. Sirocco Co., Windsor, Ont.
Goldie & McCulloch Co., Galt.
Inglis Co., The John, Toronto, Ont.
Laurie & Lamb, Montreal.
John MacDougall Caledonian Iron Works, Montreal.
Waterous Engine Works Co., Brantford.

ENGINES, HOISTING, LOGGING, CABLEWAY
Can. Allis-Chalmers, Ltd., Toronto, Ont.

ENGINES, MARINE
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.

ENGINES, SAW MILL
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Laurie & Lamb, Montreal.
Waterous Engine Works Co., Brantford.

ENGINES, SINGLE COMPOUND AND TRIPLE EXPANSION
Canadian Griscom-Russell Co., Ltd., Montreal.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Laurie & Lamb, Montreal.
John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Kerr Engine Co., Walkerville.
Waterous Engine Works Co., Brantford.

ENGINES, VERTICAL
Laurie & Lamb, Montreal.

ENGINEERING BOOKS
MacLean Publishing Co., Toronto.

EXHAUST HEADS
Can. Sirocco Co., Windsor, Ont.
Darling Bros., Ltd., Montreal, Que.
Direct Separator Co., Syracuse, N.Y.
Elliott Co., Pittsburgh, Pa.
Jas. Morrison Brass Mfg. Co., Toronto.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Watson & McDaniel Co., Philadelphia.

EXPANSION JOINTS
Alberger Heater Co., Buffalo, N.Y.
Direct Separator Co., Syracuse, N.Y.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.

FANS, VENTILATING
Can. Sirocco Co., Windsor, Ont.
C. T. Coe Co., 10 Johnson St., Newark, N.J.
Coppus Engr. & Equip. Co., Worcester, Mass.
Green Fuel Economizer Co., New York, N.Y.
Sturtevant Co. of Canada, B. F., Galt, Ont.

FEED WATER HEATERS
Alberger Heater Co., Buffalo, N.Y.
Babcock & Wilcox, Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Stewart Heater Co., Buffalo, N.Y.
Waterous Engine Works Co., Brantford.

FEED WATER PURIFIERS
Stewart Heater Co., Buffalo, N.Y.

FEED WATER REGULATORS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Chaplin, Fulton Mfg. Co., Pittsburg, Pa.
Elliott Co., Pittsburgh, Pa.
Laurie & Lamb, Montreal.

FILTERS
Bowser & Co., Inc., S. F., Toronto, Ont.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.

FILTERS, WATER
Canadian Griscom-Russell Co., Ltd., Montreal.
Darling Bros., Ltd., Montreal, Que.
Frick Co., Waynesboro, Franklin Co., Pa.
Hungerford & Co., Sherbrooke, Que.
Scaife & Sons, Wm. B., Pittsburgh, Pa.
York Manufacturing Co., York, Pa.

FIRE BRICK, PLASTIC
Dom. Fire Brick & Mosaic Co., Montreal.
Gates, John W., St. James St., Montreal.

FIREPROOF COLD STORAGE DOORS AND WINDOWS
Jamison Cold Storage Door Co., Hagerstown, Md.

FITTINGS, AIR, AUTOMOBILE, GAS, HYDRAULIC, PIPE, PIPE FLANGED, SCREWED PIPE, STEAM
Jefferson Union Co., Lexington, Mass.
Dart Union Co., Ltd., Toronto, Ont.
H. Mueller Mfg. Co., Sarnia, Ont.

FLANGED STEAM FITTINGS
Direct Separator Co., Syracuse, N.Y.
McAvity, T., & Sons, Ltd., St. John, N.B.

FLANGES
Dart Union Co., Ltd., Toronto, Ont.
Jefferson Union Co., Lexington, Mass.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.

FLOORING COMPOSITION
Armstrong Cork & Insulation Co., Montreal, Que.

FLUE CLEANERS
Babcock & Wilcox, Montreal.
Liberty Mfg. Co., Pittsburg, Pa.
Pilley Packing and Flue Brush Mfg. Co., St. Louis, Mo.
William B. Pierce Co., Buffalo, N.Y.
Wm. C. Wilson & Co., Toronto.

FLUE GAS ANALYSIS INSTRUMENTS
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Uehling Instrument Co., New York.
Precision Instrument Co., Detroit, Mich.
Penberthy Injector Co., Windsor, Ont.

FLUMES, STEEL
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.

FREEZER DOORS
Jamison Cold Storage Door Co., Hagerstown, Md.

FRICTION LEATHERS
Graton & Knight Mfg. Co., Montreal.

FURNACES, BOILER
Gates, J. W., Montreal, P.Q.

FURNACES, SMOKELESS
Babcock & Wilcox, Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Detroit, Mich.

FUSES
Can. H. W. Johns-Manville Co., Toronto, Ont.
Economy Fuse & Mfg. Co. of Canada, Montreal.
Johns-Pratt Co., The, Hartford, Conn.

GAS ANALYSIS INSTRUMENTS, ETC.
Penberthy Injector Co., Windsor, Ont.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Uehling Instrument Co., New York, N.Y.

GASKETS, RUBBER, ASBESTOS
Can. H. W. Johns-Manville Co., Toronto, Ont.
Durabla Mfg. Co., New York, N.Y.
Frick Co., Waynesboro, Franklin Co., Pa.
Garlock Packing Co., Hamilton, Ont.
Johns-Pratt Co., The, Hartford, Conn.
Peerless Rubber Mfg. Co., New York, N.Y.
Thomson-Gordon, Ltd., Hamilton, Ont.

GASKETS, LEAD, COPPER AND LEATHER
Graton & Knight Mfg. Co., Montreal, Que.
Shell Bar Boico Supply Co., Toronto, Ont.
Wm. C. Wilson & Co., Toronto, Ont.

GAS COLLECTORS
Precision Instrument Co., Detroit, Mich.

GAS PRODUCER PLANTS
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Laurie & Lamb, Montreal.

GAUGE COCKS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Garlock Packing Co., Hamilton, Ont.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.
W. J. Wall, Montreal.

GAUGE GLASSES
Wm. C. Wilson & Co., Toronto.

GAUGES, AMMONIA, OIL, GAS, AIR
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

GAUGES, PRESSURE, VACUUM, DRAFT AND RECORDING, AND MICROMETER
Babcock & Wilcox, Montreal.
Foxboro Company, Foxboro, Mass.
Lunkenheimer Co., Cincinnati, O.
Precision Instrument Co., Detroit, Mich.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.

GAUGES, WATER
Babcock & Wilcox, Montreal.
Jenkins Bros., Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
Penberthy Injector Co., Windsor, Ont.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

GEARS, FIBRE CUT
Beveridge Paper Co., Ltd., Montreal, Que.

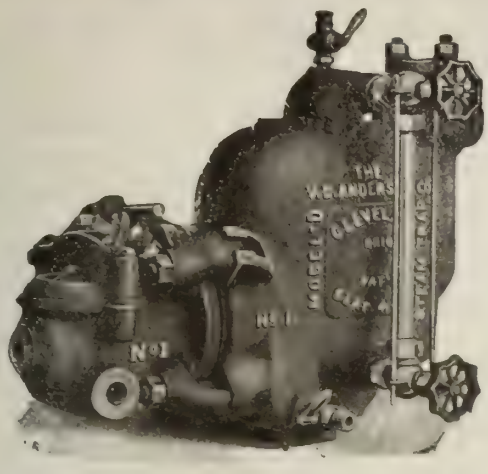
GEARS, CUT, WORM, MORTISE
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

GENERATORS, STEAM TURBO
Can. General Electric Co., Toronto, Ont.
Laurie & Lamb, Montreal.

GENERATORS AND CONVERTORS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. General Electric Co., Toronto, Ont.

GOVERNORS, ENGINE
Escher Wyss & Co., Montreal, Que.
McAvity, T., & Sons, Ltd., St. John, N.B.
Waterous Engine Works Co., Brantford.

GRAPHITE, BOILER
Jos. Dixon Crucible Co., Jersey City.
Wm. C. Wilson & Co., Toronto.



The Anderson Model "D" Steam Trap

Steady and Continuous Drainer

Disposes of Condensation as Fast as it Accumulates in Steam Coils, Jackets, Radiators, etc., Without Reducing Pressure or permitting Live Steam to Escape.

All Parts Interchangeable

All parts are machined to solid gauges, thus insuring absolute accuracy.

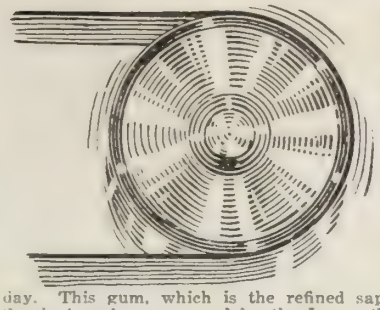
The trap is so constructed that you can change the valve and seat from high to low pressure or vice versa in five minutes without disturbing or unscrewing a single steam joint or pipe connection.

A removable strainer is part of the equipment. It prevents pieces of scale, packing, etc., from entering the trap.

Every "Anderson" Model "D" Steam Trap is fully guaranteed to give satisfactory service.

Drop us a line to-day for valuable description booklet.

The V. D. Anderson Co.
1935 West 96th St., Cleveland, Ohio



Balata gum does not deteriorate with age.

From what we know of this gum it would be safe to assume that belting impregnated with it would be in just as good shape and ready for use in 100 years from now as it is to-day. This gum, which is the refined sap of the Bocia tree in South America, was used by the Incas, the original inhabitants of Peru, to coat their shields, which were made of bull hide. The gum was used both as a preservative for the leather and also because this coating was exceedingly tough. These shields were found hundreds of years after and were in a perfect state of preservation. The gum coating was just as pliable and tough as if recently made. This is the gum that is used in

LANCO BALATA BELTING

and is not used merely as a cement to hold the plies together, but the whole fabric passes through a solution of this gum. The solvent on evaporating leaves a solid mass of balata, not only between the plies, but in the duck itself. This gum is responsible for the properties which make the belt really waterproof and long-lived. It is an expensive belt, but will give the service. Order your supply in rolls, as it will not deteriorate in your warehouse. Special prices for full roll lots.

Federal Engineering Co., Limited
172 John Street, Toronto, Ontario

Morehead

Back to Boiler

SYSTEM

Drains Your Steam Lines Back to Boiler Automatically Without Pumps

After steam's expansive energy is exhausted, there are heat units left. These the Morehead System returns to your boiler as pure HOT feed water. It lowers your fuel cost by 10 per cent.

It would pay you to talk with the owner of a plant in which the Morehead System is installed. **Write.**

Canadian Morehead Mfg. Company
Dept. A
WOODSTOCK, ONTARIO

GRATES, DUMPING, ROCKING, STATIONARY
Babcock & Wilcox, Montreal.
Boiler Repair & Grate Bar Co., Toronto, Ont.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
[illegible]
Mason Regulator & Engineering Co., Montreal.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Waterous Engine Works Co., Brantford.

GREASE CUPS
Albany Lubricating Co., New York City.
Detroit Lubricator Co., Walkerville.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
[illegible]

GREASE AND OIL EXTRACTORS
[illegible] & Valve Mfg. Co., Boston, Mass.
Canadian Griscom-Russell Co., Ltd., Montreal.
Elliott Co., Pittsburgh, Pa.
[illegible]

GREASES
Albany Lubricating Co., New York City.
Can. Economic Lubricant Co., Montreal, Que.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Jos. Dixon Crucible Co., Jersey City.
Wm. C. Wilson & Co., Toronto.

HAND LEATHERS OR PADS
Graton & Knight Mfg. Co., Montreal.

HANGERS
Can. General Electric Co., Toronto, Ont.
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Can. S K F Co., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Goldie & McCulloch Co., Galt.
Waterous Engine Works Co., Brantford.

HEATERS
Alberger Heater Co., Buffalo, N.Y.
Babcock & Wilcox, Ltd., Montreal.
Can. Sirocco Co., Windsor, Ont.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
Laurie & Lamb, Montreal.
McAvity & Sons, T., St. John, N.B.
Scaife & Sons, Wm. B., Pittsburgh, Pa
Sturtevant Co. of Canada, B. F., Galt, Ont.
Waterous Engine Works Co., Brantford.

HEATERS, EXHAUST STEAM
Can. Allis-Chalmers, Ltd., Toronto, Ont.

HEATERS, METERING
Can. Allis-Chalmers, Ltd., Toronto, Ont.

HEATING SYSTEMS, FANS
Can. Sirocco Co., Windsor, Ont.

HOISTS, GRIP
Jordan Bros., Inc., New York, N.Y

HOISTING AND CONVEYING MACHINERY
Babcock & Wilcox, Ltd., Montreal.
Waterous Engine Works Co., Brantford.

HOSE, METALLIC
Pennsylvania Flexible Metallic Tubing Co., Boston, Mass.

HOSE, STEAM, SUCTION AND WATER
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Asbestos Co., Montreal.
Garlock Packing Co., Hamilton, Ont.
[illegible] Rubber Co., Toronto.
Peerless Rubber Mfg. Co., New York, N.Y.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

HYDRAULIC ACCUMULATORS
Smart-Turner Machine Co., Ltd., Hamilton.

HYDRAULIC MACHINERY
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
John McDougall Caledonian Iron Wks., Montreal.

HYDRAULIC PRESSES
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

ICE MAKING MACHINERY
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Griscom-Russell Co., Ltd., Montreal.
Frick Co., Waynesboro, Franklin Co.
Linde Canadian Refrigeration Co., Montreal.
York Mfg. Co., York, Pa.

INDICATORS, ELECTRIC—ALL TYPES
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Tobling Instrument Co., New York, N.Y.

INDICATORS, STEAM AND GAS ENGINE
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Canadian Fairbanks-Morse Co., Montreal.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Tobling Instrument Co., New York, N.Y.

INDICATORS, AMMONIA, HYDRAULIC
Can. Detroit Lubricator Co., Walkerville, Ont.

INDICATORS, SPEED
[illegible]

INJECTORS
Babcock & Wilcox, Ltd., Montreal.
[illegible] Toronto, Ont.
[illegible] Cincinnati, O.
[illegible] St. John, N.B.
[illegible] Mfg. Co., Toronto.
[illegible] Windsor, Ont.

INSULATING BRICK
[illegible] Co., Montreal, Que.
[illegible] Ltd., Montreal, Que.
[illegible] Co., Toronto, Ont.

INSULATING COMPOUNDS
[illegible]

INSULATORS
Ed. Bennis & Co., Little Fulton, Bolton, Eng.
Beveridge Paper Co., Ltd., Montreal, Que.
Johns-Pratt Co., The, Hartford, Conn.

IRON FILLER
Can. H. W. Johns-Manville Co., Toronto, Ont.

LACE LEATHERS
[illegible] Mfg. Co., Montreal
Wm. C. Wilson & Co., Toronto.

LAMPS, ARC
Canadian Fairbanks-Morse Co., Montreal.
Can. General Electric Co., Toronto, Ont.
Can. H. W. Johns-Manville Co., Toronto, Ont.

LAMPS, ELECTRIC
Wm. C. Wilson & Co., Toronto.

LAMPS, INCANDESCENT
Canadian Fairbanks-Morse Co., Montreal.
Can. General Electric Co., Toronto, Ont.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Can. Laco-Philips Co., Ltd., Toronto, Ont.

LAMPS, NITRO
Can. Laco-Philips Co., Ltd., Toronto, Ont.

LAMPS, TUNGSTEN AND NITRO
Can. General Electric Co., Toronto, Ont.
Can. Laco-Philips Co., Ltd., Toronto, Ont.

LEATHER STRAPPING
Graton & Knight Mfg. Co., Montreal.

LUBRICANTS
Albany Lubricating Co., New York City.
Canadian Economic Lubricant Co., Montreal.
Jos. Dixon Crucible Co., Jersey City.

LUBRICATORS, CYLINDER
Albany Lubricating Co., New York City.
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

LUBRICATORS, FORCE FEED
Can. Detroit Lubricator Co., Walkerville, Ont.
Darling Bros., Montreal.
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

LUBRICATORS, PLAIN
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

MACHINERY INSULATION
Armstrong Cork & Insulation Co., Montreal, Que.
Beveridge Paper Co., Ltd., Montreal, Que.

MANGENESITE PASTE
Wm. C. Wilson & Co., Toronto.

MECHANICAL STOKERS
Babcock & Wilcox, Ltd., Montreal.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Dertoit, Mich.

METERS, ELECTRIC
Can. H. W. Johns-Manville Co., Toronto, Ont.

METERS, STEAM
Can. Allis-Chalmers, Ltd., Toronto, Ont.

METERS, WATER
Allen General Supplies, Toronto, Ont.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Foxboro Company, Foxboro, Mass.
McAvity & Sons, T., St. John, N.B.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Precision Instrument Co., Detroit, Mich.

MIXING VALVES
Mueller Mfg. Co., H., Sarnia, Ont.

MILL AND MINING MACHINERY
Canadian Fairbanks-Morse Co., Montreal.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Goldie & McCulloch Co., Galt.
Waterous Engine Works Co., Brantford

METER TESTERS
Mueller Mfg. Co., H., Sarnia, Ont.

MOTORS
Canadian Fairbanks-Morse Co., Montreal.
Can. General Electric Co., Toronto, Ont.

OAKUM
Wm. C. Wilson & Co., Toronto.

OFFICE RAILINGS
Jas. Morrison Brass Mfg. Co., Toronto.

OIL CUPS
Albany Lubricating Co., New York City.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

OILER, COMPOUND FEEDERS
Lunkenheimer Co., Cincinnati, O.

OILERS, GAUGE
Lunkenheimer Co., Cincinnati, O.

OILERS, MULTIPLE
Can. Detroit Lubricator Co., Walkerville, Ont.
Lunkenheimer Co., Cincinnati, O.

OIL FILTERS AND CIRCULATING SYSTEMS
Bowser & Co., Inc., S. F., Toronto, Ont.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
Jas. Morrison Brass Mfg. Co., Toronto.

OIL SEPARATORS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
Direct Separator Co., Syracuse, N.Y.
Elliott Co., Pittsburgh, Pa.
Leitch Co., Arthur S., Toronto, Ont.
Liberty Mfg. Co., Pittsburgh.
Jas. Morrison Brass Mfg. Co., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.

OILING SYSTEMS
[illegible] Lubricating Co., New York City.
Bowser & Co., Inc., S. F., Toronto, Ont.
Lunkenheimer Co., Cincinnati, O.

OILS, LUBRICATING
[illegible] Lubricating Co., New York City.
Can. Economic Lubricant Co., Montreal, Que.
Kellogg & Co., E. H., New York, N.Y.
Wm. C. Wilson & Co., Toronto.

PACKING, ASBESTOS
Johns-Pratt Co., The, Hartford, Conn.

PACKING ENGINE
Can. Asbestos Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Can. B. K. Morton Co., Toronto, Montreal.
Canuck Supply Co., Ltd., Montreal, Que.
Crane Packing Co., Chicago, Ill.
Garlock Packing Co., Hamilton, Ont.
Johns-Pratt Co., The, Hartford, Conn.
Peerless Rubber Mfg. Co., New York, N.Y.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING FIBRE
Beveridge Paper Co., Ltd., Montreal, Que.
Can. B. K. Morton Co., Montreal, Que.
Johns-Pratt Co., The, Hartford, Conn.
Wm. C. Wilson & Co., Toronto.

PACKING, HYDRAULIC
Can. Asbestos Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Can. B. K. Morton Co., Toronto, Montreal.
Crane Packing Co., Chicago, Ill.
Durabla Manufacturing Co., New York.
Garlock Packing Co., Hamilton, Ont.
Goodyear Tire & Rubber Co., Toronto.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, METALLIC
Can. B. K. Morton Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Crane Packing Co., Chicago, Ill.
Greene, Tweed & Co., New York.
Holmes Metallic Packing Co., Wilkesbarre, Pa.
Steel Mill Packing Co., Windsor, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, ROD
Can. Asbestos Co., Montreal, Que.
Can. B. K. Morton Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Crane Packing Co., Chicago, Ill.
Garlock Packing Co., Hamilton, Ont.
Canuck Supply Co., Ltd., Montreal, Que.
Steel Mill Packing Co., Windsor, Ont.
Peerless Rubber Mfg. Co., New York, N.Y.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, SHEET
Can. Asbestos Co., Montreal, Que.
Can. B. K. Morton Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Canuck Supply Co., Ltd., Montreal, Que.
Durabla Manufacturing Co., New York.
Garlock Packing Co., Hamilton, Ont.
Jenkins Bros., Ltd., Montreal.
Johns-Pratt Co., The, Hartford, Conn.
Peerless Rubber Mfg. Co., New York, N.Y.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, AMMONIA, STEAM AND WATER
Can. Asbestos Co., Montreal, Que.
Can. B. K. Morton Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Canuck Supply Co., Ltd., Montreal, Que.
Crane Packing Co., Chicago, Ill.
Garlock Packing Co., Hamilton, Ont.
Greene, Tweed & Co., New York.
Goodyear Tire & Rubber Co., Toronto.
Johns-Pratt Co., The, Hartford, Conn.
Steel Mill Packing Co., Windsor, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, LEATHER
Can. B. K. Morton Co., Toronto, Montreal.
Canuck Supply Co., Ltd., Montreal, Que.
Garlock Packing Co., Hamilton, Ont.
Graton & Knight Mfg. Co., Montreal.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING PISTON
Crane Packing Co., Chicago, Ill.

PACKING, VALVE STEM
Crane Packing Co., Chicago, Ill.
Johns-Pratt Co., The, Hartford, Conn.

PAINTS
Wm. C. Wilson & Co., Toronto.

PAINT, DAMP RESISTING
Toch Bros., Toronto, Ont.

PENSTOCKS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.

PILLOW BLOCKS
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Waterous Engine Works Co., Brantford.

PIPE COILS
York Mfg. Co., York, Pa.

PIPE COVERINGS, STEAM, BRINE, AMMONIA AND ICE WATER
Armstrong Cork & Insulation Co., Montreal, Que.

PIPE STEEL
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

PIPE VISES AND CUTTERS
Armstrong Mfg. Co., Bridgeport, Conn.

PIPE, GAS
Can. Allis-Chalmers, Ltd., Toronto, Ont.

PIPES, WATER
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

PIPING AND FITTINGS
Frick Co., Waynesboro, Franklin Co., Pa.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
York Mfg. Co., York, Pa.

PIPING, STEAM
Babcock & Wilcox, Ltd., Montreal.

PLATE WORK
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd. St. Catharines, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

PLUG COCKS
Homestead Valve Mfg. Co., Pittsburgh, Pa.

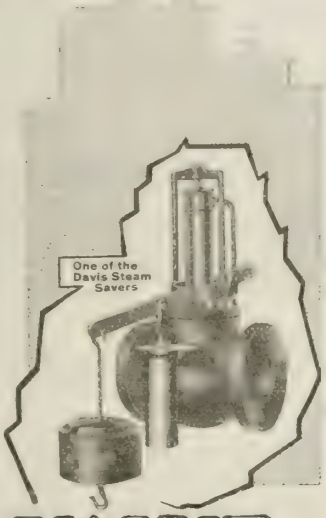
PLUMBING SUPPLIES
Mueller Mfg. Co., H., Sarnia, Ont.
Wm. C. Wilson & Co., Toronto.

DAVIS
PRESSURE REGULATORS
CAN SAVE STEAM IN EVERY PLANT—IN YOUR PLANT

In big power plants and in little plants, correct steam pressure for the various uses is essential to economical operation. The Davis Pressure Regulator saves steam by reducing the generated high pressure to the lower pressures as needed.

The desired pressure is obtained by adjusting the number of weights on the lever arm. The pressure is *weighed*, because the Davis Pressure Regulator is built like a pair of balance scales—just as simple and just as accurate. As simple and unfailing as the law of gravity, because it is controlled by gravity. There are no springs; no diaphgram to give trouble.

The new valve booklet contains some mighty useful information about valves and piping and will be sent free on request to the G. M. Davis Regulator Co., 434 Milwaukee Avenue, Chicago



DAVIS VALVE SPECIALTIES
STEAM SAVERS SINCE 1875
D

UEHLING WASTE METER
COMBINED
CO_2 AND TEMPERATURE RECORDER

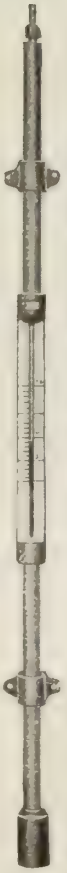
Record of CO_2 and stack temperature on one chart.

Does your fireman know how much fuel he is wasting? Do you know?

The **Uehling CO_2 Recorder** makes a complete 24 hr. record of your combustion efficiency and the **CO_2 indicator at the Boiler Front** holds the fireman responsible.

Get more **Steam** per pound of **Coal** and reduce your annual fuel consumption.

Let us know the number and size of your boilers and coal consumed per year, upon receipt of which information we will be glad to send you full particulars.



CO_2 Indicator for Boiler Front

Let us hear from you. We are pioneers in the manufacture of Indicators and Recorders for Power Plant purposes.

Send for our Bulletin No. 110.

Uehling Instrument Company
2008 Empire Building New York City

ESTABLISHED

Look for the registered TRADE-MARKS

"WORLD" OR "McAVITY"

As a GUARANTEE of QUALITY

T. McAvity & Sons
Limited

Wholesale and Retail Hardware
Brass and Iron Founders

ST. JOHN, N.B.
CANADA

Branches at

MONTREAL, TORONTO, WINNIPEG, VANCOUVER
LONDON (England) DURBAN (South Africa)

If any advertisement interests you, tear it out now and place with letters to be answered.

POWER PUMPS
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Goldie & McCulloch Co., Galt.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
Waterous Engine Works Co., Brantford.
Garlock Packing Co., Hamilton, Ont.
Laurie & Lamb, Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.

POWER, TRANSMISSION MACHINERY
American Pulley Co., Philadelphia, Pa.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Goldie & McCulloch Co., Galt.
Jeffrey Manufacturing Co., Montreal.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
MacCaffrey & Co., New York.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Morse Chain Co., Ithaca, N.Y.
Waterous Engine Works Co., Brantford.

PRESSES
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

PRESSURE BLOWERS, CENTRIFUGAL
Can. Sirocco Co., Windsor, Ont.

PULLEYS
American Pulley Co., Philadelphia, Pa.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Wm. Hamilton Co., Ltd., Peterboro.
Jeffrey Manufacturing Co., Montreal.
Waterous Engine Works Co., Brantford.

PULP MILL MACHINERY
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Jeffrey Manufacturing Co., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

PUMPING MACHINERY
American Steam Pump Co., Battle Creek, Mich.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Bawden Machine Co., Toronto.
Laurie & Lamb, Montreal.
McAvity & Sons, T., St. John, N.B.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.
Waterous Engine Works Co., Brantford.

PUMPING MACHINERY, ELECTRICAL
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Jeffrey Manufacturing Co., Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.

PUMPS, AIR
American Steam Pump Co., Battle Creek, Mich
Bawden Machine Co., Ltd., Toronto.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Montreal.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co. Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, CONTRACTORS'
Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
McAvity & Sons, T., St. John, N.B.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, ELECTRICAL
American Steam Pump Co., Battle Creek, Mich

PUMPS, FEED WATER
Can. Allis-Chalmers, Ltd., Toronto, Ont.

PUMP GOVERNORS AND REGULATORS
Bawden Machine Co., Ltd., Toronto.
Darling Bros., Montreal.
G. M. Davis Regulator Co., Chicago.
D'Este Co., Julian, Boston, Mass.
Elliott Co., Pittsburgh, Pa.
Mason Regulator Co., Boston, Mass.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.
Watson & McDaniel Co., Philadelphia.

PUMP STRAINERS
Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Darling Bros., Ltd., Montreal.
Liberty Mfg. Co., Pittsburgh, Pa.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, HAND AND POWER
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Darling Bros., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, CENTRIFUGAL
American Steam Pump Co., Battle Creek, Mich.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Darling Bros., Montreal.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Pulsometer Engineering Co., Ltd., London, Eng.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Waterous Engine Works Co., Brantford.

PUMPS, DUPLEX
Can. Allis-Chalmers, Ltd., Toronto, Ont

PUMPS, GEARED, COMPOUND
Bawden Machine Co., Ltd., Toronto.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Montreal.

The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, HYDRAULIC, PRESSURE
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Darling Bros., Montreal.
Inglis Co., The John, Toronto, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.

PUMP LEATHERS
Beveridge Paper Co., Ltd., Montreal, Que.
Can. B. K. Morton Co., Toronto, Montreal.
Graton & Knight Mfg. Co., Montreal.

PUMPS, OIL
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Ltd., Toronto.
Bowser & Co., Inc., S. F., Toronto, Ont.
Can. Detroit Lubricator Co., Walkerville, Ont.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, STEAM TURBO
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Darling Bros., Montreal.
Escher Wyss & Co., Montreal, Que.
Pulsometer Engineering Co., Ltd., London, Eng.

PUMP TANK, RECEIVER
American Steam Pump Co., Battle Creek, Mich.
Smart-Turner Machine Co., Hamilton, Ont.

PUMPS, STEAM
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Ltd., Toronto.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
Inglis Co., The John, Toronto, Ont.
Laurie & Lamb, Montreal.
Leitch Co., Arthur S., Toronto, Ont.
McAvity & Sons, T., St. John, N.B.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, TRIPLEX
Smart-Turner Machine Co., Hamilton, Ont.

PUMPS, VACUUM
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Ltd., Toronto.
Laurie & Lamb, Montreal.
Leitch Co., Arthur S., Toronto, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PYROMETERS
Foxboro Co., The, Foxboro, Mass.
Jas. Morrison Brass Mfg. Co., Toronto.
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.

RADIATOR TRAPS
Sarco Co., Inc., New York, N.Y.

RADIATOR AIR VENTS
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

RAGS
Wm. C. Wilson & Co., Toronto.

REBOILERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

RECEIVERS, AIR
Can. Allis-Chalmers, Ltd., Toronto, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.

RECORDING INSTRUMENTS
Can. H. W. Johns-Manville Co., Toronto, Ont.
Foxboro Co., The, Foxboro, Mass.
Precision Instrument Co., Detroit, Mich.
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.

REFRIGERATOR DOORS, WINDOWS, ETC.
Jamison Cold Storage Door Co., Hagerstown, Md.

REFRIGERATING MACHINERY
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Griscom-Russell Co., Ltd., Montreal.
Frick Co., Waynesboro, Franklin Co., Pa.
Linde Canadian Refrigeration Co., Montreal.
Vilter Mfg. Co., Milwaukee, Wis.
York Mfg. Co., York, Pa.

REFUSE DESTRUCTOR
Canadian Griscom-Russell Co., Ltd., Montreal.
Laurie & Lamb, Montreal.

REGULATORS, PRESSURE
Chaplin-Fulton Mfg. Co., Pittsburgh, Pa.
D'Este Co., Julian, Boston, Mass.
Jas. Morrison Brass Mfg. Co., Toronto.
Taylor Instrument Co., Rochester, N.Y.

REGULATORS, TEMPERATURE
Sarco Co., Inc., New York, N.Y.
Taylor Instrument Co., Rochester, N.Y.

RETORTS
MacKinnon, Holmes & Co., Sherbrooke, Que.

REVOVLING DOORS FOR HARDENING ROOMS
Jamison Cold Storage Door Co., Hagerstown, Md.

ROOFING
Wm. C. Wilson & Co., Toronto.

ROPE
Wm. C. Wilson & Co., Toronto.

ROPE PRESERVATIVE
Oliver Surface Co., Buffalo.

ROTARY CONVERTERS
Canadian Fairbanks-Morse Co., Montreal.

RUBBER HOSE
Can. H. W. Johns-Manville Co., Toronto, Ont.
Garlock Packing Co., Hamilton, Ont.
Liberty Mfg. Co., Pittsburg, Pa.
Thomson-Gordon, Ltd., Hamilton, Ont.

RUBBER MOLDS
Bawden Machine Co., Ltd., Toronto.

SAFES
Canadian Fairbanks-Morse Co., Montreal.
Goldie & McCulloch Co., Galt.

SCALE REMOVERS
Babcock & Wilcox, Ltd., Montreal.
Beveridge Paper Co., Ltd., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
William B. Pierce Co., Buffalo, N.Y.

SEAM PROTECTORS, GIRTH
National Boiler Protector Co. of Canada, Montreal, Que.

SHAFTING
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Waterous Engine Works Co., Brantford.

SHAKING AND DUMPING GRATES
Babcock & Wilcox, Ltd., Montreal.
Galt Foundry Co., Galt, Ont.
Waterous Engine Works Co., Brantford.

SMOKE BOXES, STACKS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

SMOOTH-ON
Wm. C. Wilson & Co., Toronto.

SPECIAL MACHINERY
Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Waterous Engine Works Co., Brantford.

SPEED INDICATORS
Foxboro Co., The, Foxboro, Mass.
Schaeffer & Budenburg Mfg. Co., Brooklyn, N.Y.
L. S. Starrett Co., Athol, Mass.

SPLICE PROTECTORS
Jordan Bros., Inc., New York, N.Y.

SPROCKET CHAIN ATTACHMENTS
Waterous Engine Works Co., Brantford.

SPROCKET RIMS
Babbitt Steam Specialty Co., New Bedford, Mass.

SPUR WHEELS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Waterous Engine Works Co., Brantford.

STACKS, STEEL
Babcock & Wilcox, Ltd., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.

STAND PIPES, STEEL
MacKinnon, Holmes & Co., Sherbrooke, Que.

STAYBOLTS, FLEXIBLE
Can. Allis-Chalmers, Ltd., Toronto, Ont.

STEAM SEPARATORS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Darling Bros., Montreal.
Direct Separator Co., Syracuse, N.Y.
D'Este Co., Julian, Boston, Mass.
Elliott Co., Pittsburgh, Pa.
Leitch Co., Arthur S., Toronto, Ont.
Penberthy Injector Co., Windsor, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Watson & McDaniel Co., Philadelphia.

STEAM SPECIALTIES
Alberger Heater Co., Buffalo, N.Y.
Canadian Fairbanks-Morse Co., Montreal.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
D'Este Co., Julian, Boston, Mass.
Liberty Mfg. Co., Pittsburg, Pa.
Lunkenheimer Co., Cincinnati, O.
Mason Regulator & Engineering Co., Montreal.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor.
Watson & McDaniel Co., Philadelphia.

STEAM TRAPS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Anderson Co., Y. D., Cleveland, O.
Canadian Fairbanks-Morse Co., Montreal.
Can. Sirocco Co., Windsor, Ont.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
Davis Regulator Co., G. M., Chicago.
D'Este Co., Julian, Boston, Mass.
Elliott Co., Pittsburgh, Pa.
J. T. Long, 84 Adam St., Montreal, Que.
Can. Morehead Mfg. Co., Woodstock.
Mason Regulator & Engineering Co., Montreal.
Nashua Mach. Co., Boston, Mass.
Sarco Co., Inc., New York, N.Y.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Watson & McDaniel Co., Philadelphia.

STEEL BARRELS
Smart-Turner Machine Co., Hamilton, Ont.

STEEL DRUMS
Smart-Turner Machine Co., Hamilton, Ont.

STEEL TANKS
Babcock & Wilcox, Ltd., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.

STOKERS
Babcock & Wilcox, Ltd., Montreal.
Ed. Bennis & Co., Little Fulton, Bolton, Eng.
Detroit Stoker Co., Detroit, Mich.
Galt Foundry Co., Galt, Ont.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Dertoit, Mich.

STRAINERS
Babcock & Wilcox, Ltd., Montreal.
Bawden Machine Co., Ltd., Toronto.
Elliott Co., Pittsburgh, Pa.
Self-Cleansing Strainer Co., Chicago.

STRUCTURAL STEEL WORK
Babcock & Wilcox, Ltd., Montreal.
MacKinnon, Holmes & Co., Ltd., Sherbrooke, Que.

SUPERHEATERS, STEAM
Babcock & Wilcox, Ltd., Montreal.

The Real Efficient Lamp for Power Plants

WHEN England first made munitions in present-day quantities, holidays were forbidden—"to increase production." Presently holidays were *enforced*—for the same reason! Why the reversal? Because it was found that no man can work to utmost capacity *under constant strain.*

If your plant is inefficiently lighted *your* workers are under a *strain* that affects their capacity to a very appreciable extent — they are laboring under a handicap that in your own interest you should remove.

TWENTY-FOUR hours of sunlight—or its *closest* equivalent are possible to the plant equipped with Laco Nitro Lamps.

They represent the latest development of the tungsten bulb — a tungsten filament burning in nitrogen gas. They consume less current — possess a longer utility—yet give a greater candle-power per watt than any other type of lamp. Decide to-day with your nearest dealer that Laco Nitro Lamps shall cut your cost and increase your plant's efficiency!

LACO NITRO LAMPS

Sold by the leading Electrical and Hardware Dealers, or the

CANADIAN LACO-PHILIPS COMPANY, LIMITED

Montreal, Toronto, Winnipeg and Vancouver

If any advertisement interests you, tear it out now and place with letters to be answered.

SWITCHBOARDS
Can. General Electric Co., Toronto, Ont.
SWITCHES AND SWITCH BOXES
Can. H. W. Johns-Manville Co., Toronto, Ont.
TACHOMETERS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Can. H. W. Johns-Manville Co., Toronto, Ont.
Foxboro Co., The, Foxboro, Mass.
[illegible]
TANKS, BLOW-OFF
[illegible]
TANKS, FREEZING, STORAGE AND WATER COOLING
Frick Co., Waynesboro, Franklin Co., Pa.
TANKS, OIL
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Bowser & Co., Inc., S. F., Toronto, Ont.
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd., [illegible]
MacKinnon, Holmes & Co., Sherbrooke, Que.
[illegible] Co., Brantford.
TANKS, WATER
Inglis Co., The John, Toronto, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Q
Waterous Engine Works Co., Brantford.
TAPPING MACHINES
Mueller Mfg. Co., H., Sarnia, Ont.
TECHNICAL BOOKS
MacLean Publishing Co., Toronto.
THERMOMETERS
Foxboro Co., The, Foxboro, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Taylor Instrument Co., Rochester, N.Y.
[illegible] New York, N.Y.
THERMOSTATS
Sarco Co., Inc., New York, N.Y.
TOOLS
Mueller Mfg. Co., H., Sarnia, Ont.
TRANSFORMERS
Can. General Electric Co., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.
TRANSMISSION MACHINERY
American Pulley Co., Philadelphia, Pa.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Can. Bond Hanger & Coupling Co., Alexandria, [illegible]
Canadian Fairbanks-Morse Co., Montreal.
Goldie & McCulloch Co., Galt, Ont.
Jeffrey Manufacturing Co., Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Waterous Engine Works Co., Brantford.
TRAPS, STEAM AND WATER-LINE
D'Este Co., Julian, Boston, Mass.
TRUCKS, FACTORY
Beveridge Paper Co., Ltd., Montreal, Que.
Canadian Fairbanks-Morse Co., Montreal.
TUBE CLEANERS
Babcock & Wilcox, Ltd., Montreal.
Elliott Co., Pittsburgh, Pa.
Liberty Mfg. Co., Pittsburg, Pa.
[illegible] and Flue Expander Mfg. Co., St. [illegible]
TUBE CUTTERS
Babcock & Wilcox, Ltd., Montreal.
Liberty Mfg. Co., Pittsburg, Pa.
TUBES, BOILER
Babcock & Wilcox, Ltd., Montreal.
TUBE EXPANDERS
Babcock & Wilcox, Ltd., Montreal.
Liberty Mfg. Co., Pittsburg, Pa.
TUBING, FELXIBLE METALLIC
Pennsylvania Flexible Metallic Tubing Co., Cleveland, O.
TUNGSTEN LAMPS
Bawden Machine Co., Toronto.
TURBINE OIL
Kellogg & Co., E. H., New York, N.Y.
TUNGSTEN LAMP (Vacuum and Gas Filled Types)
Can. Laco-Phillips Co. of Toronto, Ont.
TURBINE WATER WHEELS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Boving Co., Hamilton.
[illegible] and Machine Works of Canada, Ltd., St. Catharines, Ont.
TURBINES, STEAM
Belliss & Morcom, Birmingham, Eng.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Coe Co., C. T., 10 Johnson St., Newark, N.J.
Coppus Engr. & Equip. Co., Worcester, Mass.
Escher Wyss & Co., Montreal, Que.
Kerr Turbine Co., Wellsville, N.Y.
Laurie & Lamb, Montreal.
John McDougall Caledonian Iron Works, Montreal.
Sturtevant Co. of Canada, B. F., Galt, Ont.
UNIONS
Canadian Fairbanks-Morse Co., Montreal.
Dart Union Company, Toronto.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
UNIONS, BALL JOINT, COMBINATION, FLANGED PIPE, GROUND JOINT, MALLEABLE IRON, FLANGE, PIPE, SWING
Jefferson Union Co., Lexington, Mass.
Dart Union Company, Ltd., Toronto, Ont.
VACUUM GOVERNORS
Smart-Turner Machine Co., Ltd., Hamilton.
Canadian Steam Boiler Equipment Co., Toronto.
G. M. Davis Regulator Co., Chicago.
Leitch Co., Arthur S., Toronto, Ont.
VACUUM REGULATING VALVES
Darling Bros., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
VACUUM TRAPS
Can. Morehead Mfg. Co., Woodstock, Ont.
Can. Sirocco Co., Windsor, Ont.
Cole, Ltd., Geo. W., Toronto.
Nashua Mach. Co., Boston, Mass.
VALVE DISCS
Wm. C. Wilson & Co., Toronto.
VALVE LEATHER
Beveridge Paper Co., Ltd., Montreal, Que.
Can. B. K. Morton Co., Toronto, Montreal.
Graton & Knight Mfg. Co., Montreal.
VALVE RESEATING MACHINES
Darling Bros., Montreal.
VALVES
Babcock & Wilcox, Ltd., Montreal.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Frick Co., Waynesboro, Franklin Co., Pa.
G. M. Davis Regulator Co., Chicago.
D'Este Co., Julian, Boston, Mass.
Homestead Valve Mfg. Co., Pittsburg.
Jenkins Bros., Montreal.
Kerr Engine Co., Walkerville, Ont.
Liberty Mfg. Co., Pittsburg, Pa.
Lunkenheimer Co., Cincinnati, O.
Mason Regulator & Engineering Co., Montreal.
Mason Regulator Co., Boston, Mass.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor.
Pratt & Cady, Hartford, Conn.
Watson & McDaniel Co., Philadelphia.
Wm. C. Wilson & Co., Toronto.
York Manufacturing Co., Philadelphia.
VALVES, ACID RESISTING
Homestead Valve Mfg. Co., Pittsburg.
McAvity & Sons, T., St. John, N.B.
VALVES, BACK PRESSURE
Can. Allis-Chalmers, Ltd., Toronto, Ont.
VALVES, BLOW-OFF
Babcock & Wilcox, Ltd., Montreal.
Canadian Fairbanks-Morse Co., Montreal.
Elliott Co., Pittsburg, Pa.
Homestead Valve Mfg. Co., Pittsburg.
Jenkins Bros., Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Watson & McDaniel Co., Philadelphia.
VALVE CHAIN WHEEL
Babbitt Steam Specialty Co., New Bedford, Mass.
VALVES, FOOT
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Smart-Turner Machine Co., Ltd., Hamilton.
VALVES, GATE
Babcock & Wilcox, Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.
VALVES, MULTIPORT
Can. Allis-Chalmers, Ltd., Toronto, Ont.
VALVES, NON-RETURN STOP
Canadian Fairbanks-Morse Co., Montreal.
VALVES, REDUCING
D'Este Co., Julian, Boston, Mass.
Leitch Co., Arthur S., Toronto, Ont.
Liberty Mfg. Co., Pittsburg, Pa.
Mason Regulator Co., Boston, Mass.
Jas. Morrison Brass Mfg. Co., Toronto.
Mueller Mfg. Co., H., Sarnia, Ont.
Watson & McDaniel Co., Philadelphia.
VALVES, RELIEF
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
McAvity & Sons, T., St. John, N.B.
VALVES, RADIATOR
Jenkins Bros., Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
VALVES, POP
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
VALVES, PUMP
Beveridge Paper Co., Ltd., Montreal, Que.
Canadian Fairbanks-Morse Co., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
VALVES, SAFETY THROTTLE
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Detroit Lubricator Co., Walkerville, Ont.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
VALVES, VACUUM
Sarco Co., Inc., New York, N.Y.
VAULTS AND VAULT DOORS
Canadian Fairbanks-Morse Co., Montreal.
Goldie & McCulloch Co., Galt.
VENTILATING APPARATUS
Sturtevant Co. of Canada, B. F., Galt, Ont.
VOLTMETERS
Can. H. W. Johns-Manville Co., Toronto, Ont.
WASHERS, FIBRE
Beveridge Paper Co., Ltd., Montreal, Que.
WASHERS, LEATHER
Graton & Knight Mfg. Co., Montreal.
WASTE
Wm. C. Wilson & Co., Toronto.

WATER SOFTENING OR FILTRATION
FOR BOILER FEED AND ALL INDUSTRIAL USES
WM B SCAIFE & SONS CO. PITTSBURGH, PA.

YOU CAN DEPEND ON
TRADE MARK
VULCABESTON
REG. U. S. PATENT OFFICE
RED FIBRE SHEET PACKING
FOR EVERY NEED
Montreal, Que., Can., Ross & Greig
Toronto, Ontario, Canada
James Morrison Brass Mfg. Co., Ltd.
THE JOHNS-PRATT CO.
HARTFORD, CONN., U.S.A.
Vancouver, B.C. . Fleck Bros, Ltd.
Winnipeg, Man., Can. . Crane Co.

Don't buy that New Electrical Apparatus Just Yet

WE can supply you with high-grade apparatus that has been slightly used and discarded through no fault of its own, at an **immense saving in cost.** For instance, in many cases we take over entire plants simply because of changed conditions such as increased capacity, change of system, etc.

EVERYTHING IS OVERHAULED AND REFINISHED BY US AND **GUARANTEED** AS GOOD AS NEW, BOTH ELECTRICALLY AND MECHANICALLY.

Our catalogs of offerings should be in the hands of every power plant superintendent each time they are gotten out, and it will be worth while for anyone interested in this class of power plant equipment to be on our mailing list to receive all offerings.

Nearly all of the principal power, lighting and street railway plants in the United States are our customers.

WRITE FOR OUR LATEST CATALOG of Power House Equipment, Street Cars, Motors, Hoists, Compressors, etc.

MACGOVERN & COMPANY, Inc.

114 Liberty St., New York City

Have you a Particularly Troublesome Steam Line?

Then give these Homestead quarter-turn Valves an opportunity to show you how quickly they can relieve you of a troublesome situation!

They have relieved others and will serve you likewise.

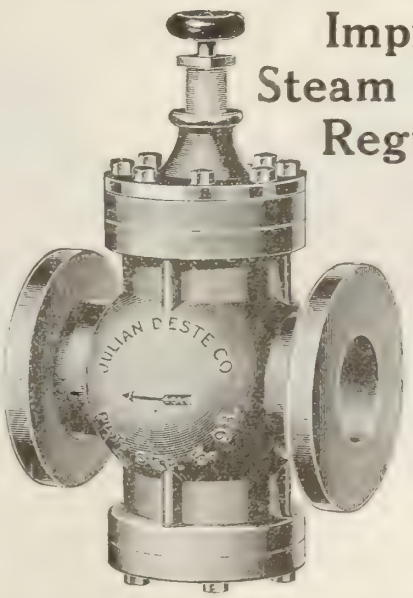
Homestead Quarter Turn Valves

are giving the best of service where other valves have failed entirely.
They greatly outlast ordinary valves, and if there is any difference in the price of a Homestead compared with ordinary valves, the Homestead will make up the difference in longer service.
Glad to demonstrate the superiority of the **Homestead Quarter Turn** by sending one for trial. Write now.

Homestead Valve Mfg. Co.
HOMESTEAD, PA.

CURTIS Engineering Specialties

Improved Steam Pressure Regulator



For Universal Application to all the varied and various conditions under which a reduced pressure of steam, water or other fluid is required, this Regulator (see illustration) has no equal. It is compact and self-contained, without levers, weights or projections.
No glands or packing; no drip or leak of steam or water. Suitable for any boiler pressure; made entirely of metal: is a lock valve, very simple and sensitive.

The universality of use of this Regulator is one of its best features, but it is in **Steam Heating** that its use is most common and obvious. Send for leaflet fully descriptive of this Regulator (contains price list) to the manufacturers.

MANUFACTURED BY THE

JULIAN D'ESTE COMPANY

Main Office, 26 Canal St., Boston, Mass.

Agencies: 216 FULTON ST., NEW YORK CITY; 174 N. MARKET. ST., CHICAGO, ILL.

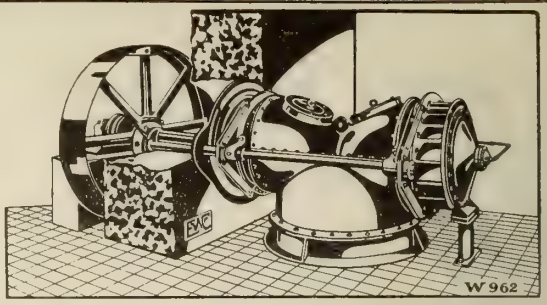
If any advertisement interests you, tear it out now and place with letters to be answered.

WATER - TURBINES

Francis and Tangential Wheels

GOVERNORS

PIPELINES



ESCHER WYSS & Cie. S.A.

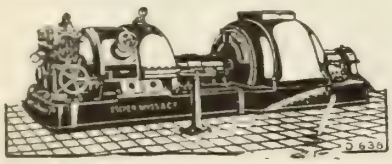
Zurich

Switzerland

A 173

Zoelly Steam Turbines

Turbo-Pumps



MONTREAL OFFICE : 211 Coristine Building

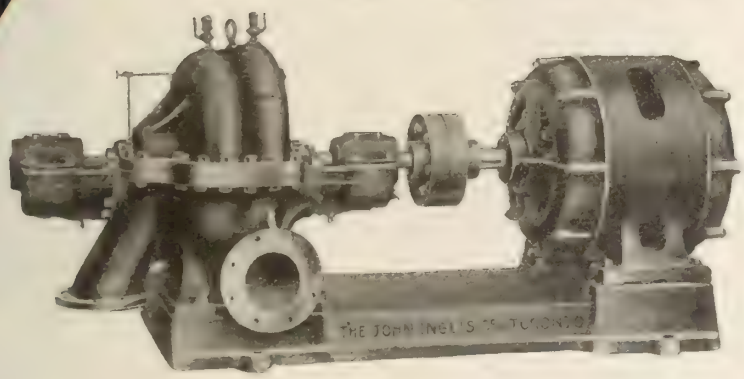
62-17

INDEX TO ADVERTISERS

	PAGE
A	
Albany Lubricating Co.	73
Alberger Heater Co.	54
American Steam Gauge & Valve Mfg. Co.	52
American Steam Pump Co.	3
Anderson Co., V. D.	81
Armstrong Cork Insulation Co.	11
B	
Babbitt Steam Specialty Co	64
Babcock & Wilcox	78
Bennis & Co., Ltd., Ed.	4
Boiler Inspection Dept.	77
Boving Hydraulic & Eng. Co.	76
Bowser, S. F., & Co., Inc.	60
C	
Can. Assoc. Stationary Engrs.	70
Can. Bond Hanger & Coupling Co	73
Can. Detroit Lub. Co.	68
Can. Fairbanks-Morse Co.	49
Can. General Electric Co.	9
Can. H. W. Johns-Manville Co., Ltd	..
Can. Laco-Philips Co.	85
Can. Morehead Mfg. Co.	81
Can. S K F Co.	55
Canuck Supply Co., Ltd.	66
Chaplin-Fulton Co.	64
Cling-Surface Co.	73
Cole, Geo. W.	57
Coppus Eng. & Equip. Co.	6
Crane Packing Co.	68
D	
Darling Bros.	68
Dart Union Co.	62
Dean Rapidaire Co.	..
D'Este Co., Julian	87
Direct Separator Co.	50
Dixon Crucible Co., Jos.	59
Dominion Belting Co.	74
Dominion Coal Co.	76
Dunham & Co., C. A.	3
Durabla Mfg. Co.	52
E	
Economy Fuse & Mfg. Co. of Canada	1
Elliott Co.	47
Engineering & Mach. Works of Canada, Ltd.	2
Escher Wyss & Co.	88
F	
Federal Engineering Co.	81
Financial Post	62
Francis, Walter J., & Co.	59
Frick Co.	11
G	
Galt Foundry Co.	..
Garlock Packing Co.	72
Garth Co.	76
Gates, John W.	58
Goldie & McCulloch Co.	16
Graton & Knight Mfg. Co.	51
Greene, Tweed & Co.	53
H	
Holmes Metallic Packing Co.	76
Homestead Valve Mfg. Co.	87
Hoyt Metal Co.	2
I	
Inglis Co., John.	Inside back cover
J	
Jamison Cold Storage Door Co.	12
Jefferson Union Co.	67
Jeffrey Mfg. Co.	..
Jenkins Bros.	61
Johns-Pratt Co., The	86
Jones Underfeed Stoker Co., Ltd.	4
Jordan Bros., Inc.	8
K	
Kellogg & Co., E. H.	59
Kerr Engine Co.	59
L	
Ladd Co., The Geo. T.	77
Laurie & Lamb	13
Leitch Co., The Arthur S.	6
Liberty Mfg. Co.	..
Linde Canadian Refrigeration Works Co.	10
Lunkenheimer Co.	64
M	
MacGovern & Co.	87
MacKinnon, Holmes & Co.	59
MacLean's Magazine	56
Magnolia Metal Co.	5
Mason Regulator Co.	6
Mason Regulator & Eng. Co., Ltd.	7
McAvity & Sons, T.	83
McDougall Caledonian Iron Wks. Co.	14
McGhie, W. C.	76
McLaren, D. K., Ltd.	71
Merchants Rubber Fdy.	48
Mettskin Co., Inc.	50
Morrison Brass Mfg. Co., Jas.	Outside back cover
Morse Chain Co.	75
Mueller Mfg. Co., H.	65
Murphy Iron Works	3
N	
National Boiler Seam Protector Co.	76
P	
Penberthy Injector Co.	Front cover
Pennsylvania Flexible Metallic Tubing Co.	52
Pilley Packing & Flue Brush Mfg. Co.	77
Pratt & Cady Co.	50
S	
Sarco Co., Inc.	58
Scaife, Wm. B., & Sons Co.	86
Schaeffer & Budenberg Mfg. Co.	6
Shell-Bar, Boico Supply, Ltd.	5
Smart-Turner Mach. Co.	77
Starrett, L. S., Co.	78
Steel Mill Packing Co.	77
T	
Taylor Instrument Co.	8
Thomson-Gordon, Ltd.	74
Trimont Manufacturing Co.	78
U	
Uehling Instrument Co.	83
United States Rubber Co.	Inside front cover
V	
Vilter Mfg. Co.	10
W	
Wall, W. J.	58
Waterous Engine Works Co.	1
Watson & McDaniel Co.	76
Williams & Co., J. H.	74
Wilson, Wm., C., & Co.	58
Y	
York Mfg. Co.	12

INGLIS

TURBINE PUMPS



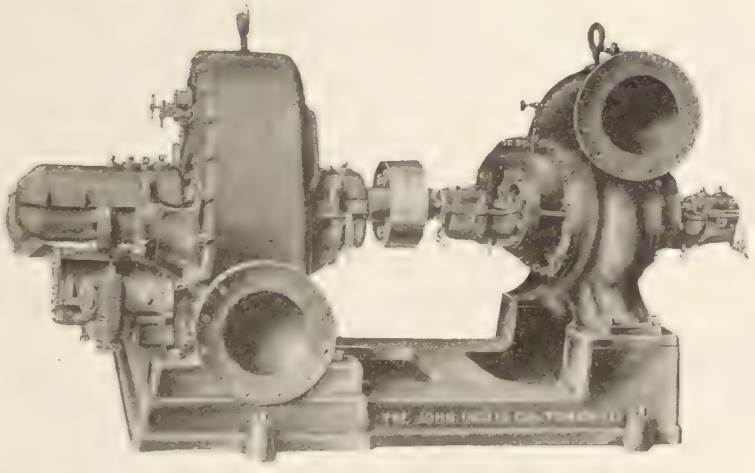
Inglis Turbine Pumps are used in power plants throughout Canada with unqualified success. They set the standard for the utmost efficiency in Turbine Pumps. They are durable, reliable, economical.

Illustration No. 1 shows our Multistage split case Turbine Pump for medium and high pressures. Direct connected to electric motor.

Illustration No. 2 shows double Suction Pump for circulating low or medium heads. Direct connected to steam turbine.

Oil ring bearings, hydraulic balance and water-cooled thrust bearings are features of their ideal construction.

Impellers and passages are highly finished, all working elements being carefully balanced against vibration.



Let Inglis Engineers give you their advice. Their knowledge and wide experience places them in a position to advise thoroughly and efficiently on all problems affecting Turbine Pumps.

The Inglis line includes Boilers, Engines and Pumps. Full information on request.

The John Inglis Company, Limited

14 Strachan Ave. *Engineers and Boilermakers* **Toronto, Canada**

MORRISON'S

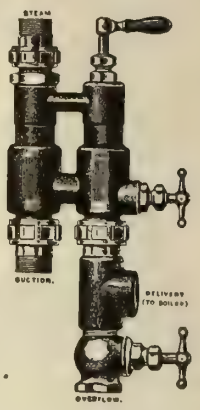
Steam Goods and Specialties

TRADE MARK J.M.T. REGISTERED A GUARANTEE OF QUALITY

J. M. T. Reducing Valve

Oil Cup

J. M. T. Gate Valve



Genuine Hancock Inspirator

Unvarying Quality

The material used in Morrison's line of steam goods and specialties is carefully selected; their construction throughout represents skill and knowledge of the highest order drawn from forty years of varied experience.

Their unvarying quality assures safety and durability and every article is thoroughly factory-tested.

Approved by the Provincial Boiler Inspection Departments.

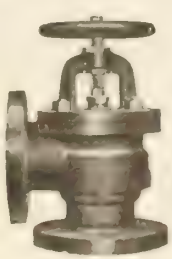
A FEW OF OUR LINES:

- Stop Valves
- Check Valves
- Gate Valves
- Safety Valves
- Relief Valves
- Reducing Valves
- Steam Traps
- General Boiler Mountings
- Injectors
- Ejectors
- Inspirators
- Jet Pumps
- Steam Gauges
- Pipe, Tools, etc.
- Vacuum Gauges
- Ammonia Gauges
- Gauge Board Outfits
- Lubricators
- Pipe Fittings
- Steam Whistles
- Engine Indicators

Asbestos Packed Cock

J. M. T. Globe Valve, Renewable Disc

Gem Ejector



Beaver Valve

Everything for the Engine and Boiler Room in steam goods and specialties. Full information upon request. Enquiries promptly answered. Write to-day.

J. M. T. Injector

J. M. T. Check Valve

Pressure Gauge

James Morrison Brass Mfg. Company

93-97 Adelaide Street West

Toronto Ontario

POWER HOUSE

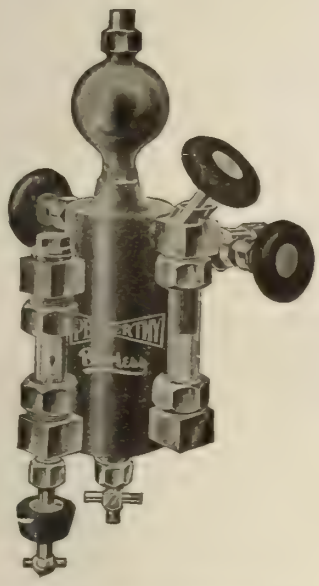
A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power; and to the operation of Refrigerating Machinery.

Published by The MacLean Publishing Company, Limited, 143-153 University Ave., Toronto

MONTREAL: Southam Bldg. LONDON, ENG.: 88 Fleet St., E.C. WINNIPEG: 1207 Union Trust Bldg.

Vol XI—No. 4 Publication Office, Toronto—April, 1918 Published Monthly $1.00 per Year.

TRADE PENBERTHY MARK



Made in both double and single connection

SIGHT-FEED LUBRICATORS

Are Reliable and Dependable

The Peerless —

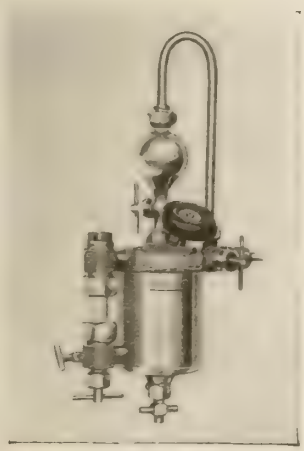
IS STRICTLY HIGH-GRADE AND SPECIALLY DESIGNED FOR STATIONARY, MARINE and THE BETTER CLASS OF ENGINES

SOME OF ITS EXCELLENT FEATURES.

The filler plug is set at an angle, giving ample space between it and condenser for grip of hand. The filler opening is funnel-shaped, with large opening, permitting use of large-spouted oil can; saves both time and oil when filling cup.

The drain valve for the sight-feed glass is directly under the oil-regulating valve, a combination of two valves in one, but operated entirely independent of each other. The position of this drain valve mentioned above protects the oil-regulating valve from being covered with oil and water when draining the sight-feed glass.

The Peerless will feed heavy oils and work well in cold weather, from the fact that the arm passing through the oil body is constantly filled with live steam which keeps the oil always in a liquid condition.



Made in both single and double connection

The POLAR —

The Penberthy Polar Lubricator is built principally for outdoor service, and is specially adapted for portable and traction engines, hoisting engines, steam pumps, etc., on acount of its excellent feeding qualities in cold weather. This lubricator is designed with a sight-feed glass on the same order as those found on the most expensive cups; the feed being oil through water, which shows clearly the exact amount of oil being fed to the engine. Polar Lubricators are made of the best steam metal, are carefully assembled and tested, and will give the best of satisfaction.

Write for Our Ready Reference Catalog To-day.

Penberthy Injector Co., Limited, WINDSOR ONT.

Increased Distributing Capacity In Mechanical Rubber Goods

The demand for highest-grade mechanical rubber goods has increased so persistently during the last few years as to make rapid and efficient service particularly appreciable.

This company's colossal manufacturing facilities have kept pace with the growth in the use of such famous "Mechanicals" as:

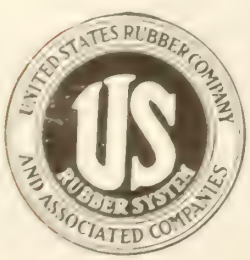
Peerless Rainbow Belting, Rainbow Packing, Sawyer Canvas Belting, Eureka Fire Hose, Giant Steam Hose, Rinex Soles, Supremo Conveyor Belting, Hold-tite Friction Tape, Peerless Honest John Packing, Relio Belting, Usco Radiator Hose. Rainbesto Packing, Buckeye Splicing Tape, Four Ace Seamless Belting, Paragon Fire Hose, Anaconda Tender Hose, Peerless Air Hose, Kold-Pak Jar Rubber, Revero Garden Hose, Spring Step Heels, Giant Seamless Belting, Giant Suction Hose, Usudurian Packing; as well as, hundreds of miscellaneous rubber items, such as rubber soles and heels, rubber tiling, matting, mats, plumbers' supplies, rubber thread, rubber toys and golf balls.

To co-ordinate supply with distribution, the United States Rubber Company has now established branches in the principal cities. These, with the strategical location of its factories in the big centres East and West, enable the largest rubber manufacturer in the world to serve the public on a scale equal to its mighty manufacturing capacity.

In this way a nationalized service has been provided to meet every requirement of the people.

As an absolutely certain means of identification, all United States Mechanical Rubber Goods will bear, in addition to their own famous brand names, the great seal of the United States Rubber Company — the hall mark of quality.

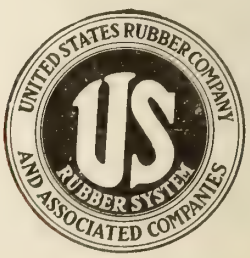
Every branch of the Mechanical Goods Division of the United States Rubber Company thus becomes Mechanical Rubber Goods Headquarters with increased capacities for distribution.



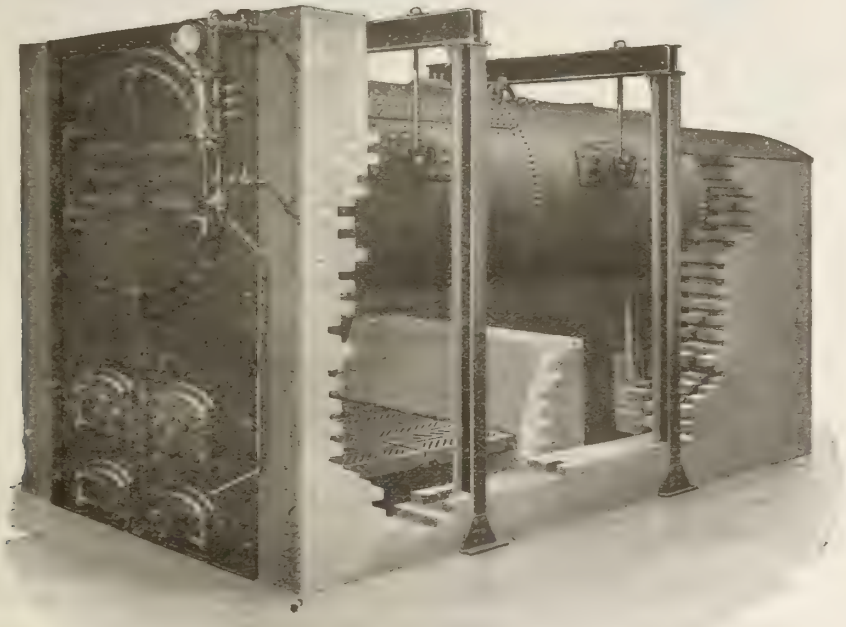
United States Rubber Company

Mechanical Goods Division

New York



BOILERS



WATEROUS Return Tubular Boilers are quick steaming, economical of fuel and absolutely reliable.

Power Boilers up to 165 H.P. Heating Boilers in sizes to 72″ x 16′—most standard sizes carried in stock.

We can supply brick or all-steel settings designed and dimensioned to give best results with whatever fuel you are using.

Boilers in stock for immediate shipment

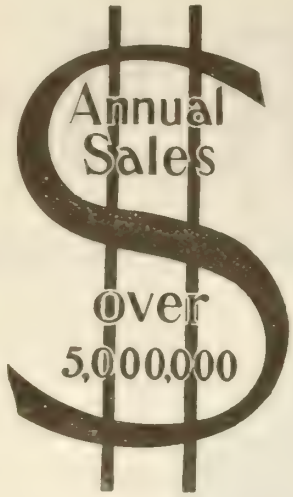
2—48″ x 14′ H.R.T. Boilers
3—54″ x 14′ H.R.T. "
7—60″ x 14′ H.R.T. "
5—72″ x 18′ H.R.T. "

Catalogue on Request.

Waterous

BRANTFORD, ONTARIO, CANADA

If any advertisement interests you, tear it out now and place with letters to be answered.



Not a War-Time Slogan

"Annual Sales over $5,000,000" — this is not a war-time slogan. This immense sale of Hoyt Metals belongs to normal times as well as war times, when babbitting metals of the **Hoyt High Quality** are in extraordinary demand.

Power house plants in all quarters of the globe (enemy countries excepted) are users of Hoyt Babbitts.

For Engines, Pumps, Mills, Pulp Machinery, Planing Mills, etc., it has no equal.

Order from your dealer—if he can't supply, have us ship you a 25-pound trial box direct.

HOYT'S FROST KING

A first-class all-round Babbitt. It will not only take care of high speed, but will stand up to heavy work in an extraordinary way.

For saw mills, planing mills, threshing engines, traction, rolling mills, pulp machinery, and all classes of stationary engines, it is without equal.

HOYT'S NICKEL GENUINE

Is designed especially for use in gas engines, gasoline engines, and all classes of marine engines and is especially adapted for automobiles. For heavy duty high speed work is probably as perfect as an alloy can be made.

HOYT METAL CO., TORONTO

NEW YORK, N.Y. LONDON, ENG. ST. LOUIS, MO.

Grey Iron Castings

Heavy or Light

Estimates promptly furnished. High grade grey iron castings up to 30,000 lbs. Modern foundry, fully equipped. Address enquiries to nearest office

Engineering & Machine Works of Canada, Limited

Formerly
St. Catharines Works of
The Jenckes Machine Co., Ltd.

Head Office and Works
St. Catharines, Ont.

Sales Offices
710 C.P.R. Building, Toronto
344 St. James Street, Montreal
Hall Machinery Co., Sherbrooke, Que.

Murphy AUTOMATIC Furnace

Murphy Stokers

A few longtime constant users, and there are others!

Lockport Paper Co.,	Lockport, N.Y.	33 years constant use
Hartje Paper Co.,	Steubenville, Ohio	24 years constant use
Sherwin Williams Co., 12 contracts 20 Stokers	Montreal, P.Q. Cleveland, Ohio Kensington, Ill.	16 years constant use
Laurentide Co., Ltd.,	Grand Mere, P.Q.	13 years constant use
Ford Motor Co., " " " "	Detroit, Mich. Des Moines, Iowa New York, N.Y.	18 years constant use
Ohio Traction Co.,	Cincinnati, Ohio	28 years constant use
16 Repeat Orders		74 Murphy Stokers

For printed matter address

MURPHY IRON WORKS,

DETROIT, MICH. BUFFALO, N.Y.

Boiler Scale Costs More than Boico

Think of all you pay for it—Boiler scale. In the course of a year you pay tons of coal, and all the time it acts as a check to power efficiency. Like corroding rust, it slowly but nevertheless surely shortens the life of your boiler.

The cost of Boico is trivial compared with all you pay for scale. For Boico positively removes boiler scale and absolutely prevents further formation. It saves fuel, oil and packing. It will not carry over in the steam; it will not cause foaming or priming, and it is guaranteed not to injure packing or valves in the slightest. **Write for free trial.**

Copper Asbestos Boiler Gaskets

are made of copper, with pure asbestos cord-filled corrugations. They put a stop to leaks in pipe lines, for they never blow-out and never stick.

Tip-It Patent Welding Process

gives you tools whose shanks are carbon and whose cutting tips are high-speed steel. A money-saver!

Get in touch with us to-day!

Anti-Clinker Shell Bar Grates

insure more heat from much less coal. Built on a scientific air-draft principle, fully 50% of the total surface air space, they provide ample air to command perfect combustion, adding as much as 25% more heat to the fuel gases and so preventing clinker formation. Moreover, Anti-Clinker Shell Bar Grates cannot twist or warp, and they're easily cleaned.

Shell-Bar Boico Supply, Limited

376 Dufferin St., Toronto, Canada

THE OLD FASHIONED WAY

Money Going Up in Smoke!

Here is a man stoking in the old-fashioned way. He is a good fireman! He'll get up steam all right but the cost is at least 15% more than it needs to be. What is wanted here is a modern stoking equipment—the

JONES UNDERFEED STOKER

The "Jones" equipment automatically maintains a uniform steam pressure; it responds instantly to load fluctuations and will make 85 tons of coal go as far as 100 tons would go with the man with shovel.

Simplest stokers built: no parts moving in contact with the fire; no grates; no losses through bars; no smoke.

A big paying investment for the large or small plants. Hundreds of plants are effecting savings from 15 to 25 per cent.—plants similar to [illegible].

Pay you to investigate the ability of the **Jones Underfeed Stoker.** We'll gladly put you in touch with a number of users.

Jones Underfeed Stoker Co.

Limited

37-41 Britain St. **Toronto, Ont.**

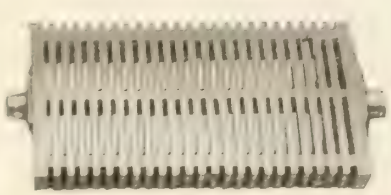
THE JONES MODERN WAY

CYCLONE Shaking and Dumping Grates

Cut Fuel Costs!

You can burn any grade of hard or soft coal or screenings and get maximum results with CYCLONE Shaking and Dumping Grates. Burning of low grade fuel and getting proper combustion is made possible by 60% air space and 90% underdraught. No ashes, no clinkers, no waste with Cyclone Grates.

Our trial proposition is convincing. We are prepared to install our grates for a bona-fide company on 30 days' trial. Easy and convenient to put in. In these days of coal scarcity Cyclone Grates prove a splendid investment. Get in touch with us.



The Canadian Steam Boiler Equipment Co., Ltd.

Sole Makers for Canada

20 McGee Street **Phone G. 2660** **Toronto, Ontario**

Agents:

ST. JOHN, N.B.	F. W. Blizard, 329 Charlotte St.
MONTREAL	Mason Regulator & Engineering Co., Ltd., St. James St.
HAMILTON	Robt. Fitzsimmons, 8 Grove St.
CALGARY	The Western Foundry & Metal Co.
WINNIPEG	Vulcan Iron Works

Typical Installation of Stokers as Applied to Four 150 H. P. Return Tubular Boilers to Operate with either Natural or Forced Draft and Burn Low-Grade Fuel without Smoke.

A BIG PILE OF COAL SAVED

with This Highly Efficient Stoker

Can be Installed on One Boiler in 12 Hours

Made in Canada

WHAT THE EXPERTS FOUND

One of the Largest Engineering Firms in Canada have just had their mechanical engineers test the economical efficiency of the Galt Sprinkler Stoker in their own power plant and have placed a further order with us to equip the whole of their boilers with our machines. The above Company writes us:

"We beg to state that we have compared the two tests made on our 250 H.P. water tube boiler before and after your stoker was installed and find that THE NET GAIN IS 13%. This saving is sufficient to warrant us in ordering the balance of the stokers (8) and we would advise you to go ahead and have them shipped as soon as possible."

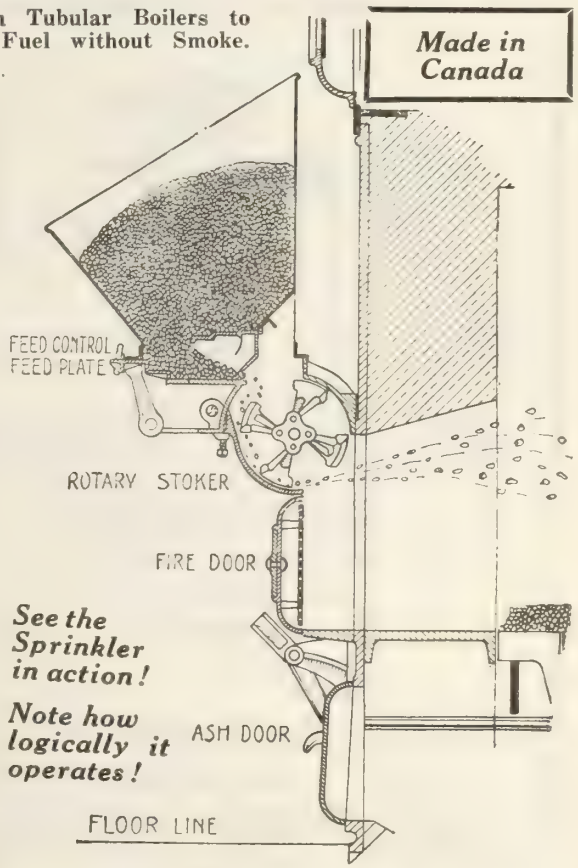
The Above Saving of Coal Must Interest You
Write Us Now

ASK FOR ILLUSTRATED CATALOGUE

GALT FOUNDRY CO., Limited, Galt, Ont.

Toronto Office, 826 Traders Bank Building

PHONES: Junc. 3354, Main 4362



See the Sprinkler in action!

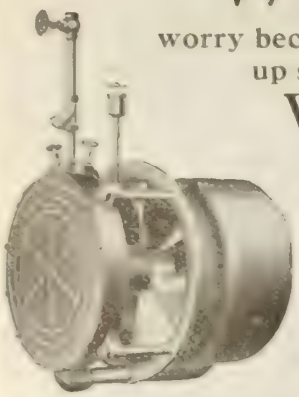
Note how logically it operates!

The Galt Sprinkler Stoker automatically feeds and uniformly spreads the fuel to the furnace in a light continuous stream and gives a perfectly level fire, 3 to 4 inches thick.

WHY

worry because you cannot keep up steam pressure

WHEN



it is so easy and cheap to overcome your difficulties by installing a

COPPUS TURBO BLOWER

It means constant steam pressure, regardless of uneven loads, poor draft and poor coal, and it will pay for itself in a short time on account of better combustion. It also will increase your boiler capacity to 200, and even 300%, of its normal rating without injury to the boiler. Cut out this Ad., put your name and address on the margin and mail to us. Without further trouble you will get all the particulars.

500,000 H.P.

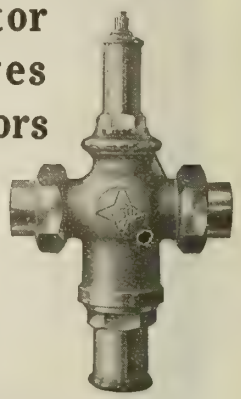
In boilers equipped with Coppus Turbo Blowers in four years. The Coppus has replaced a great many other blowers, but no other blower has ever replaced a Coppus.

Coppus Engineering & Equipment Company
167 Union Street, Worcester, Mass.
Montreal Sales Agents:
Mason Regulator & Engineering Co.
Toronto Sales Agents:
The Power Plant Equipment Co., Toronto

MASON

Reducing Valves

Pump Regulator
Balanced Valves
Damper Regulators



If you order a Mason you will get absolute satisfaction. This we guarantee you. You simply cannot make a mistake.

Dependable regulation under every possible condition.

Our complete catalog tells you WHY. Let us mail you a copy.

Mason Regulator Company
BOSTON, MASS.

TORONTO REPRESENTATIVES:
The Arthur S. Leitch Co.,
506 Kent Bldg., Toronto.

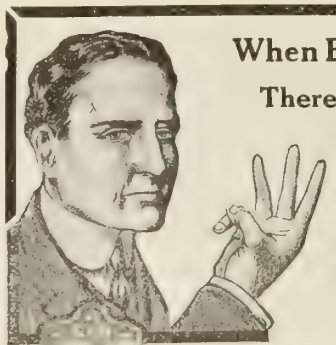
Kieley & Mueller Specialties

Regulating Valves
Back Pressure Valves
Pump Governors
Separators
Traps

FOR EVERY SERVICE

SALES ENGINEERS

THE ARTHUR S. LEITCH CO.
TORONTO



When Buying Thermometers

There's Just Three Things to Remember—

First, you must have accuracy and sensitiveness—

Second, durability is absolutely essential—

Third, the thermometer must be suitably constructed for the intended application.

Accuracy, sensitiveness and durability are absolutely guaranteed in

"Crescent" Thermometers

And with nearly seventy years of experience to our credit, we are qualified to properly interpret your needs.

Our Catalog P.H. 200 illustrates and describes "Crescent" Thermometers for every application. Also test thermometers, glass thermometers, etc.

Get a copy of Catalog P.H.-200 to-day.

The Schaeffer & Budenberg Mfg. Co.

Brooklyn, New York

Chicago
Pittsburg
St. Louis
Philadelphia
Los Angeles

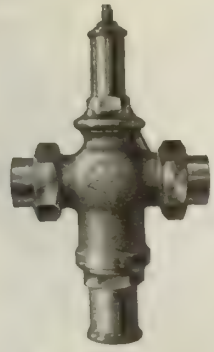
Power Plant thermometers for all temperatures not exceeding 1000° F

Also—"Columbia" Recording Gauges and Thermometers, Gauges, Gauge Testers, Tachometers, Steam Calorimeters, Counters, etc.

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

If Quality of Manufacture and Reliability in Service

have any meaning in the Engineering World, this list of our leading specialties should appeal to the best judgment of every Engineer and Power Plant Superintendent.



Mason Standard Bronze Reducing Valve

Mason Reducing Valves (Genuine),
Mason Pump Governors,
Mason Pressure Controllers.

Bundy Steam Traps for every service,
Coppus Turbine-driven Blowers,
Sims Hot Water Generators.

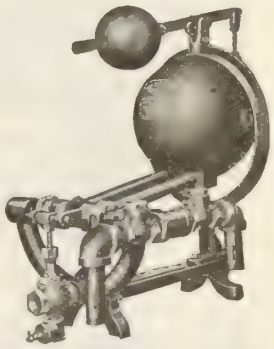
Sims Storage Heaters,
Sims Open Feed Water Heaters.

Bundy Oil Separators,
Ashton Gauges and Safety Valves.

Federal Metallic Packing,
Everlasting Blow-off Valves.

Bawden Pumps (Reciprocating & Centrifugal)
Stratton Steam Separators.

Reilly Multicoil Feed Water Heaters,
Reilly Evaporators and Distillers,
Reilly Multiscreen Feed Water Filters.



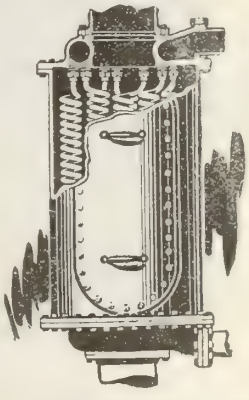
New Bundy Return Trap

Mason No. 55 Pump Pressure Regulator

ABOVE EVERYTHING

our Sales Engineers know the *practical application* of our lines to *actual conditions,* and sell from *knowledge,* not from *catalogs.* We furnish *results,* not merely *machinery.*

THIS MEANS REAL SERVICE



Reilly Multicoil Feed Water Heater

Bulletins and full information gladly furnished.

The Mason Regulator & Engineering Co., Limited

Successors to H. L. PEILER & COMPANY

MONTREAL, 380 St. James Street FACTORY, 960 St. Paul Street, Montreal

TORONTO REPRESENTATIVES, The Arthur S. Leitch Co., 506 Kent Building, TORONTO

This book should be in the hands of every pump user. A postal will bring your copy promptly

MARSH and AMERICAN

Steam and Power Driven Pumps and Air Compressors

Marsh and American Pumps are especially adapted for long, hard service because they are *extra heavy* in design and of *extremely rigid construction.* Every unit is built amply strong to withstand 24-hour-a-day service and to stand up under any unforeseen strain which may be placed upon it. Piston rods on the steam pumps are extra large and made of solid bronze. The water ends are equipped with heavy cast bronze removable bushings.

This superior construction not only insures continuous and satistactory operation, but practically *eliminates expensive shut-downs.* Marsh and American Pumps are the product of over 25 years' experience in the design and construction of high grade pumping machinery. Over 135,000 in actual service throughout the world.

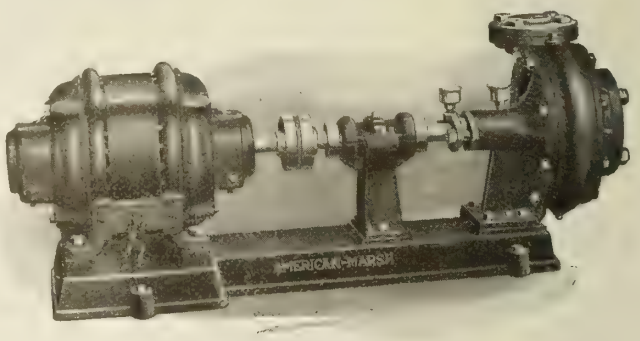
The AMERICAN-MARSH LINE OF CENTRIFUGAL PUMPS is composed of both single and double suction types which are designed for heads up to 125 feet. They are equipped with wide ring oiled bearings and the single suction type has overhanging casing enabling the discharge to be taken at any angle desired.

CANADIAN AGENTS

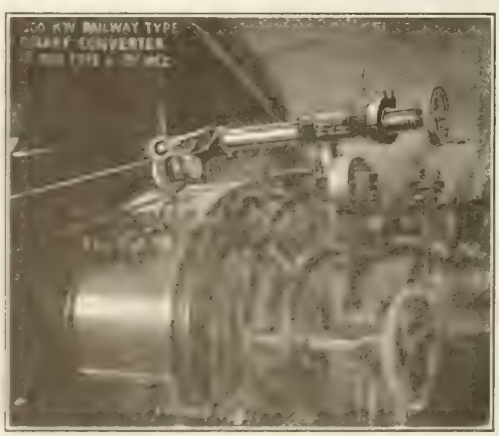
A. R. Williams Machinery Co., Toronto.
Williams & Wilson, Montreal.
London Engine Supplies Co., London, Ont.
Stuart Machinery Co., Winnipeg.
Mechanics' Supply Co., Quebec, Que.
Gorman, Clancy & Grindley, Limited, Edmonton and Calgary.
Taylor Engineering Co., Ltd., Vancouver, B.C.

American Steam Pump Company

Battle Creek, Mich.



American-Marsh Centrifugal Pump.



COMMUTATOR TRUING DEVICE

Trues your commutator without removing armature from its bearings. Send for Booklet No. 5.

Jordan Bros., Inc.

82 Beekman St. New York City, N.Y.

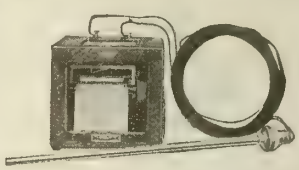
Canadian Representative:
CANADA SALES CO., 183 Church Street, Toronto, Canada

Tycos

TEMPERATURE INSTRUMENTS

Indicating Recording Controlling

- Mercurial, Recording and Index Thermometers for all industrial and laboratory applications.
- Electric Contact Thermometers.
- Temperature, Pressure and Time Regulators.
- Mercury Column Vacuum Pressure and U Gauges.
- Base Metal, Rare Metal and Radiation Pyrometers.
- Fery Radiation Pyrometers.
- Hygrometers.
- Hydrometers.
- Mineral Oil Testing Instruments.
- Aneroid Barometers.
- Mercurial Barometers.
- Recording Barometers.
- Pocket Compasses.
- Surveying Compasses.
- Rain Gauges.
- Anemometers.
- Air Meters.
- Thermographs.
- Hand Levels.
- Aviation Barometers.
- Inclinometers.
- Sphygmomanometers.
- Fever Thermometers.
- Urinary Glassware.
- Thermometers of all kinds for home and general use.



Tycos Recording Pyrometer

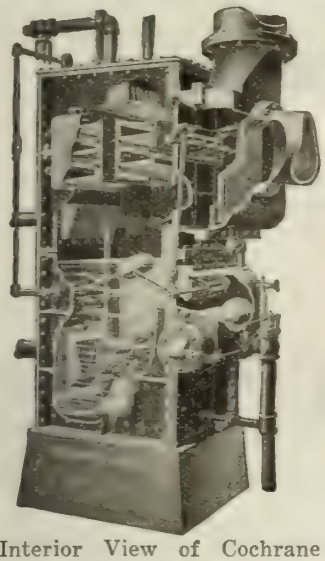
Tycos **Pyrometers are a necessity in every industry involving the application of high temperatures.**

Just write for our catalogue describing these efficient *Tycos* aids.

Taylor Instrument Companies
ROCHESTER, N.Y.
201 Royal Bank Bldg., Toronto, Ont.

C7

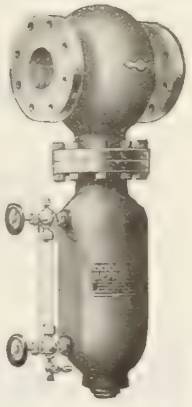
STEAM SPECIALTIES
FOR
The Power House



Interior View of Cochrane Open Feed Water Heater

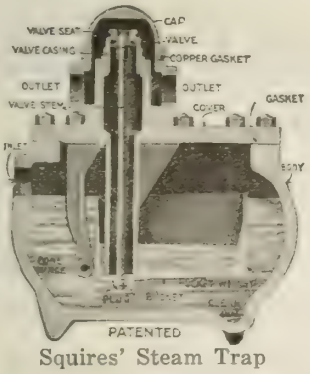
Cochrane Heaters as used in Heating, Metering and Softening water for boiler feed and other purposes.

Cochrane Separators for removing water from live steam, water and oil from exhaust steam and compressed air.



Cochrane Steam Separator

Cochrane Multiport Safety Exhaust Outlet Valves designed to release steam and prevent accumulation of pressure. They are the only valves of the kind absolutely free from sticking, pounding or overloading.



Squires' Steam Trap

The merits of the Squires Steam Traps have repeatedly been demonstrated in marine service, high pressure power plants, low pressure heating systems, on laundry machinery, steam separators, vulcanizers in rubber plants, dry kilns, drying rolls of paper machines and other places where steam traps are required.

Cochrane Multiport Valves

CANADIAN ALLIS-CHALMERS
LIMITED

Head Office - TORONTO

Sales Office: Montreal, Halifax, Sydney, Ottawa, Cobalt, South Porcupine, London, Winnipeg, Calgary, Edmonton, Nelson and Vancouver.

— LINDE —

REFRIGERATING MACHINERY

Is known and recognized the world over as

The Standard Refrigerating Machine

We have carefully studied Refrigeration under all conditions in Canada for the past 25 years and know what is best in this line. *Special attention given to Fish Freezing and Storing Plants.*

Our Machinery is "Made in Canada"

The Linde Canadian Refrigeration Co., Ltd.

MONTREAL: 37 St. Peter Street

TORONTO, WINNIPEG, CALGARY, EDMONTON, VANCOUVER

Twenty-five Years' Service to Canadian Users.

Vilter Refrigerating and Ice-Making Equipment

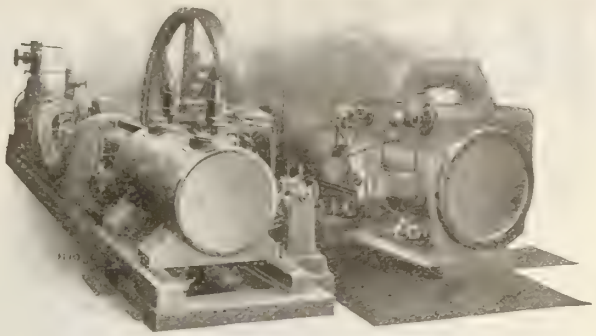
is recognized as standard throughout the world. Our product is built in all sizes and capacities, suitable for every service to which refrigeration is applied. Write us for an estimate covering your requirements.

BULLETINS SENT UPON REQUEST.

THE VILTER MANUFACTURING CO.

242 Beecher St. Milwaukee, Wis.

ECONOMY
SIMPLICITY
DURABILITY



The combination that increases the proprietor's profits and makes the engineer happy.

Our designers have been following these guiding points for nearly forty years and they have been found to

REDUCE
—OPERATING EXPENSE
—REPAIR BILLS
—AMMONIA BILLS
—ENGINEER'S TROUBLES

Proof of the above is universal. Ask any Frick User.

Write for catalogues and bulletins.

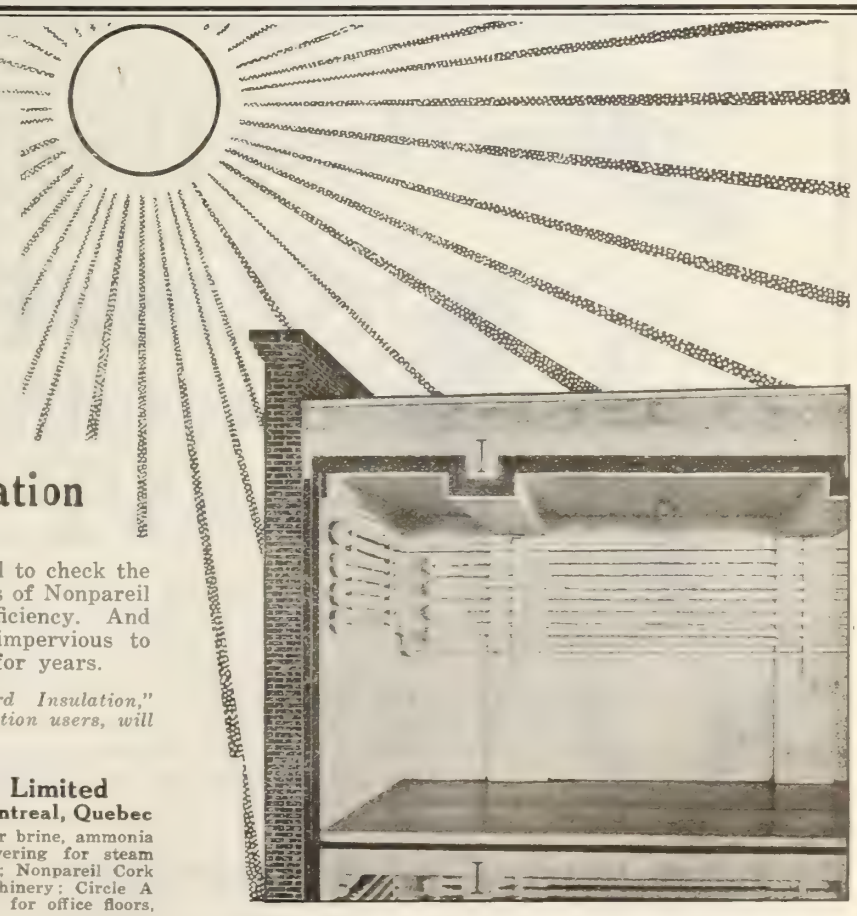
Frick Company
WAYNESBORO, PA. U.S.A.
ICE MACHINERY SUPERIOR SINCE 1882

Canadian Representatives:

FRICK ICE & REFRIGERATING COMPANY, MONTREAL CANADA

Repulsing the Attacks of the Cold Storage Enemy

Heat, the inveterate enemy of refrigeration, presses forward in unceasing attempts to enter cold storage rooms through the walls, ceilings and floors. Because of poor insulation it often wins decisive victories and confiscates a large share of the profits.



Nonpareil Corkboard Insulation

For Cold Storage Rooms

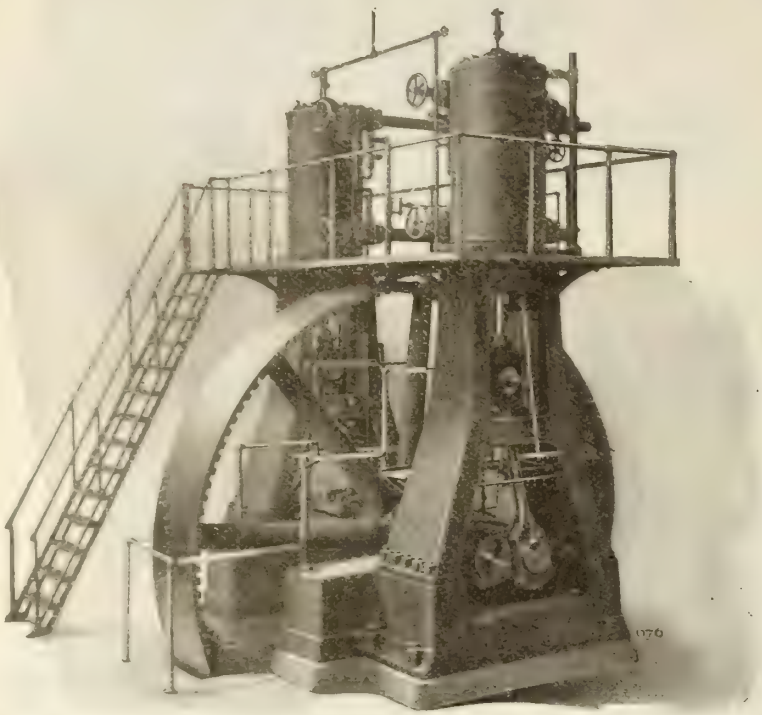
is the most practical fortification yet devised to check the onslaughts of heat. The tiny, sealed air-cells of Nonpareil Corkboard give it exceptional insulating efficiency. And being structurally strong and practically impervious to moisture, its original efficiency is retained for years.

A 152-page bound book, "Nonpareil Corkboard Insulation," containing data of vital interest to all refrigeration users, will be sent, free of charge, on request.

Armstrong Cork & Insulation Co., Limited
504 McGill Building, Montreal, Quebec

Also manufacturers of Nonpareil Cork Covering for brine, ammonia and ice water lines; Nonpareil High Pressure Covering for steam lines; Nonpareil Insulating Brick for boiler settings; Nonpareil Cork Machinery Isolation for deadening the noise of machinery; Circle A Cork Brick for cold storage room floors, and Linotile for office floors, residences, etc.

REFRIGERATION



Owing to the conditions imposed by the War, the use of Mechanical Refrigeration was never more of a necessity than now.

Our mission is to advise with prospective customers concerning their requirements and then to furnish a plant best suited to meet existing conditions.

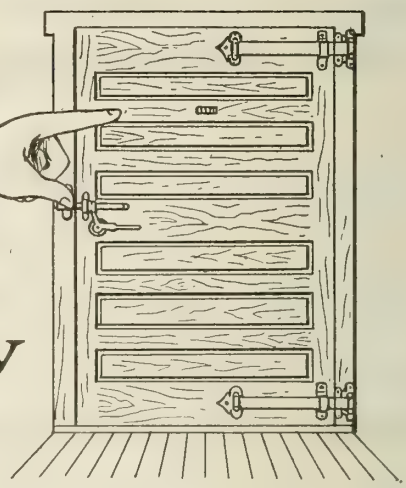
There is a YORK Machine to meet every practical condition of MECHANICAL REFRIGERATION.

WRITE US ABOUT IT

York Manufacturing Co.
(Ice-Making and Refrigerating Machinery Exclusively)
York, P.A.

Represented in the Dominion by
CANADIAN ICE MACHINE COMPANY
Toronto, 82 Chestnut St. Montreal, 626 Coristine Bldg.
Winnipeg, 85 Lombard St.

These Doors SERVE Because They SAVE



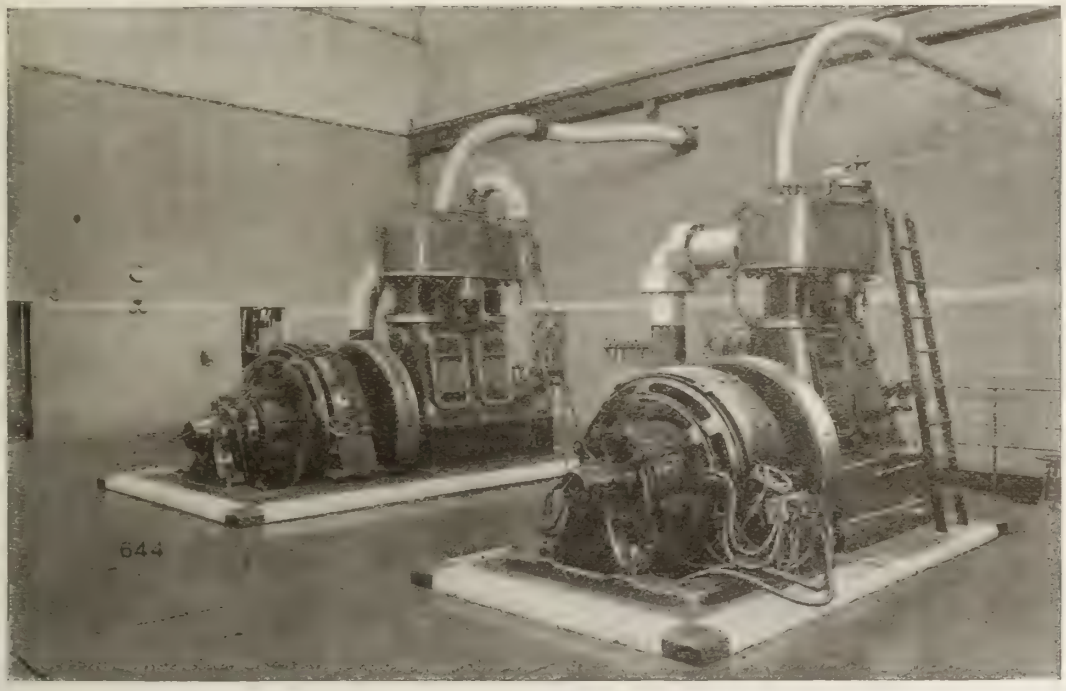
That these DOORS do SERVE and SAVE is evidenced by the fact that OVER 50% of our business is REPEAT ORDERS. No, not for replacements, but FOR ADDITIONS! JAMISON DOORS promote EFFICIENCY and ECONOMY to the extent larger facilities and new plants are necessary. Our motto is: "Build for your customers' success—your own must follow." We long ago substantiated our claims and established our present enviable prestige through competitive tests, and now, are advocates of the most thorough investigation into relative merit of various makes prior to ordering. There is a reason: our latest catalog explains it.

Jamison Cold Storage Door Company

Formerly Jones Cold Storage Door Co. P.O. Box 93 HAGERSTOWN, Md., U.S.A.

If what you want is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

BELLISS & MORCOM, LTD.
Engines and Air Compressors



Belliss & Morcom Engines installed in McGill University Power House
Total Horse Power, 1010 B.H.P.

We have for immediate delivery several Engine Generator Sets. Write for Particulars.

Send Us Your Enquiries For

Steam Engines	Condensing Plants	Hydraulic Pumps
Gas Engines	Centrifugal Pumps	Hydraulic Accumulators
Oil Engines	Boiler Feed Pumps	Pressure Filters
Diesel Engines	Water Wheels	Gravity Filters
Steam Turbines	Water Meters	Water Softening Plants
Air Compressors	Hydraulic Presses	Refuse Destructors

Activated Sludge Sewage Disposal Plants

Complete Power Plants Designed and Erected

LAURIE & LAMB

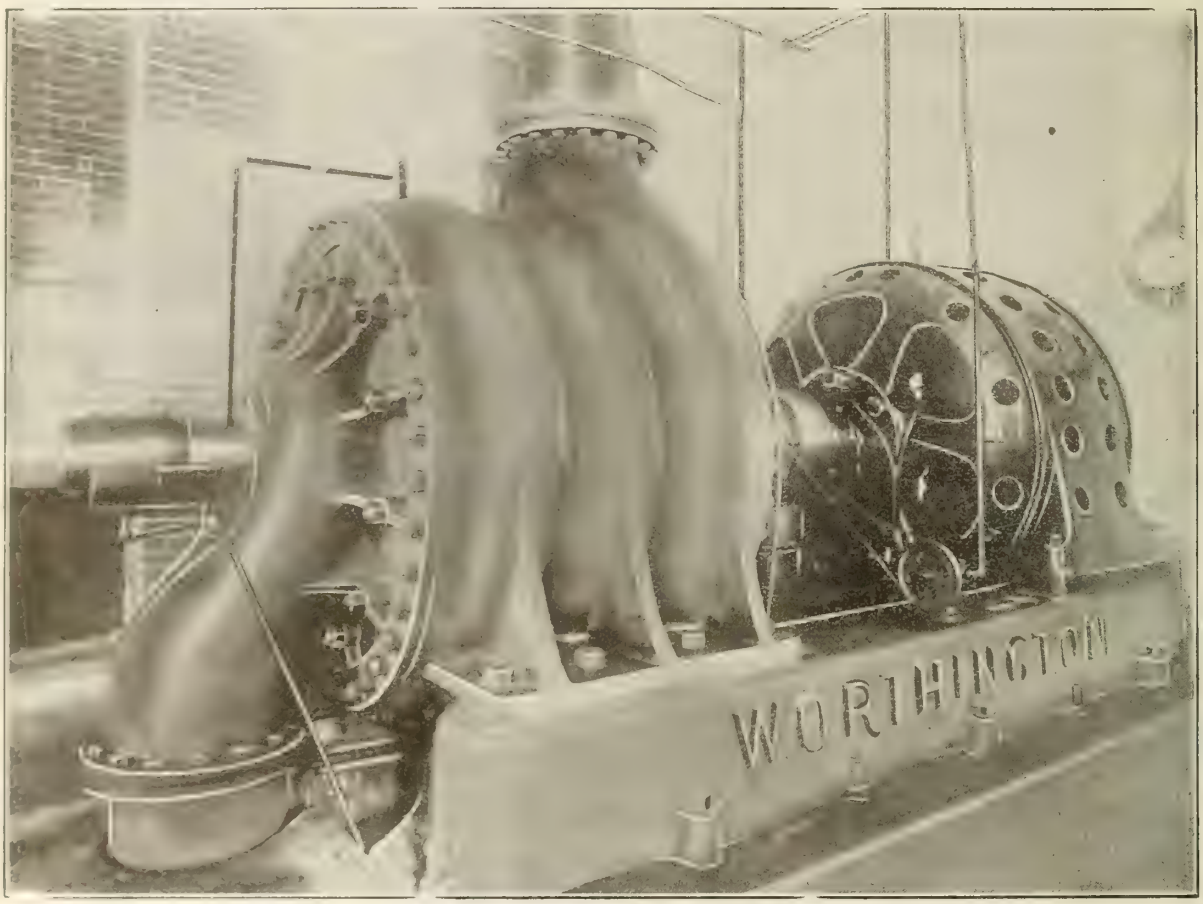
Engineers

211 Board of Trade Bldg. :-: :-: MONTREAL

THE JOHN McDOUGALL CALEDONIAN IRON WORKS CO., Limited

Manufacturers of Boilers, Castings, Condensers, Elevators, Engines, Filters, Forgings, Hydraulic Machinery, Pumps — centrifugal and reciprocating, Steam Turbines, Tanks, Water Wheels, Water Works Plants

Works: Seigneurs and William Streets, MONTREAL



5,000,000 gallons daily—Montreal Water Works—Driven by 400 H.P. Induction Motor.

Our Engineers have spent many years developing Centrifugal Pumps and we are now able to offer you perfected designs in any size pump from inch and a half and up for any service you may desire, and to be driven either with motor, engine or belt.

Write us for Engineering information, or prices, any time.

Sole Canadian Agents for H. R. Worthington Co.

Keeping in Stock at Montreal a large assortment of their Boiler, Feed and General Service Pumps

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

The Publisher's Page

TORONTO APRIL. 1918

INCORPORATED MAY. 1887.

INCORPORATED AT OTTAWA JUNE. 1917.

Mr. E. G. Newton,
Manager,
Power House,
153 University Ave.,
Toronto.

Hamilton, Feb. 12, 1918.

Dear Sir:

In answer to your enquiry as to whether the Canadian Association of Stationary Engineers have added to their membership through the advertising which has been appearing in POWER HOUSE I take great pleasure in stating that our membership has increased to a marked degree.

As a matter of fact we have received enquiries from all over Canada and I have received one letter from the trenches in France, and I can truthfully state that I have had difficulty in keeping up with my correspondence as a result of the enquiries which have been pouring in.

As you know, this advertising has been running in POWER HOUSE for seven or eight months and judging by results already secured our year's campaign will net us a great many new members. A feature which speaks well for POWER HOUSE and which is significant is the fact that enquiries have been from good engineers in first-class standing and in charge of good plants.

Speaking for other engineers with whom I have talked, as well as for myself, I can say that POWER HOUSE Buyers' Directory is invariably consulted when supplies are needed. If the average engineer does not mention POWER HOUSE when writing to advertisers it is probably because they do not think it necessary or they may forget to do so. Of one thing I can assure you and that is our members certainly prefer goods advertised in POWER HOUSE to any others.

I would like to mention the exchange of views among the engineers through the medium of POWER HOUSE. If Canadian engineers would use the pages of POWER HOUSE to exchange their ideas more one among the other, they would be not only benefiting themselves but would be helping those less fortunate. We have in Canada engineers who will compare with any engineers in the world and I feel that there should be a greater exchange of ideas and I am taking this up with our members at once.

Wishing you all success and assuring you of our continued co-operation, I am,

Yours faithfully,

Jno H Hale

Executive Secretary,
Canadian Association of
Stationary Engineers,
Hamilton, Ont.

To Manufacturers

Meet Mr. Hale, Executive Secretary of the C.A.S.E. Live wire and all-round good fellow. Look at his frank, open smile! Read his frank, open message. There's a whole lot in it for manufacturers of power equipment and supplies. A whole lot.

P.S.—We used Mr. Hale's photograph some months ago in connection with an article which he contributed. That's how we happened to have it.

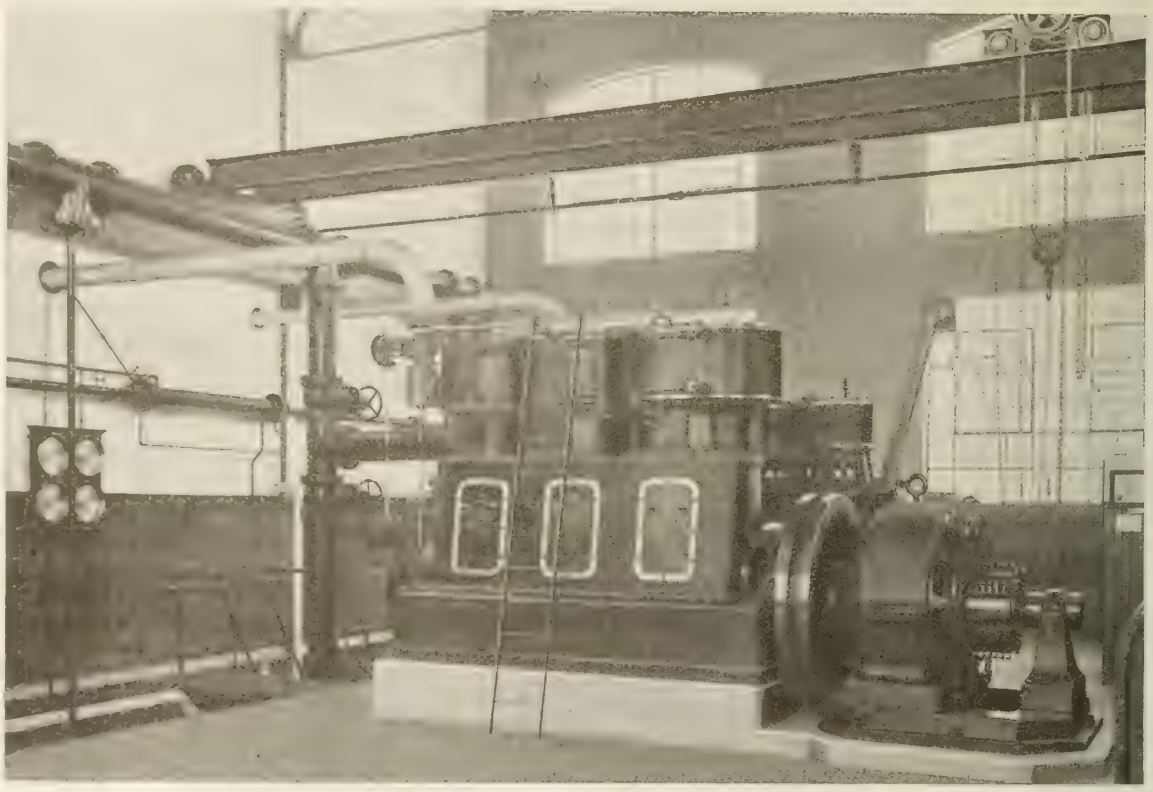
To Engineers

We would like every engineer to read Mr. Hale's letter reproduced herewith, especially the fifth paragraph. What's the use being a "brother engineer" if you don't extend the brother's helping hand to *as many* engineers as you possibly can? By sending to POWER HOUSE your ideas, your pet schemes for overcoming difficulties, the solutions you have worked out for yourself, you will be extending a glad and helping hand to hundreds. That's the way to apply forced draft to a good idea!

JOHN H. HALE

POWER EQUIPMENT

Built to Meet Your Own Requirements



A corner in the Engine Room of our New Power Plant recently erected at our Main South Works. Equipped with G. & McC. Co. Three-Cylinder Compound and Two-Cylinder Compound Vertical Forced Lubrication Steam Engines.

G. & McC. CO. ENGINES and BOILERS

will provide your plant with

A Continuous and Economical Service

WE BUILD

Horizontal and Vertical Steam Engines; Steam Turbines; Return Tubular and Water Tube Boilers; Heaters; Tanks; Pumps and Condensers; Transmission Machinery; Safes, Vaults and Vault Doors.

The advice of our Engineering Experts, our Catalogues, Specifications, Photographs, etc., will be cheerfully supplied to interested parties.

The GOLDIE & McCULLOCH CO., Limited

Head Office and Works: GALT, Ontario, Canada

TORONTO OFFICE:	WESTERN BRANCH:	QUEBEC AGENTS:	BRITISH COLUMBIA AGENTS:
Suite 1101-2, Traders Bank Bldg.	248 McDermott Ave., Winnipeg, Man.	Ross & Greig, 412 St. James St. Montreal, Que.	Robt. Hamilton & Co., Vancouver, B.C.

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

Electricity as a Factor in Modern Rolling Mill Operation

By L. Rothera

The advantages of electric drive for rolling mills are so well known that in many cases only the cost of changing over and the trouble encountered in obtaining equipment prevent the remodelling of mills doing widely different classes of work. The present article deals with the engineering problems connected with the installation of electric drive.

THE electrical horse-power used in British steel and metal works is now well in excess of 300,000. Taking, perhaps, the greatest stronghold of the steam drive, namely, mills with heavy reversing duty, it is interesting to note that whilst in 1914 only four such electric drives were in operation, of which two were of comparatively small size, there have since that date been no fewer than nine equipments put in hand, according to Mr. L. Rothera in a paper read before the Manchester Association of Engineers, with powers at the mill ranging up to 20,000 horse-power, and most of the big steel manufacturers are giving very serious consideration to electrical plants of this description, and a further number would have been installed had it been permitted.

Power Required

In Figs. 1, 2 and 3 respectively are shown the form of power demand in the case of a heavy sheet mill, a wire rod mill and a section mill rolling joists, and a study of these curves gives a measure of what the prime mover may be called upon to do. It must be borne in mind also that apart from the power requirements there have to be taken into consideration the needs of the mills as regards speed control, and the complications introduced by the lack of uniformity of the power systems on which the motors have to work. It is possible for the makers of electrical machinery to point to a very wide series of equipments which have satisfactorily and efficiently met the varying demands, and proved the entire adaptability of the electric motor to meet the most arduous conditions.

The advantages which can be claimed for the electric drive have been stated

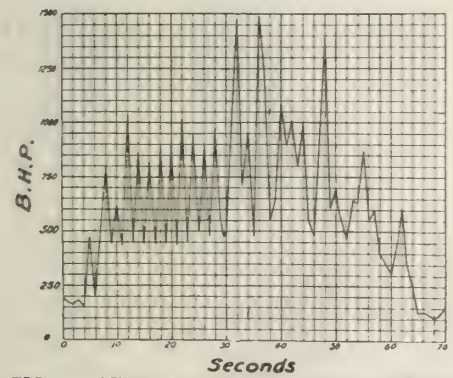


FIG. 1. CURVE SHOWING POWER DEMAND OF HEAVY SHEET MILL.

time and again, but it is impossible in a paper dealing with this subject to avoid some reference to the reasons which tend to its adoption, and a short summary of them is as follows:

(1) Economy of working, i.e., reduction in cost per ton of material rolled. This results from a number of causes, such as the great rapidity of working and high efficiency of the electric plant at all loads, from light load to the maximum permissible overload. This economy of working persists throughout the whole life of the plant, as electrical machinery maintains its efficiency unimpaired independently of the time during which it has been at work.

(2) Reduced space taken up. Partly on account of the small size of a motor as compared with its output, and partly due to the possibility of placing the motor in the most convenient position, without having to consider the run of steam pipes or the relative position of the boiler-house.

(3) Ease of control, such as stopping, starting, or varying the speed of the drive.

(4) Constant check on the power consumed. A recording instrument gives immediate information as to an undue consumption of power, thus enabling adverse circumstances to be promptly noticed and remedied.

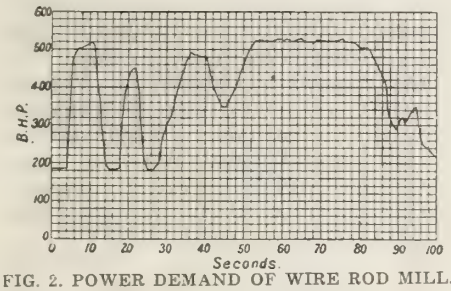


FIG. 2. POWER DEMAND OF WIRE ROD MILL.

(5) Increased output from a given plant. This results from the large overload capacity and constant speed of the electric motor under all conditions of load.

(6) More uniform drive. The turning moment of a motor is constant for any position of the rotor, whereas a steam engine turning moment fluctuates, depending on the position of the cranks.

(7) Smaller initial cost. This is particularly the case where electric power is available from a neighboring central station, and, on the other hand, boilers would be required in the event of a new steam engine being put down.

The above represent only the main points that can be put forward in favor of the electric drive, and there is a very large number of additional advantages which, whilst small in themselves, serve to advocate its use. Amongst these may be mentioned the cleanliness of the drive, the small cost of upkeep, reduction in oil consumption, information easily available as to the actual demand on the prime mover for varying classes of material and draughts, and many others.

The advantages carrying the greatest weight vary with the varying conditions of each equipment, and when any new scheme is under consideration, a full knowledge of such factors is essential for a true estimate to be made in this respect. Take, for instance, the saving

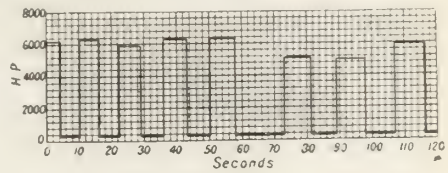


FIG. 3. POWER DEMAND OF SECTION MILL.

of space; this naturally is of greatest importance when a plant is installed in the centre of a town where it is impossible to extend, and every square foot of ground is valuable. Such an instance occurs in the Birmingham district, where motors have been installed under the floor, and also on platforms under the roof to leave the floor space clear for mills. Where a new plant is being laid out with ample ground at command, this argument has not nearly so much weight.

Equipment for Tin Bar Rolling

The layout of the motor house for driving a 30 in. reversing finishing mill for tin bar rolling is given on page 142.

The motor in this case was designed to give a maximum peak horse-power of 5,300, and is direct coupled to the mill, the speed being variable in either direction between 0 and 180 revolutions per minute. The cooling of such a machine, owing to the periods at which it is at rest, is not so satisfactory as in the case of a continuous running motor, and, consequently, a forced draught is blown into the machine by means of a motor driven fan, to produce the necessary cooling. To prevent an undue amount of dust settling on the windings of the machine, which ultimately might cause trouble, a filter is introduced which cleans the air before it reaches the motor.

Equipment for Reversing Work

When designing an equipment for reversing work, two main factors have to be taken into consideration—first, the maintenance of a steady demand from the supply in place of the rapidly recurring peaks called for by the mill, which may exceed 20,000 horse-power, and, secondly, the reversal, in a simple manner, of a mill motor, the rotating portion of which may weigh up to 120 tons.

These two difficulties are met by the introduction of a motor generator flywheel set, the fly-wheel acting as a reservoir of energy. The motor driving the flywheel is calculated out on the average load taken by the mill over a period, and may be of ¼ or even 1/6 of the horse-

power of the mill motor, depending on the class of work being done, the difference in power between the demand of the mill and the power of the fly-wheel motor being either given out by, or stored up in the fly-wheel, as the power demand is greater or less than the average.

The reversal of the motor is done very simply by altering the direction of the

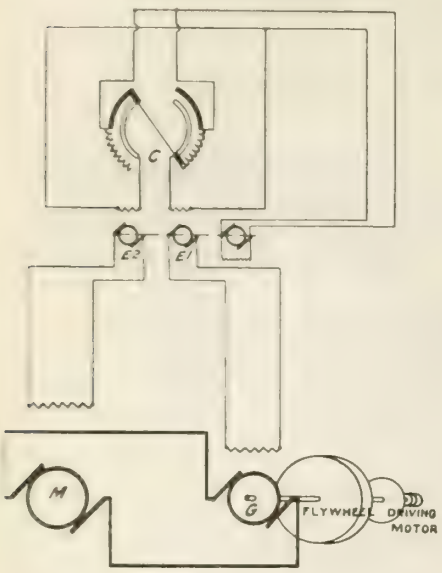


FIG. 4. DIAGRAM OF CONNECTIONS.

current supplied to its armature by the generator of the fly-wheel set, the control of the latter being done by varying its field current in strength and direction. Thus, no armature currents, which may exceed 8,000 amperes, need be controlled.

As the use of this type of equipment is coming rapidly into prominence, a short description of the method of control is, perhaps, not out of place.

The operator for the mill is on a platform raised over the live roll track on the incoming side of the mill, and the whole of the control of the speed and direction of rotation of the mill motor is done by means of a lever moving backwards and forwards in a straight slot. The centre position of the lever corresponds to a state of rest of the motor, and a forward or backward movement gives a rotation in the one direction or the reverse.

This procedure is similar to that adopted in the case of a steam drive, but where it differs in an important particular is that each position of the lever corresponds to a definite speed of the mill motor independently of the power being given. Thus, under no circumstances can the speed of the motor exceed the maximum for which it is designed, and the racing so noticeable with a steam engine when the metal leaves the rolls is entirely avoided, and the attendant stresses produced eliminated.

It may be mentioned also at this point that the stored energy in the rotating parts of the motor is, on reversal, not wasted as in the case of an engine, but restored to the fly-wheel and thus rendered available for the next pass.

Method of Control

The function of the control lever is to vary the field currents of a small motor generator set embodying two generators, the armature output of which is used for exciting the fields of the variable voltage generator and the mill motor respectively. With the control lever in the central position, the field current in the exciter supplying the variable voltage generator is at zero, whilst the field current in the exciter supplying the mill motor is at maximum. Thus you have the condition that the mill motor is fully excited whilst the variable voltage generator is at zero voltage. A forward or backward movement of the lever serves to raise the voltage on the generator supplying the mill motor armature by acting on its exciter, and the speed of the motor corresponds to the voltage thus applied and its direction of rotation to the design of the voltage. This raising of the voltage continues until the maximum speed is reached, at which the full torque is required, after which a further movement of the lever weakens the mill motor field through its exciter and the speed of the motor increases to its maximum value. Constant horsepower, that is, reducing torque with increasing speed, is given throughout this latter portion of the speed range.

Fig. 4 shows in skeleton the diagram of connections for the plant, E 1 and E 2 representing exciters of the variable voltage generator and mill motor respectively, C being the main controller and M and G being the mill motor and variable voltage generator.

This method of control, whilst somewhat cumbersome to explain, is very simple in practice, as the only currents to be controlled are those flowing in the fields of the small exciters, the value of which in this instance represents only 1/3 of 1 per cent. of the full-load current of the mill motor. The controller itself is consequently of very small dimensions, and takes a form not widely different from the well-known face-plate type crane controller. In earlier plants the control was carried out by varying the fields of the mill motor and variable voltage generator themselves, but this entailed the use of somewhat complicated cantractor gear, which is avoided under this later arrangement.

The fly-wheel motor generator set consists of an 1,800 horse-power 3-phase induction motor, a 30-ton 12 ft. fly-wheel, and the variable voltage generator mentioned above, the working speed varying between 500 revolutions per minute and 390 revolutions per minute.

The set is carried in four bearings and mounted on a combined bed-plate, the fly-wheel bearings taking half the weight of the machines, which are placed one on each side of it.

The Fly-Wheel

An interesting feature of this plant is the type of fly-wheel employed. To keep the weight of the wheel a minimum whilst embodying at the same time a large stored energy—the value of this latter being 100,000 horse-power seconds—it is necessary to use a fly-wheel with a very high peripheral speed of the order of 20,000 ft. a minute.

Fig. 5 shows a cross-section of the wheel, and indicates the method of bolting up. This design lends itself very easily to perfect balancing, which is essential for satisfactory running, an out-of-balance on the rim of 1 lb. exerting a pull equal of 500 lb. To reduce the windage losses to a minimum, the sides of the spider are enclosed by polished steel plates, and a cover surrounds the outer rim of the wheel for the same purpose. when first experimenting with high-speed fly-wheels, a test was made to see whether any considerable saving in windage loss could be obtained by running the fly-wheels in vacuo, but it was found that more power was used in maintaining the vacuum than was saved by adopting this practice.

Special means are adopted for lubricating the fly-wheel bearings, oil at a pressure of about 300 lb. to the square inch being forced in under the shaft by means of small gear pumps, one for each bearing. These pumps are driven by belts from the fly-wheel shaft, but on account of the importance of maintaining a continuous supply an alternative set of motor-driven pumps is provided, which are used for starting-up purposes, and also as a stand-by to the belt-driven pumps.

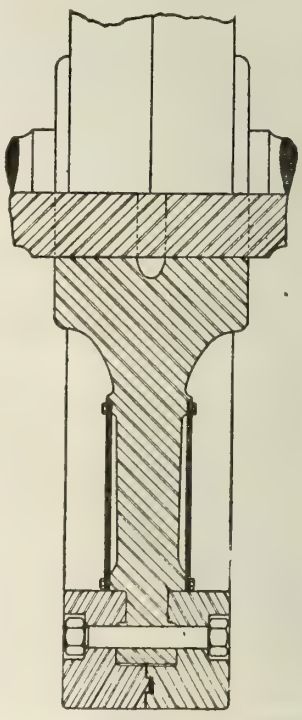


FIG. 5. SECTION OF FLYWHEEL.

The oil on its return from the bearing is first passed through a filter and then through a cooling tank before being used over again. In addition to this forced lubrication system, oil rings are provided, which serve the purpose of keeping the plant running for a short time in the

event of the failure of the forced lubrication.

The interchange of power from and to the fly-wheel is brought about by means of an automatic slip regulator. This consists of a water resistance, the value of which is altered by raising and lowering suitably shaped metal plates in the tanks containing the water. The movement of the plates is brought about by a so-called torque motor, which can be seen in the illustration. This machine is similar to an ordinary induction motor, but the rotor is prevented from moving by the restraining force of the plates. The weight of these serves to counterbalance the tendency of the rotor to move at such times as the normal current is being taken by the motor driving the fly-wheel set. When a piece of metal enters the rolls there is a heavy demand for power from the fly-wheel set generator, which power would, under ordinary circumstances, be reflected in the power given by the motor driving it. In the present instance, however, as soon as the current taken by the motor tends to rise, the torque motor, which is controlled by this current, exerts a larger turning moment and raises the plates, thus inserting an increased resistance in the rotor of the driving motor, which, consequently, falls in speed, and the make-up power between the demand of the mill and the normal power of the motor driving the fly-wheel set is given out by the fly-wheel. When the metal leaves the rolls the demand from the mill immediately falls below the normal and the reverse action takes place: the weight of the cable connections leading to the motor and they are lowered into the liquid, thus reducing the resistance in the rotor, and the motor speeds up, restoring energy in the fly-wheel.

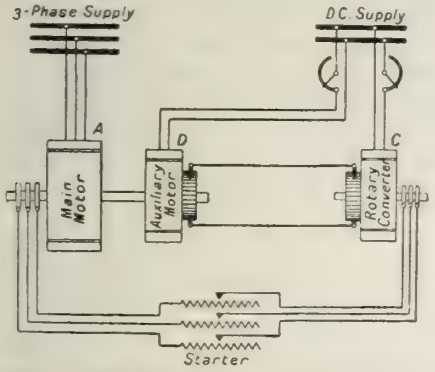


FIG. 6. DIAGRAM FOR 16 IN. MERCHANT MILL.

A speed variation of 20 per cent. is usually allowed on the fly-wheel set, thus rendering available for useful work 36 per cent. of the total stored energy of the fly-wheel. The torque motor is operated by a series transformer mounted in the cable conections leading to the motor of the fly-wheel set, and by having tappings on this transformer a simple adjustment varies the power taken by the motor. This is of service when rolling lighter material, as the average demand from the power station can be reduced proportionally, and in the case of the plant in question, one-half the normal power has successfully been used on certain classes of material.

Instrument

Mounted alongside the control lever is an instrument pillar which serves to give the driver full information as to the operation of the complete set. An ammeter indicates the power being given at any moment by the mill motor, whilst an indicator simultaneously gives the speed at which this motor is revolving. Three lamps which light up at different speeds of the fly-wheel set give information as to the reserve power in the fly-wheel, and if the lamp corresponding to the lower working limit of the set comes in, it is necessary to roll slowly until such time as the fly-wheel set has regained its speed, as otherwise the mill demand would be reflected on the supply and the driving motor would be overloaded.

Motor Drive for 16 in. Merchant Mill

The illustration, Fig 6, represents the motor drive for a 16 in. merchant mill for rolling general sections, with an output per shift up to 140 tons. The motor installed was rated for a normal continuous output of 1,000 horse-power with an overload capacity of 25 per cent. above that figure for two hours, and 100 per cent. momentarily.

The mill consists of three stands of rolls working three high, of which two stands are employed when rolling angles, and three stands when rolling rounds, and is fed from a continuous heating furnace within a short distance of the incoming side. Power-driven live rolls work on both the incoming and outgoing sides of the mill.

To meet the various classes of work dealt with in a merchant mill a variable speed is essential, and the question arose as to how this could best be obtained with only a three-phase power supply available. It was decided finally to to adopt a composite set which, whilst taking power from the supply, gave all the characteristics of a D.C. motor, such as easy and efficient speed control, constant horse-power, i.e., increasing torque with reducing speed, and a drop in speed from no load to full load without loss of efficiency, so that a fly-wheel could be beneficially utilised.

A number of other drives of this type have been employed throughout the country with good results, but in modern practice it is now more usual to install rotary converters connected to the three-phase mains, which generate direct current which is applied directly to a direct current motor on the mill.

Fig. 6 gives a diagrammatic arrangement of the plant and its connections.

The power, which at the lower speed would normally be wasted in the rotor resistances, is taken to the slip-rings of

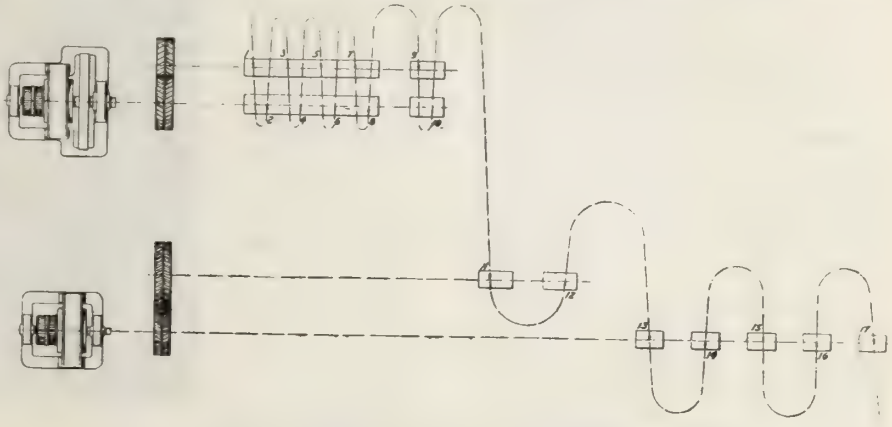


FIG. 7 LAY-OUT FOR A 7-IN. WIRE ROD MILL.

a rotary converter C, and is there transformed to direct current power which is delivered back to the direct current motor D, which is coupled directly to the induction motor. Consequently, the reduced horse-power of the three-phase motor with reduced speed is compensated for by the increased power of the direct current motor, the horse-power output of the set remaining constant independently of the speed.

The motor set is designed for a constant output of 1,000 horse-power at any speed between 75 and 150 revolutions per minute, the lower speed and increased torque being used when rolling the heavier sections. A flexible coupling mounted on the motor shaft extension couples up to a 40-ton 14 ft. 6 in. diameter fly-wheel, which is connected directly to the mill. The speed control of such a plant is carried out by altering the field of the direct current motor D. by means of a shunt regulator mounted on the switchboard, and by having this auxiliary motor compound wound, a fall in speed is automatically produced between no load and full load, thus enabling the fly-wheel to give out a portion of its stored energy when the peak loads occur.

Drive for 7 in. Wire Rod Mill

A diagram of the layout for a 7 in. wire rod mill is given in fig. 7. The mill consists of two sets of rolls, the bolting and finishing rolls respectively, and these were originally driven through belts from the two engines mentioned above. When the new drive was installed the belting was done away with and two motors were directly coupled, one to the bolting roll train and one to the finishing roll train. The bolting rolls are of the double two-high type with repeaters

behind the rolls, and the finishing train is three-high, and the wire is looped by hand in the usual way with this type of mill.

Before the size of motors and generating plant was definitely determined, careful tests were taken on the existing steam engines as a guide to the power required. This was necessary, as the drive represented the first example of a wire mill to be electrically driven in this country. An ample margin was allowed on the power so obtained to cover the greater output it was proposed to roll in the mill, and the motors finally installed were of 400 horse-power for the bolting rolls and 550 horse-power for the finishing rolls. The generating plant was designed for an output of 750 kilowatts at 440 volts direct current, the turbine being of the mixed pressure type.

The incoming billet for the bolting rolls is about 2 in. square, and leaves this train of rolls with an area of about $\frac{1}{8}$ square inch. This passes straight forward to the finishing rolls, and as many as ten passes may be occurring simultaneously. The normal size of rod finished is about 3/16 in. in diameter.

The 2 in. billet enters the bolting rolls with a length of about 3 ft., and heavy draughts are taken on the first few passes, resulting in short but heavy peak loads. The average demand for power throughout this period is comparatively small, and the motor is designed from the usual point of view, viz., that of the average demand rather than that of the peak demand. This has two advantages, the first and most important being that

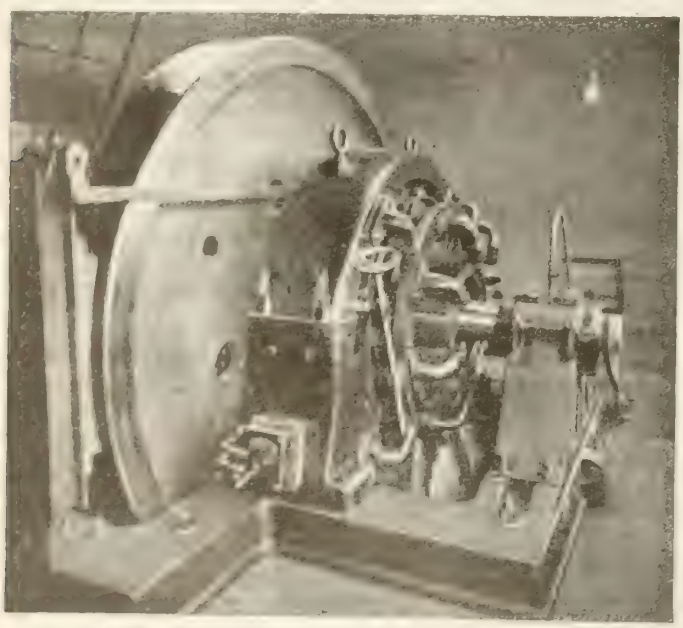


FIG. 8. FLY-WHEEL FOR WIRE ROD MILL.

the peak loads required from the supply are reduced in value and lengthened in time, thus giving a much more favorable condition for efficient working. Secondly, the capital cost of the plant is reduced. The difference in power between the average demand and the peak demand is obtained from a fly-wheel inserted between the motor and the mill, which automatically has its speed reduced during such periods of load.

A cast steel fly-wheel, about 15 tons in weight, 12 ft. 6 in. in diameter, was supplied in the present instance and arranged in the manner seen in Fig. 8.

The armature of the motor was mounted directly alongside the fly-wheel and the whole supported by two solid bearings carried on an all-round bed-plate. This method has the advantage of considerably reducing the overall length of the drive and of avoiding any form of coupling between the motor and the fly-wheel.

The motor, to meet the varying classes of work, was designed with a speed range between 190 and 270 revolutions per minute, at full load, and a compound winding automatically gives a fall in speed from no load to full load, so that the stored energy in the fly-wheel may be utilised.

To ensure good commutation under all conditions on load, a compensating winding is added to the field to neutralize the heavy armature reaction which occurs on peak loads. This practice, whilst adding slightly to the capital cost involved, is fully justified by the improved commutation which results.

A director mounted on the frame of the machine is used for shunting a portion of the current flowing round the compound winding, and enables the fall in speed between no load and full load to be adjusted at will, thus on light material the average speed of the motor can be kept up by using a less drop in speed.

The finishing mill motor—Fig. 9—is also of the variable speed type, the range being 400 to 550 revolutions per minute at full load. No fly-wheel was employed in this case, as the peak loads, owing to the long length of material rolled, persist for an appreciable period, and an equalising effect could only be obtained by having a fly-wheel of a

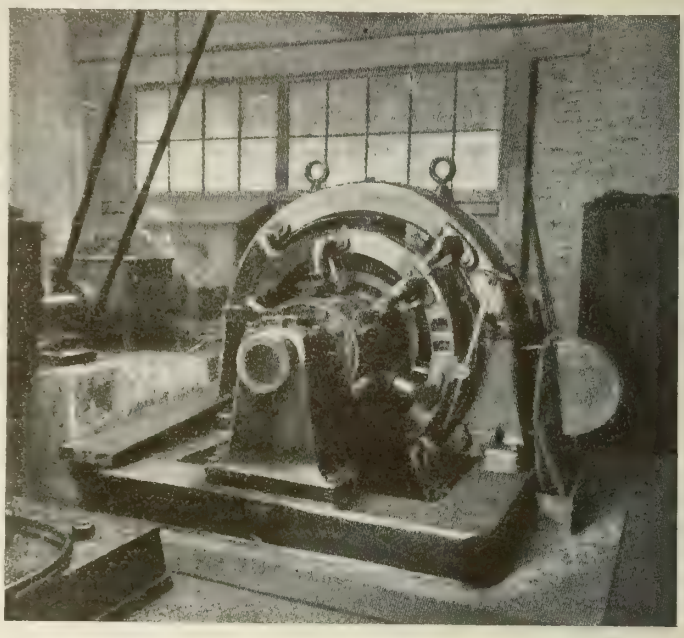


FIG. 9. MOTOR FOR FINISHING MILL.

weight which would prove a non-commercial proposition. The results obtained from this drive were so satisfactory that the conversion of the remaining plant has been proceeding steadily since that date, and three additional motor drives have been installed. The mills are engaged on general merchant work which, from its variety, necessitates, for efficient rolling, a wide range of speed on the motor. This in turn renders the employment of direct current motors almost obligatory, and for this reason the generating plant was of the direct current type.

It may be stated generally that direct current motors have proved themselves more suitable than three-phase motors over a wider range of work, and for steel works practice it would appear as though such motors would be the more widely adopted in the future.

Methods of Driving

In the above-mentioned examples the motors have been direct coupled to the mills, and have run at the same speed. This practice is one which can be recommended as being the most efficient, and, at the same time, the most reliable as any form of transmission, whether gear or ropes is omitted. Such direct coupled motors have been used even for sheet mill drives where a speed of, perhaps, 30 to 35 revolutions per minute has been necessary, and although the adoption of such a slow speed increases the capital cost of the plant, yet in most instances the efficiency saving can be shown to justify such a drive, particularly when taken into conjunction with the elimination of the upkeep of ropes or gears, and the extra cost involved, when considered as part of the capital cost of the com-

plete mill, represents only a fraction of the total.

In certain cases, and particularly where an existing drive has to be converted, it may be necessary to have some form of transmission drive, such as gear or rope, the most usual reason for adopting such transmission being the desire to put down the electrical plant without stopping the mill. It is also usually somewhat less costly to have high-speed motors with some form of reduction to the mill.

FUEL SITUATION IN WAR TIME*

By T. Britt†

NEVER in the history of the world has coal been of such vital importance, it is the life-blood of the nations engaged in this unfortunate world-wide war, and the success of the Allies is very largely dependent upon its increased production and careful conservation.

It was customary in former years to send the surplus coal produced in Eastern Canada to the New England States and from Western Canada to the Western States. Central Canada and that part west of the Great Lakes and as far as Brandon being supplied with American coal.

The total production of Canadian coal prior to the war was 15,000,000 tons per annum, and in the United States between 500,000,000 and 600,000,000; the latter being the production for 1916.

During the year 1917 Canada will produce nearly 2,000,000 tons less, and the United States approximately 50,000,000 tons more than in 1916. But as the increase in consumption is approximately 100,000.000 tons, there is a shortage of 50,000,000 tons to be made up by elimination of wastage.

Sending Eastern and Western Canadian coal to the United States and American coal to Central and part of Western Canada was with the object of sending coals by the most suitable rail traffic routes and waterways, and providing more even distribution.

If the Eastern Canadian coal was moved west it would be against the current of traffic to Fort William, and if Western Canadian coal was moved to Eastern Canada it would put onto railroads the burden of transporting the longest distance on the American continent.

What Is Expected of Us

The United States Government has been very considerate towards Canada, and will continue to be so, the intention being to treat Canada on an equality with any state in the Union, but, while doing this, they expect and insist that we do the same as they doing, viz., inaugurate a campaign for the intensive conservation of fuel.

It is not the purpose of this paper to point out in what way our share of the deficiency is to be made up, it being principally a matter of good engineering and true fuel conservation in the boiler-room.

Canadian railways have already reduced their annual passenger train mileage by 10,000,000 miles, and have further decreased the fuel consumption by lengthening out the times of other trains and by eliminating fast freights and instead running trains with full tonnage, and by equipping locomotives with superheaters, and the best known modern means of lessening fuel consumption.

The Canadian Pacific Railway has been helping the cause by breaking up and using old ties for fuel—this even at considerable expense of labor, train service, etc., gathering and handling.

The United States have also made a start in reducing their passenger service and loading their trains to the tonnage limit, thereby affecting a saving of several million tons of coal per annum.

Action Advocated

I think that we should go further, and I would submit to the consideration of this club the necessity of the mechanical members getting together and inaugurating an active educational campaign among the firemen, both locomotive and boiler-house men.

To my mind this should not be done by printed instructions but by actual illustration by competent firemen. While it is all very well to write a fireman and tell him what he should do, it is far more educational for a competent instructor to show how it should and could be done.

There is a lot of fuel wasted by automatic stokers not receiving intelligent attention from the fireman. The stoker itself when in proper working order will do all that is required of it, but there are, however, occasions when it will not do what it is supposed to, it is then that a properly instructed fireman will give necessary assistance with a consequent saving in fuel.

The majority of our passenger trains, particularly the sleeping cars, are overheated—it being largely left to the discretion of the colored porter as to what is considered a comfortable temperature, the result is that the temperature is kept up to a point that means comfort for the porter and discomfort for the passengers.

Our houses are being maintained at an unhealthy temperature. Pneumonia takes a little more than one man in eight, and therefore it grasps from tuberculosis the grim honor of killing the most human beings.

Man is a marine animal, seven-eighths water, he needs cool air and moisture around him, overheated dry air makes him susceptible to disease, and in a temperature of over 68 degrees it is difficult for men and women to exist healthfully.

If the people can be taught to live in this temperature, the number of pneumonia victims wil shortly decrease. Fresh, cool, moist air is the foe of pneumonia, and persons who keep their houses cool and breathe pure fresh air have no fear of it.

Normal Temperatures

Celebrated doctors have decided that 65 degrees is ample for persons in robust health actively engaged, 70 is too much, with 68 we have a fair healthy average.

Many activities which involve large consumption of fuel, and many methods of using this fuel, which are practically legitimate in time of peace, will be found susceptible of changes which involve very slight sacrifices of material interests but afford opportunities for considerable saving of fuel.

We have in the past been an extravagant people in the use of fuel, and as the war continues it will be necessary to get down to bedrock in the matter of fuel economy.

Manufacturers of non-essentials should during these war times voluntarily forego the manufacturing of such articles before being compelled to do so by Government direction.

Wherever possible water power should be utilized. In wooded districts, of which there are several in Canada, wood should be utilized wherever possible. One cord of hard wood is equal to one ton of coal, and one ton of coal is released for use in war work for every cord of wood substituted. It will be found that there is a vast quantity of dead wood in many sections of the country. It will also be found that the supply of wood in many communities is sufficient for domestic purposes in these parts. This wood in many instances is destroyed as waste, and its conservation will not only serve the patriotic purpose of conserving coal needed to win the war, but will also prove a measure of economy to the user.

In certain districts prison labor might be used as a means of cutting and collecting wood, where, of course, the labor of the prisoners could be utilized without interference with free labor.

As a matter of fact the one practical and needful thing to-day is to save coal in order that our transportation lines and munition plants may have sufficient to carry on. It may be patriotic and a certain amount of pleasure may be derived from singing "Keep the Home Fires Burning," but the saving of one ton of coal is of more practical benefit towards assisting the boys in the trenches than the singing of one hundred songs.

*A paper read before the Canadian Railway Club. Montreal, Jan. 8, 1918.

†General Fuel Agent, C.P.R., Montreal.

THE Advisory Council for Scientific and Industrial Research of Great Britain has made special grants for the purpose of research into the questions of the use of better methods of heating and improvement in the ventilation of dwelling rooms, and of atmospheric pollution, the causes for producing it, its results on public health, buildings, etc., and the value of various means of counteracting it.

Electricity and Hydraulics

PRINCIPLES AND OPERATION OF MODERN ELECTRICAL EQUIPMENT—II.

By A. M. Pere.

IN the study of the principles governing the flow of energy in the form of electricity from the source of supply an interesting illustration presents itself. Several of these principles may be compared very readily with those occurring when the flow of liquids is observed.

When the transfer of electrical energy takes place there must be a source of supply, a conducting medium, and a means of utilizing the energy transferred. The same three conditions apply to the transmission of power by a hydraulic system, or one in which the medium used is water. As will be seen, the analogy can be further extended to take in the facts relating to flow, such as quantity, pressure and rate of flow. One particular limitation must be imposed on the electrical circuit—that it be closed upon itself and have neither beginning nor end, like the circumference of a circle.

Hydraulic Analogy

Fig. 1 shows an imaginary arrangement which might be used to transmit power by means of a pump, a pipe line, and a water motor or water wheel, which we will suppose to be full of water, so as to form a completely water-filled system.

If the valve shown be closed and the pump started up, it is readily seen what relations the pressures in the pipe line will bear to each other, for the pressures between the points A to B, C to D, and E to F will all be equal to each other, and the pressure between the points G to H will be equal to zero.

The gauges shown are supposed to be made of glass filled with mercury and connected up in such a manner that one end of the U-tube is in communication with one side of the system and the other end with the other side. A difference in pressure will indicate its presence by altering the levels of the mercury until the difference in weight will counterbalance the difference in pressure.

There will, of course, be no flow of water through the system, but a pressure will exist between the outgoing or pressure line and the suction line. No power would be transmitted, and if the pump were of the centrifugal type and of the proper design very little power would be needed to maintain the pressure, and that used would be dissipated in the form of friction and heat in the pump itself.

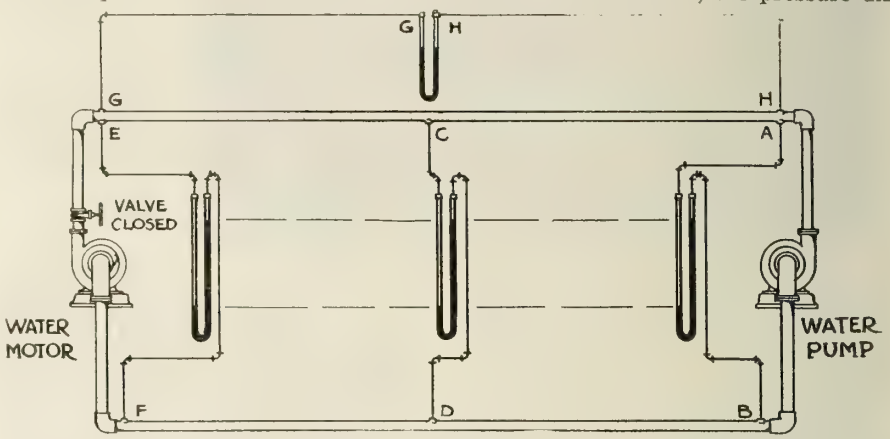


FIG. 1. ILLUSTRATING SIMILARITY EXISTING BETWEEN A HYDRAULIC AND AN ELECTRIC SYSTEM FOR TRANSMITTING POWER. THIS ILLUSTRATION SHOWS CONDITIONS EXISTING WHEN THE VALVE IS CLOSED

Hydraulic Pressure Drop

If now the valve be opened so as to allow a flow of water, the pressure differences would alter immediately, as shown in Fig. 2. The pressure existing between E and F would be less than the pressure between C and D, and still less than the pressure between A and B.

This is easily understood when the friction due to the pipe is taken into account, and it simply means that the whole of the pressure exerted by the pump is not available at the point where the power is to be utilized.

When the pressure between G and H is now measured it will be found to be quite an appreciable amount instead of zero as formerly. This difference in pressure is again caused by the friction losses due to the passage of water through the pipe, and, as the flow of water is increased by the further opening of the valve, it will be noticed that this pressure difference will be found to increase in magnitude.

In view of what follows it should be borne in mind that the pressure generated by the pump tends to create a flow of water, and it is only when the proper conditions are found, as when the valve is opened, that the current of water is established.

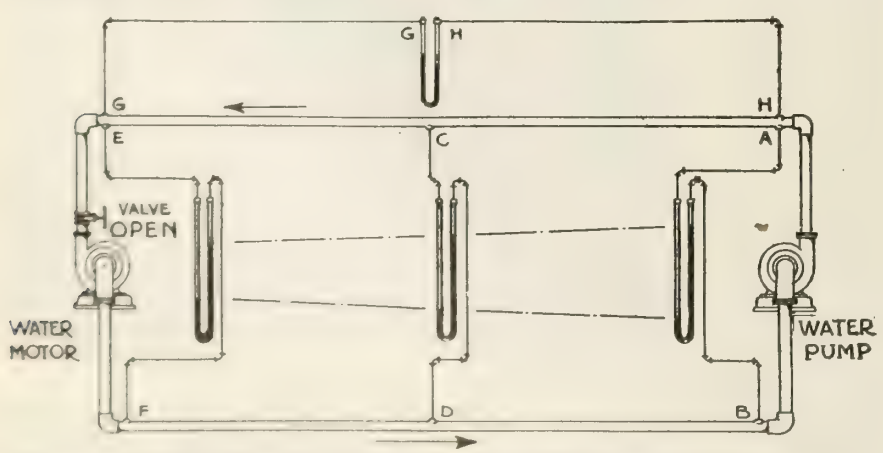


FIG. 2. ILLUSTRATING SIMILARITY EXISTING BETWEEN A HYDRAULIC AND AN ELECTRIC SYSTEM FOR THE TRANSMISSION OF POWER. THIS ILLUSTRATION SHOWS CONDITIONS EXISTING WHEN THE VALVE IS OPENED AND POWER IS BEING TRANSMITTED.

Corresponding Electrical Circuit

In Fig. 3 is shown an electrical circuit similar in its fundamentals to that described above. It also consists of a source of power, two conducting paths and a motor or other means of utilizing the power transmitted.

As before, we will suppose the generator running and the switch shown

near the motor open, so that the motor is not in operation and no power is being transmitted.

When all the meters are read, those across the two sides of the transmission line—that is, those indicating from A to B, C to D, and E to F—will all show the same readings; or suppose voltmeter A B read 110 volts, voltmeters C D and

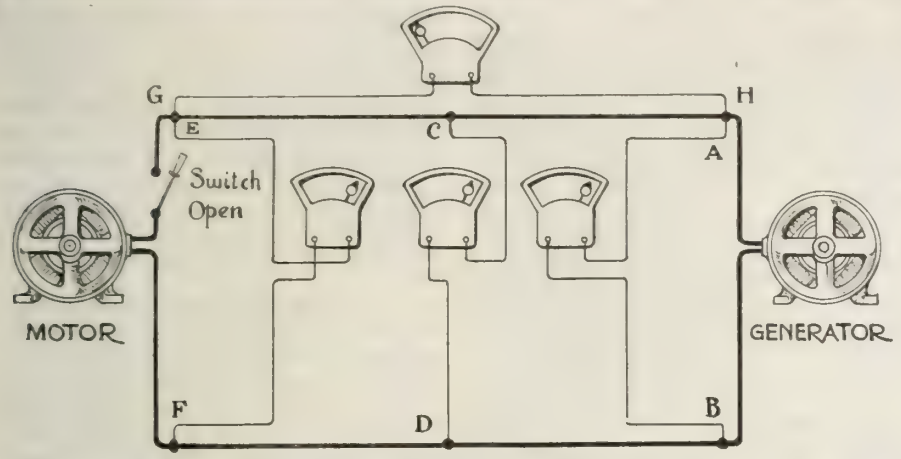


FIG. 3. AN ELECTRIC CIRCUIT ARRANGED IN A SIMILAR MANNER TO FIG. 1. THE SWITCH BEING OPEN, PRESSURE DIFFERENCES CORRESPOND TO THOSE SHOWN IN FIG. 1.

E F would also indicate 110 volts. Voltmeter G H, on the other hand, would show no reading, and would thus indicate that there is no difference in potential between the points to which it was attached.

Now if the switch be closed the motor will start and will deliver power, and a change will be noticed in the reading of all the voltmeters connected with the circuit. (See Fig. 4.)

Change in Voltmeter Readings

Voltmeter A B will indicate slightly less than before, voltmeter C D will indicate less than A B, and voltmeter E F will indicate less than either of the other two; while voltmeter G H, instead of reading zero voltage as formerly, will show a decided reading, whose amount will depend, of course, on the length of line and the characteristics of the circuit.

It will be noticed that the similarity between the behavior of the two systems is very marked, and corresponding to that property of the hydraulic circuit which we term pressure there exists a similar property of the electrical circuit. This property is given various names, such as voltage, potential difference, and electro-motive force (E M F). It is that property of an electric circuit which tends to cause a current of electricity to flow, and, as in the case of the hydraulic system, pressure can exist without a flow of water, so in an electric circuit electrical pressure or potential can exist without causing an electrical current or flow.

The unit of measurement in universal use for this electrical pressure is termed the volt.

Referring to our hydraulic analogy once more, we find another characteristic which may be considered—the amount of water passing a given point in a given time. This quantity is always expressed as a certain amount of water passing a point in unit time, such as gallons per minute or cubic feet per minute.

Rate of Flow

In like manner also there exists a property of the electric circuit—that is, current or rate of flow. This quantity is measured in terms of a unit called an ampere, and an ampere means simply a unit quantity of electricity passing through a conductor in the unit time of one second.

Thus when we speak of so many amperes and so many gallons per minute, we are speaking of properties which, while widely different and having nothing in common, yet convey the same sense to our minds, that of quantity rate of flow.

A question that naturally arises at this stage, and which at times has troubled some students, is, why do we simply say so many amperes and not amperes per second when speaking of current strength or rate of flow, arguing from everyday expressions relating to the flow of liquids, etc.? The answer is, the term ampere includes within itself the idea of time, and it is not correct to say amperes per second in the same way as we say gallons per minute when speaking of rate of flow.

Amperes per second is a term which is analogous to saying feet per second per second, and when an expression such as feet per second per second is used it expresses a change in velocity or acceleration. Later on when the study of alternating current is taken up it will be seen that amperes per second means the rate of increase or decrease in the current flowing, not the measurement of a steady rate of flow.

The Unit of Quantity

Unlike material things, electrical energy can not be measured directly. We cannot speak of it in terms of cubic feet, pounds or gallons, but it can be measured by the effects produced by its presence or flow, and in this respect it is like all other forms of energy.

A definite amount of electrical energy will always produce the same effect or do the same amount of work under the same conditions, and this renders it easy to define a unit of quantity measurement.

In one of the above paragraphs we defined the ampere as meaning the flow of a unit quantity of electricity in the time of one second. This quantity is called the coulomb, and is so chosen that it bears a simple relation to the unit denoting the rate of flow (ampere). The quantity of electricity conveyed by a current of one ampere flowing for the time of one second is called one ampere-second, or one coulomb. Thus when electricity flows at the rate of one ampere during the time of one hour the quantity of electricity which has flowed past any given point in the circuit is 3,600 coulombs.

If I is the number of amperes of current strength, t the number of seconds it lasts, and Q the number of coulombs of electricity thereby conveyed, the relation between them is expressed by the formula:

$$Q = I \times t$$

Example—If a current of 80 amperes flows for 15 minutes the total quantity of electricity conveyed will be $80 \times 15 \times 60 = 72{,}000$ coulombs. This is equal to 20 ampere hours.

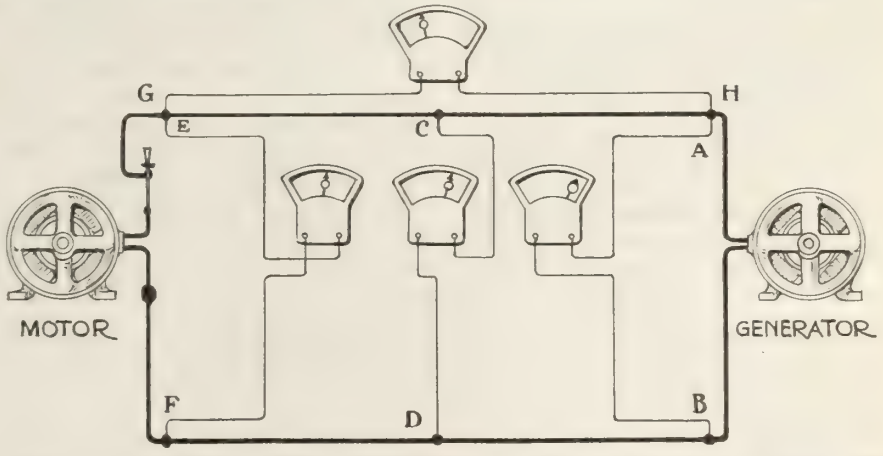


FIG. 4. AN ELECTRIC CIRCUIT ARRANGED IN A SIMILAR MANNER TO FIG. 2. THE SWITCH BEING CLOSED, PRESSURE DIFFERENCES CORRESPOND TO THOSE SHOWN IN FIG. 2.

The coulomb, representing as it does a definite quantity of electrical energy, can be defined with respect to the amount of work done by it, and it has been found that when one coulomb is

passed into a silver plating solution .001118 grams. of silver are deposited.

Resistance

The resistance of an electric circuit to the flow of current through it is readily understood by reference to the accompanying illustrations and by means of the analogy already established. As has been noted above, when no water flows through a system of piping the pressures existing between different points as A to B, B to C, and C to D, Fig. 1, are all the same and no pressure difference exists between G and H; but when water flows through the system, the pressure differences change in comparative magnitude, as was explained under pressure and voltage.

In a water or hydraulic system it may readily be surmised that these differences in pressure have something to do with the friction loss caused by the piping.

In a similar manner there exists a property of the electric circuit which affects the voltage. In Fig. 3 we note that the voltmeters across the two lines all register the same, while the voltmeter across the ends of the top conductor registers zero. When the switch is closed, as in Fig. 4, the relations of all these voltmeter readings change in a similar manner to those of the gauges of the hydraulic system.

From this similarity it may be argued that there is some property of the electric circuit which tends to impede the flow of current through it. This property is called the resistance of the circuit, and is measured in a unit called the ohm. This resistance increases as the length of the circuit, decreases as the area of the conductor is made greater, and varies with the different materials of which the conductor is composed.

Those materials which offer a relatively low resistance, such as the metals, are said to be conductors; while those which offer a relatively high resistance, such as glass, rubber, dry paper, etc., are called insulators.

* * *

Answers to Last Month's Problems

A. Magnetic circuit, armature conductors, and collecting devices or commutator and brushes.

B. Field magnets, with their exciting coils and pole pieces and the armature core.

C. Hard copper segments, mica insulation and steel frame or shell.

D. Carbon, leaf copper and copper gauze formed into suitable shapes.

* * *

This Month's Problems

A. Can electrical pressure exist without the flow of current or energy?

B. To what property do we give the names, voltage, potential and electromotive force?

C. What name is given to the unit of potential?

D. What name is given to that property of the electric circuit which corresponds to the rate of flow in hydraulics?

E. What measure of quantity of electric energy corresponds to the units used in everyday life, such as gallons, pounds, etc.?

F. If a motor runs for 2 hours and takes a current of 50 amperes, how many coulombs of electricity will have passed through the motor?

G. What is the unit in which resistance is measured?

SEARCHING FOR BURIED SHELLS

AS an example of the uses to which abstract science may be put the application of the induction balance to the finding of unexploded shells on the battlefields of Europe is of more than passing interest.

In the early days of the Hughes' induction balance the hope was expressed that the balance would aid in the prospecting for certain magnetic ores and would also aid the surgeon in the probing for iron and steel objects embedded in the flesh.

The Génie Civil of November 10 gives a description of a portable induction balance used for spotting live shells.

The problem was simply to devise a suitable portable instrument which would function properly, and at the same time would be easily carried.

The instrument consists of a pair of primary and secondary coils, so combined with a telephone and a "hummer" or vibrator that, when the one primary comes near a mass of iron, a sound is heard in the telephone, whilst the telephone will remain silent when the two primary circuits are exactly in the same condition. As the symmetry will rarely be perfect, a regulator is added to the instrument by means of which balance is established each time before use. The two pairs of coils are wound on two wooden discs, C and C^1, 60 cm. in diameter; the I and I^1 are the two primaries which, in the application of the instrument, are lying flat on the ground, and S and S^1 are the two secondaries; the distance between the centres of the two discs is 1.5 m., about 5 ft. The jointed arms with which the coils are connected in the way the diagram shows are made of wood; at the apex is the wooden handle, of which the observer takes hold; the main weight of the instrument is, however, taken up by a strap which is carried over the shoulder. The regulating device mentioned is mounted at the apex. It consists of two small concentric coils; the outer one is inserted in the primary circuit; the inner coil, in the secondary circuit, can be turned, and the angle between the two coils can thus be varied between 0 deg. and 90 deg. The vibrator and the induction coil and battery of three cells which actuate the vibrator are placed in a box which is carried by the observer's assistant; a flexible conductor joints the two parts of the instrument. The weight of the instrument is not mentioned. In conducting his search the observer, followed by his assistant, walks over the ground, keeping the flat coils as near the ground as is advisable and listens in the telephone, having previously tuned the regulator to silence. It is stated that a shell of about 10 kg. weight is easily discovered by this test if buried to a depth of 40 cm. or 50 cm.; a hand bomb would betray itself if buried to a depth of 30 cm. The maximum depth stated is only 20 in., which is not much. Fortunately the plow and spade of the farmer rarely approach this depth, and as live shells are dangerous objects this device should prove very useful.

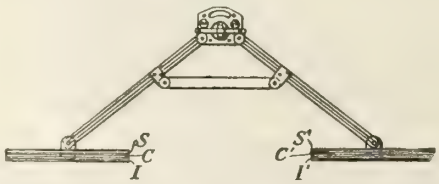


DIAGRAM OF INDUCTION BALANCE USED FOR SHELL FINDING.

It is said that experiments are proceeding for enlarging the range of the instrument, and improvements may be expected. It must be borne in mind, however, that the balance is a differential instrument, and that with greater depths and greater masses of iron, the differential effect on the two coils would be diminished; the coils and their distance apart would thus have to be enlarged, and the portability of the instrument would suffer. On the other hand, live shells are dangerous objects, especially to the farmer. Fortunately, his plough and spade do not, as a rule, go deep down into the earth.

URGE DEVELOPMENT OF HOME FUELS

FOR the purpose of studying Canada's fuel situation from every angle, an important body of civil engineers drawn from all parts of the Dominion met in session in the Physics Building of the University of Toronto, on March 26 and 27. The Canadian Society of Civil Engineers devoted two days of the convention to an exchange of views upon means of making Canada independent of the United States in regard to fuel. The first day's programme took account of the necessity for extra immediate production and systematic conservation of coal in order to tide the country over the next year or two of war scarcity, but it covered more particularly the problem in its larger sense. Full emphasis was placed in the various addresses upon the imperative need of developing Canada's fuel resources so that in the future when the supply in the United States falls short, the industrial life of the Dominion will not suffer. Increased production of bituminous coal in the Western and Maritime provinces and of peat fuel in Ontario, together with radical economies in the use of coal, were proposed.

AN air compressor cylinder unlike a steam cylinder requires only a small quantity of oil, a drop once in four or five minutes should be sufficient. The use of too much oil should be avoided as it causes an accumulation of carbon that may choke the valves and passages.

ELECTRICAL PORCELAIN

THE problem of securing desirable electrical and mechanical properties in the manufacture of porcelain used in the electrical industries is one beset with many difficulties and, while the products of some companies stand very high tests and seem in every way ideal insulators, the products of some other companies are well-nigh worthless.

Those who know the cause for this variation in quality do not seem to be inclined to distribute the information, but in general a porcelain mass will be the more resistant, the higher the proportion of kaolin and felspar also the finer the grain of kaolin used the higher will be the maturing point of the porcelain produced.

Composition

According to a paper by Arthur S. Watts appearing in the transactions of the American Ceramic Society the leading materials used in porcelain manufacturing are certain kinds of kaolin, which are very slightly plastic, quartz and felspar. Ordinary felspar displays basic properties in the fire, uniting with the silica to form silicates. Therefore the kaolin content must be in a definite ratio to the quartz and felspar for the production of desired insulating qualities.

Too much quartz makes the body too little plastic, thus making it difficult to work, and after burning the ware shows impressions and some warping due to the tendency of the clay substance to contract. Too high a content of felspar makes the body soft and liquid and increases the tendency to crack. A body low in felspar does not produce sufficient vitrification and hence decreases its insulating efficiency.

A porcelain body may shrink 15 to 18 per cent. and it is very important that the exact degree of shrinkage be known. No crazing or shivering is allowable in the glaze used on ware for electrical materials. If the glaze is too infusible the ware is likely to be dull, and if too fusible it is likely to be covered with blisters. Investigation has proven the condemnation of glazes containing metallic oxides to be unfair. Metallic oxides when used in glazes combine with silica forming silicates.

The plain bell used for low potentials and which is also practical and satisfactory for alternating currents up to 1,000 volts, does not meet the requirements of modern high voltage transmission lines. Up to tensions of 3,000 volts the ordinary double bell 75 mm. wide and 100 mm. high suffices, but above this voltage the question of further improvement arises.

At first insulators were glazed and burned, resting on the bottom edge of the bell, but the roughness of this edge seemed to cause the collection of drops of water and to prevent this, the insulator is now glazed all over, the glaze removed from the head and the insulator burned; the insulator is by this means made much more resistant and need not be so thick. The weight of porcelain used in the insulator is not of the greatest importance, but rather the quality of the porcelain and the kind of glaze.

Manufacturing Methods

In Europe, insulators are made by all five of the clay working processes, viz., turning, pressing, jollying, casting and dry pressing. The writer stated that he was familiar with all these processes except casting, but was not prepared to pass judgment on the superiority of any given process of working, as of course the product and its shape and size would greatly influence the method chosen. Dr. Seger, in his work, shows very conclusively that a semi-dry process in which the material to be pressed contains the highest percentage of water permissible for good pressing, gives the densest and strongest bodies. The turning of large insulators is done similarly to all clay turning, the product being made mouth up and the top finished when the ware is sufficiently dry to permit of its being inverted. For making threads, threaded tube like steel tops, or automatic boring apparatus is used.

Pressing is done in moulds. Clay is placed in the mould in a lump and by means of a plunger its exterior is forced to assume the shape of the inside of the mould while the plunger shapes the interior.

Dry pressing produces more exact shapes than any other method. The moulds used are of steel and are very expensive. The body must be in such shape that it will not stick to the mould. To obtain it in this condition some factories use the following process.

The clay, after drying and being thoroughly pulverized, is placed in wet cement or plaster boxes and allowed to absorb 10 per cent. to 20 per cent. moisture. The mass is then sieved thoroughly. Ten kilograms of the body will contain about 1 to 2 litres of water. Of course this proportion must be maintained exactly in order to insure a uniform shrinkage.

The moulds are sometimes complicated and are often composed of insertions. Ware is threaded by means of a screw inserted in the bottom before the clay is introduced and which is screwed out rapidly by means of a crank. The tendency is to make insulators without threads as these have always been a great source of trouble and loss in manufacture.

Porcelain which is not perfectly vitrified does not possess any great insulating efficiency even when perfectly dry.

Essential Properties

Essential properties of an insulator are: That it possess first of all a high efficiency as a nonconductor, that it stand without snapping any reasonable strain put upon it and that it withstand blows of missiles, etc., without breaking. Electrical, abrasion and tensile tests are made to show these properties in porcelain tested.

From a study of the electrical resistance tests it has been found that every specimen standing a superior test has a high silica and moderately low alumina content.

In series showing the effect of alumina content no great difference is shown in ability of specimens to resist abrasion. Much the same statement would apply to series showing results of varying of silica, medium high silica specimens seem to chip worse than extremely high silica specimens, while the low silica specimens show a lack of ability to resist abrasion.

The conclusion reached is that a moderately high silica and alumina content will bring a good strong porcelain but that not over 1 per cent. alumina and 6 per cent. silica should be used.

Shrinkage tests showed that there are three factors that may cause a variation. (1) The amount of clay substance introduced; (2) the variation in the kind of flux used; (3) the amount of silica present. Hence shrinkage may be varied to suit almost any case.

In closing it may be said that an ideal porcelain for electrical purposes may mature at any point between cone 6 or cone 12.

The bodies of high resistance porcelain in use in the United States employ potash almost exclusively as a flux, although some few may contain a small quantity of lime. The formation of small cavities in the porcelain weakens it remarkably in resisting strains. Porcelain must be thoroughly vitrified so that moisture cannot penetrate it.

FULL WAVE MAGNETIC RECTIFIER

By J. N. S.

THE accompanying illustration shows a full wave magnetic rectifier for charging storage batteries.

A battery, if not kept fully charged, loses part of its capacity for renewal, due to the hardening of the plates, and no treatment can bring it back to its first satisfactory condition.

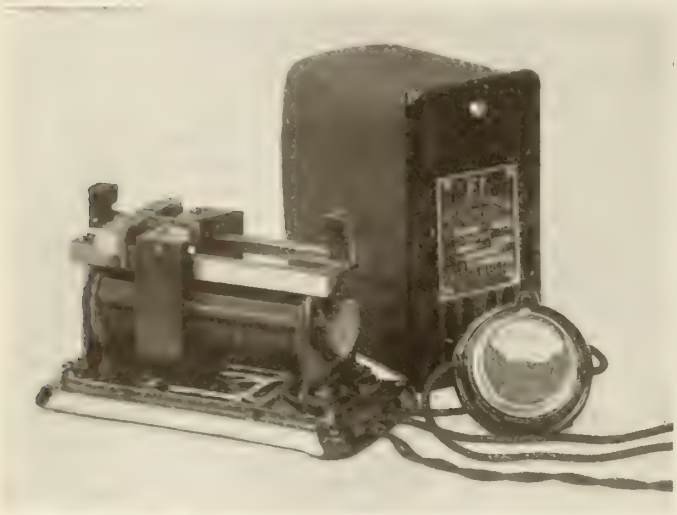
It is well known that most light and power current is alternating, that is, to reverse direction about sixty times a second and cannot be used to charge batteries. It is the purpose of the rectifier to change alternating current to direct charging current as it flows into the battery.

As to its operation, it may be said that the line voltage is reduced to the proper charging voltage by a special transformer and both the positive and negative halves of the alternating current wave are rectified into a steady unidirectional charging current which makes the cost of charging so low that the rectifier quickly pays for itself.

This device saves time, money and trouble, and it makes every lamp socket a charging station. It takes only a minute to screw the plug on the end of wire into a lamp socket and connect the other two wires to the battery, and the battery will be charged in a few hours without removal from the car, and at no more expense than for burning a 100 watt lamp for the same length of time. A complete charge for the average starting and lighting battery costs about six cents, which is at the rate of half a cent an hour to operate.

It is stated that the rectifier charges the battery in the most efficient manner. The charge starts at a high rate, from 10 to 15 amperes, which brings the temperature of the battery up to normal

working condition. This reduces the time required for charging, and as the charge nears completion the rate gradually reduces itself, due to the rising battery voltage, resulting in what is known as the "tapered charge." This tapered charge is impossible with any charging means which operates at a fixed low rate, but is automatically taken care of by the rectifier.



MAGNETIC WAVE RECTIFIER FOR CHARGING STORAGE BATTERIES FROM ALTERNATING CURRENT CIRCUITS

It is of interest to note that the rectifier is self-starting and not affected by line failures—if current is turned off, battery cannot discharge through the rectifier—and when current is turned on the rectifier starts itself, thus night charging is safe and saves time. An alternating current service requires the magnetic rectifier. Various types are portable and of 60 watt capacity, operating from lamp socket on 100 to 130 volt, 60 cycle alternating current. One form of this device will charge a 6-volt battery or two or more 6-volt batteries connected in multiple at an average rate of 10 to 15 amperes. It will fully charge the average starting and lighting battery over night. It measures 5 by 7 by 9 inches and has a weight of 14 pounds.

HIGH POWER SINGLE-RUNNER FRANCIS TURBINE

By F. R. A.

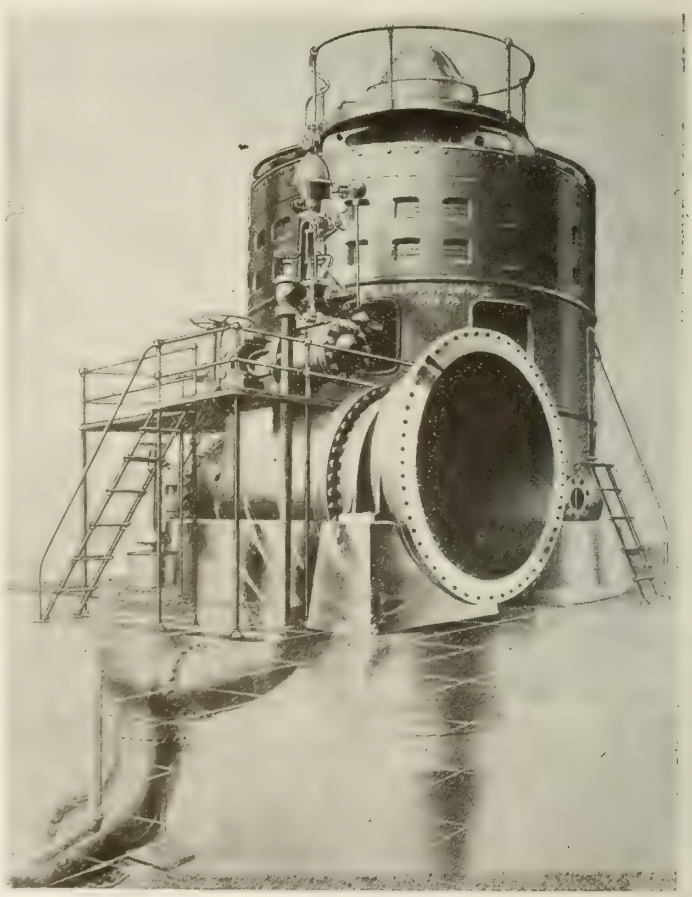
THE accompanying illustration shows a 12,000 h.p. single-runner, Francis turbine recently installed in the Roosevelt plant of the United States Reclamation Service as developed at the S. Morgan Smith works at York, Pa.

It may be stated that the installation of first machinery in the "Roosevelt" power station dates back a decade ago, at which time the original turbine unit was built. There have been installed three duplicate units of the first type used, each consisting of a 30½ in. wheel, having a maximum capacity of about 1,250 horse power, under 220 feet head. The plant was laid out for a total development consisting of six units, all of which are now supplied from the same pipe line and all of which are vertical shaft turbines, directly connected to vertical shaft generators.

It is of interest to note that the No. 4 unit is of a little larger capacity than the No. 3, consisting of a 36½ in. wheel, while the No. 5 unit is an exciter unit, driven by a 17 in. turbine. Each of these units is mounted in a spiral, cast iron pressure case, on top of which is mounted the generator. The No. 6 unit, however, is of much greater capacity than any of the others and consists of a vertical shaft, scroll case, Francis type unit, consisting of a 53 in. wicker gate turbine, as shown in the accompanying photograph.

This single-runner hydraulic turbine has a maximum capacity of 11,500 h.p. under the maximum head of 220 feet. This turbine operates at a constant speed of 300 R. M. P., over a range of head varying from 90 feet minimum to 220 feet maximum. This identical wheel was tested in the Holyoke testing flume, and computations made from the Holyoke results showed the wheel to be capable of operating at efficiencies ranging between 84 per cent. and 89 per cent. over this entire range of head. This No. 6 unit was installed and was afterwards tested by government engineers, who obtained results showing even greater efficiency than that obtained at Holyoke, which results are undoubtedly correct, as the operating conditions in connection with the scroll case give the turbine the advantage of the very best conditions of application of the water to the runner at a constant velocity.

It is claimed that the most remarkable part of this entire installation of turbines at the Roosevelt plant is the great range of head over which they are capable of maintaining a constant speed at good efficiency. The unit shown in the illustration is direct connected to a General Electric alternator with direct connected exciter and thrust bearing for supporting the weight of all the rotating parts. The regulation of this unit is effected by means of an oil pressure governor of the Woodward type, designed specially for use in connection with vertical shaft, Hydro-Electric units.



FRANCIS VERTICAL WATER TURBINE WITH SUPERIMPOSED ALTERNATER.

THOUGH the effect of clearance and of heating the air before compressing can be calculated by formulae it is well to bear in mind that the results so found are not always in agreement with actual operating conditions. The leakage of air past valves and piston, the choking of air passages, and bad valve action are variables that cannot be determined by formulae. Volumetric efficiency is most accurately determined by measuring the air delivered and comparing it with the displacement of the compressor; such a method includes all factors affecting the performance of the IF a compressor has poorly designed intake passages, the air as it enters the cylinder may be at a temperature several degrees above that of the atmosphere. The metal of the cylinder becomes quite hot after the compressor has been running for an hour or more, and after travelling through long and intricate passages the air may be heated to 100° or over.

Notes on the Design and Testing of Air Lift Pumps-II.

By A. W. Purchas *

The air-lift pump has become one of the most economical methods of raising water, the simplicity of construction and the almost entire absence of moving parts giving reliability in operation and avoiding the necessity for skilled supervision. The design of these pumps being subject to more or less development the subject matter of the following article is of more than passing interest.

Operation of the Pump as a Whole

There are several different methods of approaching this question, one of which was enunciated by Dr. H. Lorens. This takes account of friction and slip, but starts off with a "constant" which the tests by Messrs. Davis and Weidner showed to be as variable as any quantity can be. This theory is not reproduced here as it is cumbersome, and does not bring out the features of operation of the pump.

Another method of approaching the subject brings out better than either of the foregoing the details of operation of the process, and may be called the Displacement Theory. Fig. 7 represents the pump prior to the injection of any air. Since the base of the eduction-pipe is open, the pressures on both sides of the horizontal plane X—X are equal, and the liquid stands at the same height inside the pipe as outside.

Fig. 8 represents the conditions after a single bubble of air has been injected. The weight of this bubble of air is negligible when compared with an equal volume of liquid, and the bottom of the eduction-pipe being open the pressure on the two sides of the plane X—X will remain balanced; therefore there must remain in the eduction-pipe after the injection of the air the same volume of liquid as before. The liquid displaced by the air must therefore move upwards, raising the surface of the liquid inside the eduction-pipe above that outside.

Let H be the amount of the rise.

V be the volume of the air bubble, and A be the cross-sectional area of the eduction-pipe. Then

$$H = \frac{V}{A}$$

The injection of the volume V of air has done work equal to ½VH due to displacement alone, but the bubble will rise through the column of liquid, expanding as it does so and thereby increasing H. Neglecting friction, none of the energy originally contained in the air-bubble is lost until the bubble breaks the surface of the liquid and escapes into the atmosphere. When the air has finally escaped, then it may be said that the energy has been wasted in slip; but not before.

Supposing the air to be injected into the eduction-pipe at such rate that before the first bubble escapes to the atmosphere the total volume accumulated in the eduction-pipe, say V^t is such that the head $\frac{V^t}{A}$ is greater than the lift L.

Then the pump will discharge a volume of liquid equal to A (H—L). This is the volume that is violently discharged when an air-lift pump is started up. The loss of this volume from the eduction-pipe produces an unbalanced head, equal to H—L, on the plane X—X, which will force more water into the base of the pump. From this point onwards the operation of the pump may be regarded as a head H—L forcing liquid into that area of the eduction-pipe, which is not already filled with air. Analysis of the published results of tests seems to show that the great loss in the pump is not by slip, but of this head H—L due to entry losses.

Tests yielding high efficiency always show either one or both of the following features: low velocity of the rising mixture through the foot-piece, or else a low ratio by volume of air to liquid at this point which is the result of great submersion. The effects of great relative submersion may, however, be offset in many existing wells by the relative high velocities of the mixture leaving the eduction-pipe with consequent high friction losses. All of which suggests that the eduction-pipe should be of as great cross-sectional area as the well permits from its base to at least the level from which the liquid is being raised. The loss by slip of this length is negligible, as we have seen, and the larger the pipe the less will be the loss of the head H—L. Above this point, however, the velocity of the rising mixture must lie between certain definite limits, otherwise the loss by slip will be excessive; therefore the area of the eduction-pipe must bear a definite ratio to the volume of mixture flowing through it. What this ratio should be cannot definitely be stated on the data at present available, but it is hoped that the ideas here put forward may lead to more thorough tests being made of pumps in the future, and the publication of the results.

If the velocity with which the air-bubbles will rise through the liquid can be calculated, then the total volume of air in the eduction-pipe at any instant of time can be found from the known rate of ejection. If this volume produces a head less than the lift, then with the submergence fixed, a greater rate of air-supply must be used for the pump to deliver any liquid. If the rate of air-supply is fixed, then a greater submergence must be provided, in which sufficient air can accumulate to produce the necessary head. A definite volume of air must be accumulated below the water surface inside the eduction-pipe for the pump to work at all.

At the other extreme it is conceivable that the air could be injected at such high rate as to entirely hold back all liquid from entering the base of the eduction-pipe, once the original contents were discharged. Such a state could hardly be obtained in any pump installation, but probably could be brought about with a 2-inch eduction-pipe, 12-inch air-pipe, and high rate of air supply. Experiments bear out these statements, for a series of tests on a pump at increasing rates of air supply show that below a certain rate there is no discharge. Above this point the discharge of liquid increases with the rate of air supply, and then begins to grow less as the rate of air supply is still further increased, Figs. 9, 10, 11.

This Displacement Theory also shows that the volume of air required to raise a given quantity of liquid is independent of the density of the liquid, if we neglect losses from friction and slip. However, the pressure equivalent to the required submersion, and therefore the energy contained in the air injected, varies as the density of the liquid.

Submersion of the Air Injection Foot-Piece

There is no rational formula known that will determine the most efficient value for the submersion, and only a few published tests touch on the point. Messrs. Davis and Weidner made many small scale laboratory tests which are very inconclusive. Mr. Edmund Ivens also records some tests on a large scale in his book, "Pumping by Compresed Air."

The Displacement Theory, already outlined, shows that the submerged portion of the eduction-pipe is primarily necessary as an accumulator for the air. As will be seen later (pages 25 and 26), there is no such thing as a definite volume of air required to raise a given quantity of liquid to a given height, as the volume of air varies according to the submersion adopted. This conception of an accumulator for the air suggests that greater proportionate submersion is required for low lifts than for high, and that rather than bear a fixed ratio to the lift, the most efficient value will bear a definite relation to the rate of air supply and cross-sectional area of the eduction-pipe.

Current practice favors greater ra-

*Read before the Institute of Electrical Engineers. November, 1917.

tios of submergence to lift the lower the lift, and the following values are a fair average:

Lift	Submersion Ratio—Submersion / Lift	Submersion
25 feet	4.00	100
50 feet	3.00	150
75 feet	2.33	175
100 feet	2.00	200
150 feet	1.70	255
200 feet	1.38	275
250 feet	1.22	305
300 feet	1.00	300

Messrs. Davis and Weidner report as the result of 108 tests on a lift of five feet with submergence varied from 30 to 88 per cent.: "The efficiency increases as the percentage of submergence increases for all rates of input, and all practical percentages of submersion." It seems quite possible that a rational formula for determining the most efficient submergence may in time be developed from the Displacement Theory.

A Method of Designing Air-Lift Pumps

To the designer who lacks the data which the larger manufacturers have accumulated, the following method is suggested:

Let L be the lift in feet.

S be the submersion in feet.

V^w be the volume of water to be pumped per minute in cubic feet.

V^a be the volume of air required per minute measured at atmospheric pressure and a temperature equal to that of the water to be pumped.

P^a be the absolute pressure per square inch of the atmosphere.

P^s be the absolute pressure per square inch of the air under the submersion head S.

Then the energy supplied by the air to the water is:

$$144\ P^a\ V^a \log^e \frac{P^s}{P^a} \text{ — foot-pounds,}$$

and the work done on the water is 62.5 V^wL foot-pounds.

Then, if the efficiency of the pump were 100 per cent., these two quantities would be equal. In order to apply this method, two assumptions must now be made, namely, the submersion and the efficiency of the pump.

Submersion.—A guide to the probable best value for this has been given already, and these values may be taken, though it will be seen later that they may need modification as the design proceeds.

Accepting these values, then—

$$P^s = P^a + 0.434\ S.$$

Efficiency of the Pump.—This at first seems a very rash assumption, but it is the author's belief that a careful study of this and other papers will show that it is not so. The following test figures stand out as the best so far reported, and analysis of other published tests shows no reason why they cannot always be duplicated:

(1) With the reverse process of compressing air by entanglement with falling water, an efficiency of 81 per cent. has been obtained in Germany, and 71 per cent. at the plant of the Dominion Cotton Mills Co. at Magog, P.Q., Canada. This latter plant was the first installation designed on this principle.

(2) Series D of tests at Oilfields show that an efficiency of 72 per cent. can be obtained with an air-lift pump on lifts of 300 feet, and an analysis of other published tests suggests that in each case higher efficiencies could have been obtained at other rates of working, or by modification of the designs along the lines already outlined. Furthermore, most writers on the subject have in the past conceded that higher efficiencies are obtainable on low lifts than on high lifts.

There is good ground, therefore, for assuming an efficiency of 70 per cent. for all lifts up to 300 feet. This may not be obtained with the first eduction-pipe installed, but in the majority of cases the first eduction-pipe is not the final one, but is installed to find the service pumping level and the capacity of the well. A series of tests made on the first pipe at varying rates of pumping should enable the above efficiency to be obtained with the final one.

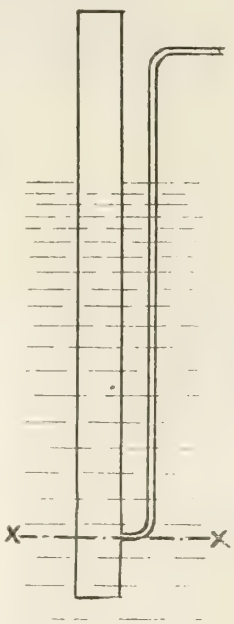


FIG. 7

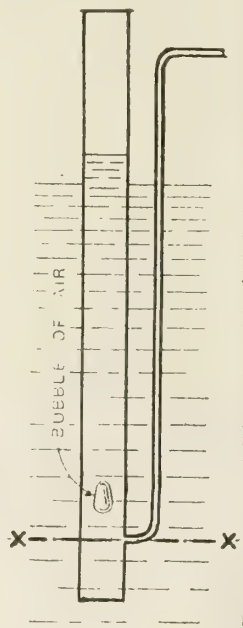


FIG. 8

These two assumptions being made, the volume of air and its initial pressure can be found from the formula:

$$0.7 \times 144\ P^a\ V^a \log^e \frac{P^s}{P^a} = 62.5\ V^w L.$$

It must be borne in mind that the above volume of air is not the same as the displacement of the compressor-piston. It is usually wise to have a reserve capacity in the compressor to cover such factors as encrusted eduction-pipe, a demand for greater output of water, and wear of the compressor itself. The manufacturers should therefore be given the fullest details, since the power required to deliver any volume of air varies very widely with the speed of the compressor, and the ratio of the desired output to the full capacity of the machine. It may be noted here that high volumetric efficiency alone is not the desirable feature of a compressor, nor high mechanical efficiency alone, but the highest combination of the two. The best machine is that which will deliver the required volume of air at the given pressure with the least expenditure of energy in the prime mover. Some of the latest designs of air-valves obtainable do not promise high volumetric efficiencies, but they conduce to high over-all efficiency.

Reference to the tests in the tables will show that 40 per cent. of the energy generated by the prime mover may be wasted in the compressor itself, and therefore that as much attention should be paid to the choice of the air-compressor as to the design of the eduction-pipe and foot-piece.

Having finally determined the best value for the air-pressure, submersion and volume of air required, the air piping, foot-piece and eduction-pipe can be designed. In proportioning the air-pipe, allowance should be made for the temperature of the air leaving the compressor being high, and the volume therefore greater than would otherwise be the case. After making this allowance, the velocity of the air in the pipes should not be over 20 feet per second. The design of a foot-piece has already been discussed, and will not be repeated here, neither the design of an eduction-pipe along the lines suggested by the Displacement Theory. But to enable others to reproduce the design, of which series D of tests in the tables show the capabilities, the original calculations for this pump are here given:

Assumptions and Conditions Based on Previous Tests of the Same Well

Volume water to be raised per second, 0.50 cb. ft.
Volume of air measured at atmospheric pressure and 70° F. required per sec. 3.30 cb. ft.
Lift ..... 300 ft.
Total length of eduction pipe..... 625 ft.
Velocity of rising mixture to be maintained, between .....8 and 15 ft. per sec.
Air pipe to be kept outside eduction pipe.

Available pipe of suitable dimensions:

Nominal Size	Actual I.D. inches	Cross-Sect. Area sq. ft.
4-inch line pipe	4	0.087
5 3/16-inch casing	5	0.136
6¾-inch casing	6¼	0.210

Calculations

Pressure of air on leaving foot-piece —141 lb. gauge—3.30 cub. ft. of air at atmospheric pressure, and 70° F., will be 0.308 cub. ft. at 141 lb. per sq. in. gauge pressure, and 70° F.

The increase in volume of the air is 3.30-0.308 cub. ft. in a length of 625 ft. of eduction pipe, equivalent to 0.0048 cub. ft. per foot-length of pipe.

For a velocity of 15 ft. per second in 4-inch pipe, the volume flowing must be 1.305 cub. ft., which in this particular case will consist of 0.5 cub. ft. of water and 0.305 cub. ft. of air. If L be the feet of 4-inch pipe required between the foot-piece and its junction with the next larger size, then:

$$0.805 = 0.308 + 0.0048\ L,$$

whence $L = 103$ feet.

In the next proposed size—5 3-16-inch casing—a velocity of 15 feet per second will require a volume of 2.10 cub. ft., which will be composed of 0.5 cub. ft.

of water, and 1.60 cub. ft. of air. Calling the required length of 4-inch and 5 3-16 inch pipe combined L_1, then:

$$1.60 = 0.308 + 0.0048\ L_1,$$

whence $L_1 = 270$ feet,

and the length of 5 3-16-inch required is 167 feet.

	ft. per sec.
At foot-piece	9.3
At top of 4-inch pipe	15.0
At bottom of 5 3/16-inch pipe	9.3
At top of 5 3/16-inch pipe	15.0
At bottom of 6⅝-inch pipe	10.0
At top of 6⅝-inch pipe	18.0

Among the more important conclusions to be drawn, which have not been previously emphasized, are the following:

(1) The apparent lack of agreement of different tests with any definite laws is due to two main causes: one, that the volume of air stated to have been used is too often the displacement of compressor-piston, or too high a percentage of this, which introduces an error of 10 to 60 per cent.; the other is the lack of segregation of the losses. For scientific purposes it is obviously useless to lump together the losses in the compression process and those in the eduction-pipe. The former are fairly well understood, but the latter are quite unknown, and will remain so, as long as only tests of the over-all efficiency of installations are made. If the laws governing the losses in the pump proper are to be studied, then a test must give the energy contained in the air immediately after passing through the injection foot-piece.

(2) That the greatest loss in an air-lift pumping installation is in the air-compressor, and therefore that the best compressor is none too good for a permanent installation.

(3) That the next greatest loss is the loss of head at entry.

(4) That any formula for calculating the submersion required would be better stated in the terms of "the volume of air used per second, at a pressure equivalent to the head of submersion," rather than in terms of the lift. This is suggested by the displacement theory conception of the submerged portion of the eduction-pipe as a space for the air to accumulate and raise the water by displacement.

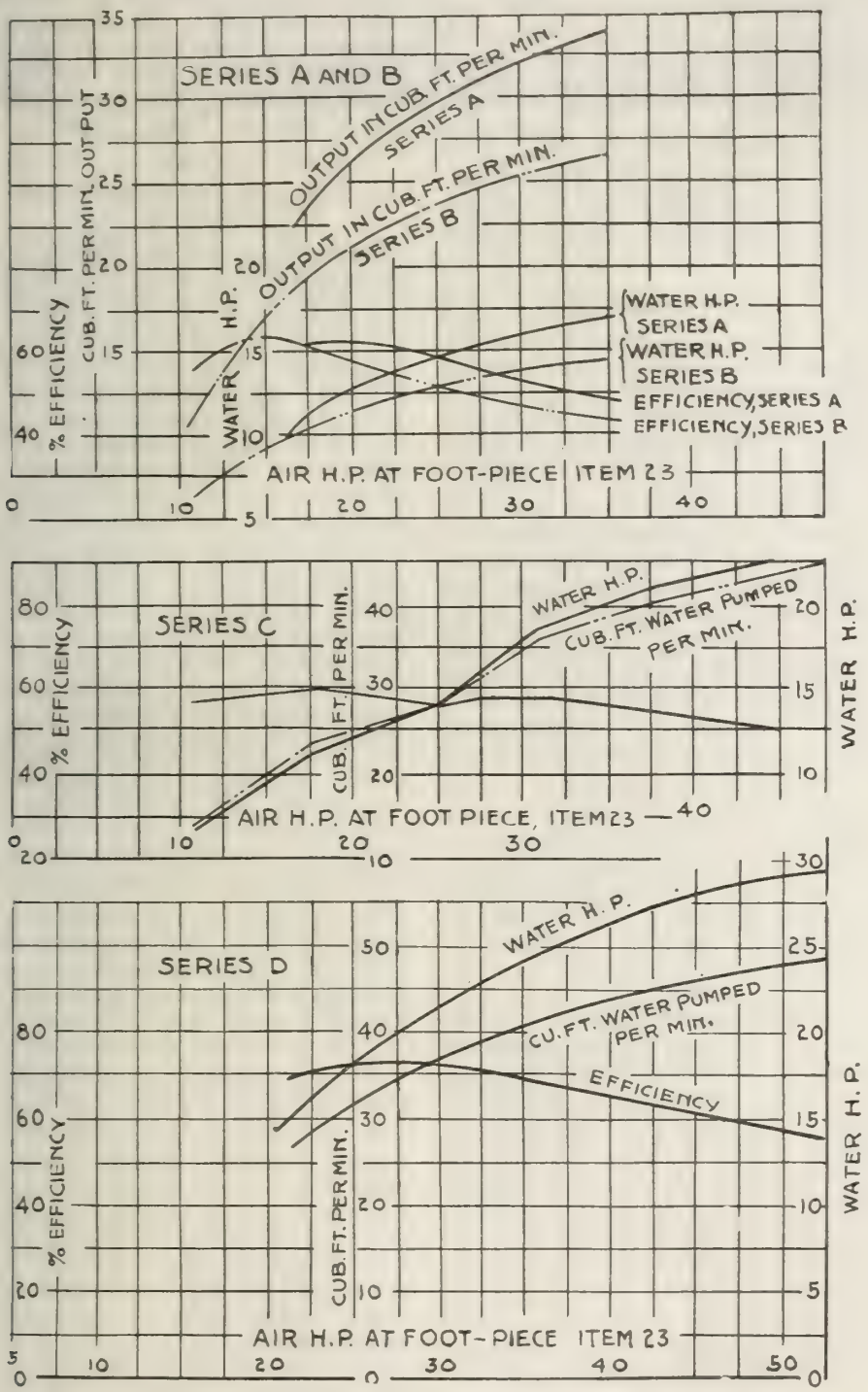
(5) That every ounce of compression which the air is compressed above that pressure, which is equivalent to the submersion head, is so much energy wasted, and that attention should be paid to the design of the foot-piece and the air-pipe with the object of reducing those losses to a minimum.

(6) That a valuable item of information to include in the report of any test is the ratio of the volume of air to water at a point immediately above the foot-piece, and that the ratio by volume of air to water at the outlet of the pump is of little comparative value, since the volume of air is not a measure of the energy contained therein, unless the initial pressure is included in some form.

(7) That the hotter the liquid to be pumped, the higher will be the efficiency of the pump. It has been shown by Professor Randall that an efficiency of 100 per cent. is possible under certain conditions when pumping water at 200° F.

(8) That many flowing oil-wells are in reality "air-lift" pumps, using natural gas in place of air. Mr. A. T. Beazley, A.M.I.C.E., has obtained very encouraging success in making wells flow which had previously to be pumped, by applying to them the principles of the air-lift pump. The great obstacle to be overcome is the lack of control both of the quantity of gas and oil, and of the point of mingling of the two.

(9) That considering the different forms of steam-engine usually used in conjunction with different types of pumps, that the fuel consumption of an air-lift installation can be made to compare very favorably with that of any other type for raising liquid more than 75 feet from a well. For shallow wells centrifugal pumps will probably prove more economical.



FIGS. 9, 10, AND 11, SERIES A. B. C AND D. WATER PUMPED, ETC.

Hence pipe desired is composed of: :

105 feet of 4-inch line pipe.
167 feet of 5 3/16-inch casing, and
355 feet of 6⅝-inch casing—a total length of 625 feet.

[Note.—6⅝-inch casing is the largest size pipe available which can be inserted alongside the air-pipe in the well.]

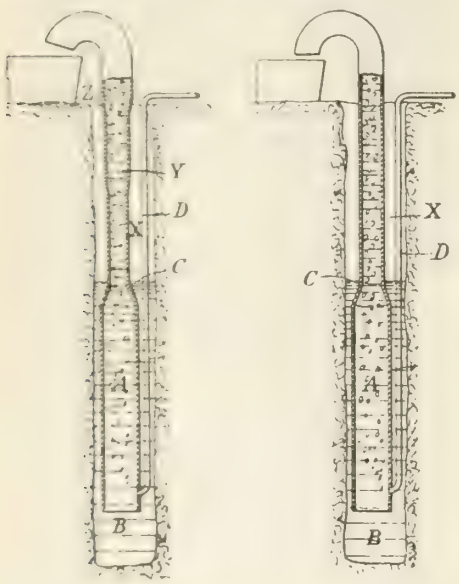
Using the above lengths of pipe, the average velocity of the rising mixture will be:

AIR LIFT PUMPS

A PATENT recently granted to A. W. Purchas of Wolverhampton, Eng., relates to an improvement in the design of air lift pumps whereby a much greater efficiency is claimed.

Experiments by the inventor are said to have proved that there is considerable loss due to friction, sudden changes in velocity and eddies in the submerged portion of eduction pipes of air lift pumps as at present constructed.

This is remedied as shown in Figs. 1 and 2. It is assumed that the eduction pipe A is immersed in a well B, in which the level of the water is at C before the air is forced into the pipe by the air pipe D. The cross section of the submerged portion of the eduction pipe is as large as possible, consistent with leaving of sufficient passageway between the pipe and the inner walls of the well casing to prevent undue frictional losses



rue to the velocity of the flow of water to the eduction pipe.

In the submerged portion of the pipe there will be no loss by slip. At a point near the level C the cross-sectional area s reduced as shown at X. To reduce the frictional losses of the rising mixture the pipe enlarges at Y and again at Z. Fig. 2 shows a modification in which the portion of the pipe above the water level C to the outlet has a constant area which is less than the submerged part.

WARMING BY HEATED AIR

By C. T.

WARMING by heated air should be divided into two methods or systems: one in which the air is warmed by passing over hot-water or steam-heated surfaces, the other in which fire-heated surfaces are used to afford the warmth. When the air receives warmth from hot-water or steam coil, or radiators, no effects prejudicial to the air or health are experienced, the general results are agreeable, and the cost in fuel low.

Whether the apparatus consists of a number of radiators, each in a case or chamber through which air is caused to pass, or whether one large battery of coils or of radiators in stacks has the air blown through it, the result is the same with the air entering the rooms, as it cannot be overheated, or over-dry or carry odors of scorched particles of dust (organic matter). In other words the air is warmed under much the same extent as with the exposed radiators, the only difference occurring when the hidden heating surfaces are not kept reasonably clean. The whole may be looked upon as a hot-water or steam-heating apparatus so far as temperature of the heating medium and cost of fuel is concerned, but the first cost of the installation is usually higher than a hot-water or steam apparatus having exposed radiation.

When the hot-air system has some form of stove as the medium by which the air is heated, it does not follow that the air is given disagreeable qualities, but it is easily possible to do this if the stove is not of a specially suitable kind. Up to a certain temperature a heated surface has no noticeable ill-effect on the air in contact with it, and if the surface is one that cannot be heated beyond the correct degree by careless stoking, for example, then it matters little whether it is a stove, or hot water, or steam that heats the air. A surface heated by fire heat direct and one heated by hot water have no different affect on the air if the temperature of each is alike at all times.

As a rule a hot air installation with a stove is less expensive to instal than one with hot water or steam for the heating medium, while the cost of fuel is very low in both cases. With large installations heated from a central chamber, each may require an air propeller to cause the air to pass along the ducts to the rooms, while with small installations the extracting action of chimneys in the rooms is relied on to induce the warmed air to flow in.

MACHINERY MARKET IN BRAZIL

AS to the requirements of Brazil generally these are exceedingly diverse. In one market alone—that of mining machinery—there are boundless opportunities for the British manufacturer. Mining is, however, but one phase, and one phase only, of the republic's industry. Agriculture, which forms so large a share of the people's occupations, demands increasing supplies of implements and machinery; the many large towns are purchasers of electric lighting machinery, pumping plants, steel rails for tramways and mines, iron and steel manufactures, motors and stationary engines, tubes, structural material, tools, cement, and sewing machines. Windmills, refrigerators, huge quantities of barbed and plain fencing wire, lubricating oils, and innumerable other articles of a similar nature are constantly in repuest.

Neither should the great sugar producing industry be overlooked, with its demands for the latest type of crushing plant and distilling apparatus, while a further opening in the engineering line is to be found in connection with the many irrigation plants and installations of pumping works that are being installed, in addition to the equipment of numerous plants, large and small, to make use of the hydro-electric power available.

The most important of all Brazil's manufacturing industries is, however, that of cotton textile. The principal cities and towns in which textile machinery is needed are those of Rio de Janeiro, Sao Paulo, Petripolis, Sorocaba, Maranhao, Pernambuco, and Bahia.

WATERPROOF WHITEWASH

By B. M.

A NEW mixture has been recently introduced producing a waterproof whitewash. The influence of bichromate of potash on glue, rendering it insoluble when once dry, is made use of as follows: Dissolve 1 pound of glue in 3½ pints of water. Dissolve 3 ounces of bichromate of potash in ½ pint of hot water, and mix the two solutions. Then add enough of whiting to produce the right consistency, and apply in the usual manner. The action of the sun on the potash and glue render them insoluble and waterproof. The mixture adheres firmly to slate, glass, metal, masonry and plaster. Authorities seem to vary on the subject of the amount of bichromate of potash required to make glue insoluble; one-fortieth by weight is considered by many to suffice, in which case one ounce would suffice for 2½ pounds of glue. Again, the weight of whiting that the above amount would hold together and bind to any surface should not be more than could be carried in 4 pints or 2 quarts of water. This is a matter that the experimenter must asecrtain for himself, on a small scale preferably.

Glue dissolved in skim milk becomes insoluble when dry and might serve the purpose, and 1½ pounds of the cheapest sweet oil added to 8½ pounds of quicklime while slaking makes a well known insoluble coating that is available everywhere in India. The pores of the most porous plaster are readily filled with good limewash, and, if it is waterproof, one coat well applied should protect the plaster against saturation. A thick porous wall takes a little longer to penetrate than a thin one, but it also takes so much longer to dry. An impervious outer coating renders them both equal.

The need for cheap waterproof coatings in India is brought to mind in each succeeding rainy season when the monsoon wind drives the water through our very porous walls. Although a damp atmosphere at a temperature of about 80 degrees has no bad effect on public health it is most injurious to household goods and to merchandise of many kinds, besides being destructive to buildings.

THE success of a lay-out of tools is dependent on the sound judgment of the designer, which in turn can only be based on past experience and familiarity with the best shop practice.—Herbert.

Steam and Its Generation

PIPE FITTING

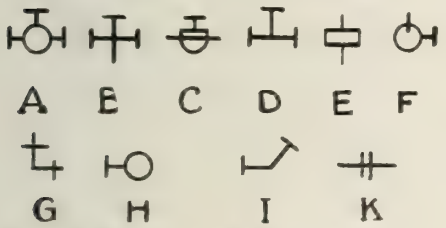
By M. H. Potter

Piping Laying Out

THE conventional signs for pipe fittings and pipe lines are shown in Figs. 1 and 2. Considerable time is saved, when a job of piping is to be done, by putting it upon paper. If the dimensions are laid down, each piece may be cut to the right length, and everything will go together without any further fitting and without spoiling pieces of pipe by cutting them too short. In laying out, always work from the centre of one fitting to the centre of the next, making the correct allowance for the fittings and then adding for the threads. Thus it is necessary to work to the actual dimensions of the fittings in order that the over-all dimensions of the pipe lengths may be obtained. If this rule is followed there will be no errors in purchasing and checking the pipe and fittings, and no trouble in putting them in place in accordance with the drawings.

Testing Pipe and Fittings

Although a piece of pipe is supposed to



A—Globe valve
B—Cross
C—Gate valve
E—Cock or plug valve
F—Riser
G—Elbow
H—Check valve
I—45° elbow
K—Union

FIG. 1. SOME SYMBOLS USED IN PIPING DIAGRAMS.

withstand a certain number of pounds pressure to the inch, there will always be found pieces of defective pipe and fittings. It is therefore necessary to test each pipe system as soon as it is in place. The testing may be accomplished by either steam, water or air. Water pressure is preferable if it can be easily obtained, the leaks show up readily and are therefore more easy to locate. Close inspection when the cutting and erecting is done prevents leaks which otherwise will develop under the test. In most communities the inspection law requires that a certain pressure be maintained for a given time. As steam condenses in pipes a leak can generally be detected from the dripping water, unless the leak is on the top side of a horizontal pipe. Should this be the case, mix a bucket of strong soap-suds using soap powder or soft soap. With a paint brush go over the weld of the pipe and the joints at the fittings. Wherever a leak blows bubbles through the soap-suds, mark with a piece of chalk.

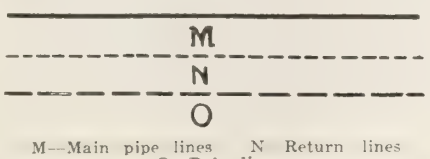
Draining Pipe Systems

Always drain the pipes in the direction of the flow of steam. Do not lead the condensation water back to the boiler by inclining the steam pipe in that direction. There is always danger of water in the bottom of the pipe being held up by steam flow with boilerward drainage; when a sudden demand comes for an increased flow of steam, the water all along the pipe is picked up by the steam rush and forced out of the pipe into the engine or other steam consuming device at the far end of the pipe line. Separators should always be used between engines and long pipe lines, avoid pockets and traps and there will be no trouble with rushes of water into the engine or other undesirable places for condensation water.

Dead Ends and Drips

No matter where placed, a dead-end always fills with water and should always be avoided if at all possible. In a large pipe if the dead end projects vertically upwards, the water may run out as fast as it collects, but unless it is drained in some way, it will surely fill with water. When a circulation has to be maintained in a dead end, a drip should be provided which will take care of the water of condensation as fast as it collects. If this is not done a loop must be made. Either hand or trap operated drips are used to prevent the loss of steam. When there are a number of drips, they may be made to work through a single trap by means of a receiver into which all the drips discharge, the trap taking care of the contents of the receiver.

It is necessary to place a check valve in each drip pipe in order that water may not be blown back into any pipe when that one is not in use and one or



M—Main pipe lines N Return lines
O—Drip lines

FIG. 2. CONVENTIONS USED FOR DISTINGUISHING VARIOUS PIPE LINES.

more of the others under pressure.

Condensation water may be returned to the boiler by the use of a steam loop. This is a dead end, so arranged that when full of water that the water will run out by gravity, leaving the dead end full of steam to repeat the operation. In Fig. 3, the steam loop is shown in connection wtih a steam boiler. A check valve A is placed in the pipe which enters the boiler at any convenient point. The system that is desired to be drained is connected with the pipe D; this acts as a dead end, the check valve closing the lower end of the pipe and against the entrance of steam from the boiler side. Any steam which may be present in pipe D is condensed and runs down upon the valve, filling the pipe to some point in the vicinity of B, or so high that the weight of water on the check valve A forces open that device, whereupon the water in pipe B flows by its own weight into the boiler.

Or a portion of the water flows in, until the weight of water in the pipe is unable to hold the check valve open.

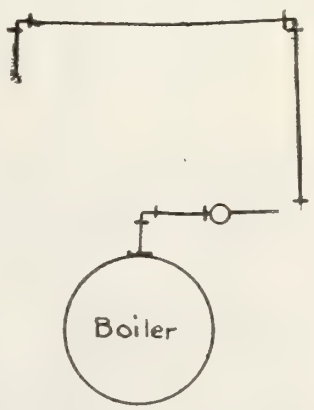


FIG. 3. DIAGRAM ILLUSTRATING THE PRINCIPLE OF THE STEAM LOOP.

Then the valve closes and remains closed until enough water to again open the valve collects in pipe B.

Making Up Flange Connections

Care should be taken to have all union surfaces clean and free from sand, metal chips or any other foreign matter, when making up flanged joints. A good gasket fit can only be secured in this manner. When tightening the bolts between a pair of flanges, make sure that the flanges are brought to an easy bearing, just touching the gasket, and then all the nuts are screwed down easily until they all bear evenly. Then screw up each nut about a quarter of a turn, passing from one to the other until all have had a quarter turn. Then go over them all again and again in the same way, until the joint is tight and the bolts all

have an equal strain upon them. Avoid screwing up one nut tight and leaving another one loose. When the flanges are the same distance apart all around the pipe, then it is certain that the bolts are all bearing evenly and the joint will not leak.

Steam Pipe Expansion

Expansion joints are sometimes used to take care of the elongation caused by the expansion of steam. It is, however, when possible, preferable to use one or two angles in the pipe and let the lever arms thus secured take up this elongation by swinging sidewise. Such a method of connecting two boilers is shown in Fig. 4. The correct arrangement is shown by the full lines and an incorrect one by the dotted lines.

Cutting Gaskets and Packing

By hammering the sheet of packing lightly over the edges of the flange, taking care not to hit with a corner of the hammer, or to strike hard enough to mar the edge of the iron surface, is the best way to cut gaskets, especially for irregular work, although soft gaskets may be cut to measure in advance by a washer cutter. Red lead is the best for a permanent joint but if it is

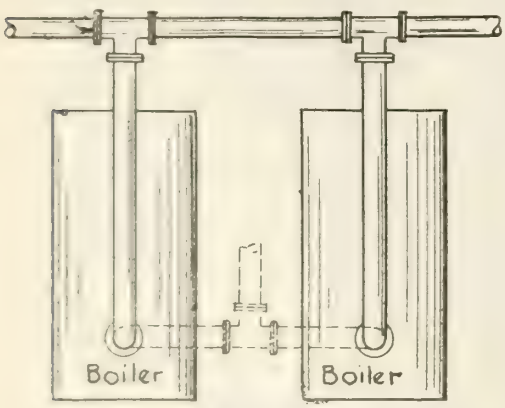


FIG. 4. PROPER METHOD OF CONNECTING BOILERS AND ALLOWING FOR EXPANSION.

desired to remove the gasket whole, cover it with plumbago before making up the joint.

Permanent screwed joints in pipe are made leak proof by the use of red lead. Screwed joints which have to be taken down frequently should be daubed with plumbago; spread it thickly upon threads.

Regrinding and Packing Valves

Soapstone with a little cylinder oil or plumbago should be used in the stem packing of steam valves. The stems of globe valves should be repacked with wicking and either plumbago or soapstone and cylinder oil. As soon as a leaky valve is discovered, remove the bonnet, true up the seat and disk. A good set of valve grinding tools as now on the market should be purchased and used immediately upon the discovery of a leaky valve.

The Proper Use of Pipe Fitting Tools

When cutting pipe with a hack-saw considerable care is necessary to prevent the pipe from ruining the saw. After the teeth cut through the wall of the pipe, while the saw is moving over the cut-through portion on one side of the cut, the saw is moving toward a sharp wedge-shaped section of pipe on the far side of the cut; and when the saw is drawn past this point if pressure is exerted the teeth against which the pipe bears will be split off the saw. It is necessary, therefore, to cut around the outside instead of cutting squarely through it.

A dull tool will not make a good pipe thread. Care should be taken to see that all dies are to size, as a first-class joint cannot be made when the thread screws in the fitting and shoulders. A Stilson wrench should be used rather than pipe tongs; however, chain tongs hold their grip equally as well on large pipe.

MODERN PRACTICE IN APPLYING GAS FIRING TO STEAM BOILERS*—III.

By T. M. Hunter, M.A., B.Sc.

The problem of finding the most satisfactory boiler for gas firing is to be solved by the boiler which abstracts the heat most successfully from the hot gases passing. There are several lines along which improvements can be made.

Possible Improvements

The first is to increase the surface exposed to the hot gases. The greatest resistance to heat transfer is at the hot surface of the tube, and, therefore, this hot surface should be increased greatly without necessarily increasing the wet surface. This has been done in some boilers by fixing projecting pieces or rings of angle iron inside the fire tubes to increase the heated surface, and has resulted in a considerable improvement in heat transfer.

The second method depends on the fact that a square foot of heating surface at right angles to the gas flow is about four times more effective than a similar surface at 45°, and about eight times more effective than a similar area parallel to the gas flow—at ordinary velocities of gas. Deflectors or retarders, of one kind or another, are put into the boiler so as to cause the gases after they have been fully burned to impinge on the tubes as directly as possible.

A third method, and probably the one most commonly used, is to put surfaces of brick or other refractory material in the boiler in such a way that the flames play upon them. These surfaces are raised to a high temperature and transfer the heat by radiation to the boiler tubes. Such surfaces, in order to give the greatest effect, must face the boiler tubes squarely, and must be as near as possible to these tubes. It is quite easy to heat surfaces at right angles to the line of gas flow, but usually very difficult to heat surfaces in the required position, as they generally have to be parallel to the gas flow.

The transfer of heat by radiation becomes much more rapid in proportion as the difference between the temperature of the two bodies concerned increases. From Stefan's law that the amount of energy radiated is proportional to the difference between the fourth powers of the absolute temperatures of the hot body and its surroundings we can deduce the following table:

Difference between Hot Body and its Surroundings	Proportional Am't of Heat Radiated
100° C. to 0° C.	1
200° "	3.3
400° "	12.
600° "	26
800° "	45
1,000° "	70

This table shows the necessity of raising our radiating surface to the highest possible temperature; and this again points to the use of the highest possible gas or air pressure in our burners in order to shorten the flame and make it more intense.

Rapid Gas Travel

A fourth method depends on the theory that the difficulty of heat transfer from gas to metal is caused by a thin layer of cooled gas, which adheres to the surface of the metal and acts as a non-conductor. The stream of hot gases is made to scour very rapidly the surface of the tubes, and in this way the cooled gas is swept away and fresh hot gas is constantly applied. Very rapid heat transfer has been obtained by this means. In Nicholson's experiment a cylinder 10 ft. long was put into the flue of a Cornish boiler so as to leave a passage between cylinder and flue wall of only 1 in. all round. These gases were drawn through this passage at a velocity of 330 ft. per second by a high suction, probably 20 in. water-gauge. They were reduced in temperature from 1,260° C. to 425° C. in the passage, giving up sufficient heat to evaporate 36 lb. of water per sq. ft. of the tube per hour.

The author has had no experience with the Bonecourt boiler, but it is claimed by the makers that the heat is taken out of the gas by means of surface combustion on blocks of refractory material in the tubes, and that the heat is transferred by means of radiation from this material. Whether or not there is any surface combustion in the process as carried on in their latest boilers, the author thinks it likely that the high velocity of the gases through the tubes, in close contact with the walls and heating the refractory blocks, may be sufficient to account for the evaporation per square foot claimed. The suction required—16 in. water-gauge for the larger evaporations, equivalent to a velocity of about 250 ft. per second—would seem to bear this out. Unfortunately it is a costly matter to get these high suctions for the very large volumes of hot gas with which we have to deal in boiler firing.

It will be noticed that each of these methods involves either the use of power or the insertion of some obstruction in the boiler. There is no doubt that boiler users object to have any kind of brick erection inside a flue, as it may burn away and require renewal, and it must be removed to clean and inspect the flue.

The author considers that for existing boilers the method of increasing the heating surface by the use of some kind of metal fitting in the flues is the one least open to objection. In regard to the use of power for forced draught or suction, it must always be remembered (although it is more usually forgotten) that such power is a charge against the boiler and that its costs must be deducted from the efficiency of the boiler before the net efficiency of the latter can be brought out. In some cases the power involved is quite small. To put the gas—or air—under 2 in. pressure, in the case of blast furnace or producer gas, requires power which would only reduce the boiler efficiency by 1½ to 2 per cent., whereas the additional efficiency attained may be from 10 to 20 per cent.

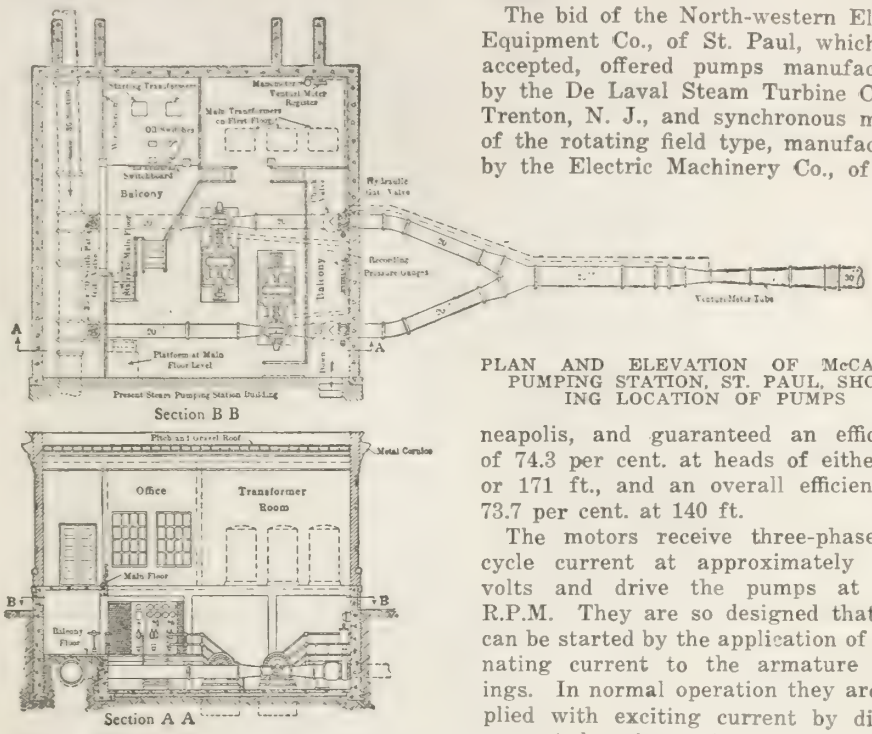
Lancashire Boilers

Boilers of this type are used very largely, and have to be utilized in the best way possible for gas firing. It is a pity that 3-flue and 5-flue boilers are not more often used, as they not only give a larger heating surface, but also allow of smaller volumes of gas being burned in each flue. With smaller volumes of gas it is easier to burn the gas with a small excess of air. A disadvantage of the Lancashire boiler when gas-fired in any of the usual ways is that the fall of temperature in the gases from one end of the flues to the other is not sufficient to set up good circulation of the water, as is done by the intense local heat of the fire when the boiler is hand-fired. In spite of all that is said against gas-fired Lancashire boilers, they will continue to be used and, in the author's opinion, successfully and economically used. As to the output to be got from these boilers, the author has experience of regular evaporations of over 9,000 lb. per hour from and at 212° F. from ordinary 30 ft. x 8 ft. boilers, both with producer gas and with blast-furnace gas. If we notice that the evaporation of 9,000 lb. per hour, i.e., nearly 10 lb. per sq. ft. of heating surface, corresponds very closely to the evaporation per square foot claimed for the Bonecourt boiler at the lower suctions, and that this evaporation is far higher than what we should expect from a water-tube boiler, we may develop a greater respect for the much maligned Lancashire boiler.

HIGH EFFICIENCIES SHOWN BY MOTOR-DRIVEN WATER WORKS PUMPS

MANY pumping problems are most conveniently solved by electric-driven pumps. Such pumps constitute a peculiarly desirable load for central stations, as they operate either at full load continuously, or in some cases are operated only during periods of light load, thus helping to fill up the "valleys" in the load curve.

Where centrifugal pumps are operated by power purchased through a meter, careful attention is likely to be given to efficiency, as a few p.c. in efficiency will in a short time amount to more than the cost of the pumps. The figures showing efficiency and other characteristics of two 12-in. motor-driven centrifugal pumps herein given are taken from a report made by Mr. J. W. Kelsey, principal asst. engineer, to Mr. G. O. House, general superintendent, of the St. Paul Water Dept., and relate to equipment recently installed at the McCarren Pumping Station.



PLAN AND ELEVATION OF McCARREN PUMPING STATION, ST. PAUL, SHOWING LOCATION OF PUMPS

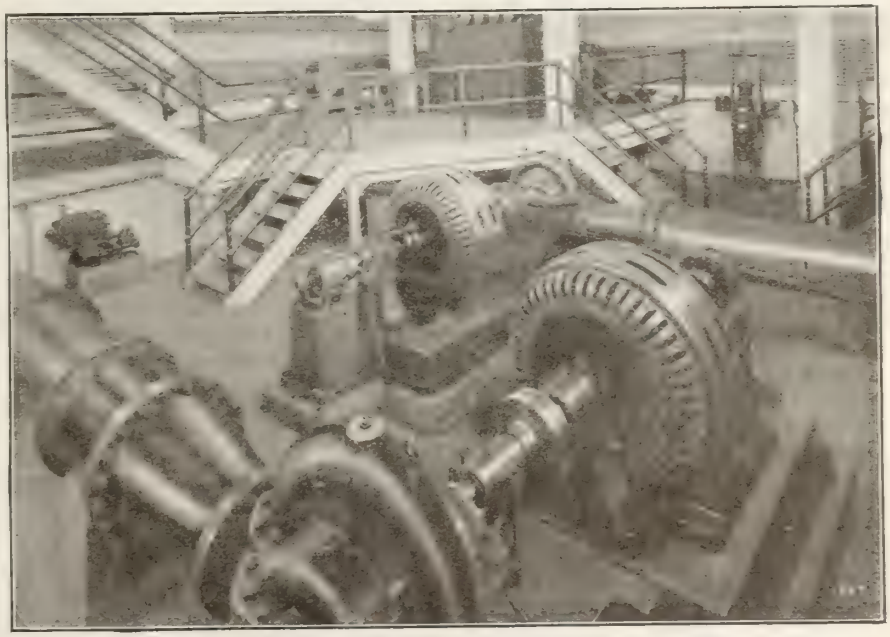
The specifications required that each unit should be guaranteed to deliver not less than 5,000 U.S. gallons per minute against a total head of 171 ft., and not more than 5,500 gallons per minute against a total head of 158 ft., the overall efficiency from "wire to water" to be not less than 72 per cent. when pumping continuously at either of the heads and deliveries. It was further required that when delivering against a reduced head of 140 ft., the motor should not be overloaded.

The bid of the North-western Electric Equipment Co., of St. Paul, which was accepted, offered pumps manufactured by the De Laval Steam Turbine Co., of Trenton, N. J., and synchronous motors of the rotating field type, manufactured by the Electric Machinery Co., of Minneapolis, and guaranteed an efficiency of 74.3 per cent. at heads of either 158 or 171 ft., and an overall efficiency of 73.7 per cent. at 140 ft.

The motors receive three-phase, 60-cycle current at approximately 2,200 volts and drive the pumps at 1,200 R.P.M. They are so designed that they can be started by the application of alternating current to the armature windings. In normal operation they are supplied with exciting current by directly connected exciters of 1¾ kilowatt capacity.

The pumps are of the De Laval single-stage double-suction volute type, having 12 in. suction and discharge nozzles. No diffusing vanes are used.

After installation both units were subected to very complete tests to determine both efficiency and head-capacity characteristics. Before the official tests were run the impellers had been turned down slightly in diameter, due to the fact that the motors were operating at 20 R.P.M. above rated speed.



DE LAVAL MOTOR-DRIVEN CENTRIFUGAL PUMPS. CAPACITY 5,000 GALLONS PER MINUTE AGAINST 171 FT. HEAD.

Before beginning the test, the pressure gauge of each pump was taken off and calibrated on a dead weight testing instrument, and then replaced, the pump stopped and the static head of water determined by finding ahe elevation of the center of the gauges and the elevation of the water in the high service reservoir. The head determined from the elevations was found to agree with the calibration obtained with the dead weight testing instrument. The readings of the suction gauges were also checked against elevations in a similar manner and found to be correct. As they registered zero with no pressure and as the variation in head was never more than 10 ft., it was assumed that readings of the gauges between zero and 10 ft. would be proportional.

The quantity of water delivered was measured by a 30 in. by 13 in. Venturi meter, supplied by the Builders Iron Foundry Co., of Providence, R.I. The recording instrument supplied with this meter includes an indicating dial, a recording card and an intergrating counter, but in order to verify the accuracy of its readings an indicating mercury manometer was also connected to the pressure pipes of the Venturi tube.

The electrical measuring instruments were checked and calibrated subsequently by comparison with standard instruments by representatives of the Northern States Power Co. In running the test, the head against which the pumps worked was controlled by means of a hydraulic gate valve on the discharge side of the pumps. After throttling the gate valve, no readings were taken until all instruments had ceased fluctuating, after which two or three readings were made and averaged, if any variations were found. Observations were made with the pumps operating under four different heads, covering a wide range of delivery.

The results obtained on the official test are shown in the tabulation given below. In computing the efficiencies of the pumps alone, motor efficiences, as obtained on tests of the motors by the University of Minnesota, were used. On motor No. 403,115, the following efficiencies were obtained:

Full load 95.5 per cent. ¾ load 94.9 per cent., ½ load 93 per cent. Motor No. 403,129 gave the following results: Full load 95.3 per cent., ¾ load 94.6 per cent., ½ load 92.5 per cent.

The test results of the units show the variations in head and capacity at constant speed together with electrical horse-power input and overall efficiencies. The efficiencies obtained on these pumps are quite high, considering the comparatively small capacity and the high head. Many builders would advocate the use of diffusing vanes for such conditions, which, however, would make the pump more expensive and complicated without any gain in efficiency. The efficiencies are further very high over a considerable range in capacity. Take for instance, pump No. 25651, which at a capacity of 6,527 G.P.M. shows an efficiency of 81.8 per cent. and at 4,097 G.P.M. an efficiency of 77.0 per cent., or for a reduction in capacity of about 37 per cent., there is a reduction in efficiency of only 5.9 per cent., which must be considered very good for a centrifugal pump.

The pumps deliver slightly more than 5,500 G.P.M. at 158 feet total head, but this was not at all objectionable, due to the fact that the efficiency was very high also at low heads, which in this particular case was of great advantage as can be seen from following quotation from the official report:

"As to the quantity of water pumped, it will be observed that it more than meets the requirements of our specifications. The clause in our specifications limiting the quantity of water to 5,500 gallons per minute when working against a head of 158 feet was inserted to insure a high efficiency at this pressure. It was our belief that the maximum efficiency would be obtained when pumps were working against a much higher head. Fortunately, however, the reverse is true, and our pumps are delivering a greater quantity of water with a higher efficiency than was anticipated at the lower heads.

"As stated before, the friction loss in our force mains is less than computed, with the result that our operating head is somewhat lower than provided in our plans, which explains one of the main reasons for reducing the effective diameter of the impellers. The consequence is a greater quantity of water at a higher efficiency against our prevailing dynamic heads."

	Motor No. 403115		Pump No. 25650		Motor No. 403129		Pump No. 25651	
Volt meter	2230	2230	2240	2240	2250	2260	2270	2295
Rec. watt hr. meter	234.0	225.0	210.0	165.0	224	217.4	204.8	188.1
A. C. ammeter	62	59.5	55.5	44.5	57.6	56	52.4	47.8
P. F. indicator %	100	100	100	100	100	100	100	100
Ind. wattmeter	233.3	226.2	210.1	165.3	226.3	220.2	206.0	188.9
Vent. manometer	9.75	8.50	7.25	4.60	9.4	8.24	7.1	5.9
Press. gage ft.	147.25	165.25	179.25	195.75	146.5	163.0	176.5	186.0
Suc. gage ft. press	4.0	6.0	7.5	10.0	3.2	5.0	6.5	8.0
Total head feet	143.25	159.25	171.75	185.75	143.3	158.0	170.0	178.0
R. P. M.	1220	1220	1220	1220	1220	1220	1220	1220
G. P. M.	6771	5900	5035	3194	6527	5722	4930	4097
Water H.P.	245.1	237.5	218.4	150.0	236.4	228.7	211.9	184.3
Electrical H.P.	312.9	303.3	282	221.7	303.4	295.2	276.1	253.1
Overall efficiency	78.4	78.3	77.7	67.7	78.0	77.5	76.4	72.8
B. H. P.	298.5	289.6	269	209.9	289.0	280.8	262.2	239.3
Pump efficiency	82.2	82.1	81.2	71.5	81.8	81.5	80.7	77.0

TENDENCIES IN BOILER-ROOM PRACTICE

DIFFICULTIES attending power house operation during the past year have multiplied rapidly due to shortage of labor and the necessity of using indifferent fuels. Further aggravation was caused by the unprecedented demand for power and the impossibility of securing deliveries of new plant. Writing in the "Electrical Review" regarding power practice in 1917. I. L. Kentish-Rankin states that the situation has gone from bad to worse. Managements that once chose laborers, when they should have selected chemists, now have to take what is available and to try and keep it. Labor has migrated to more pleasant and better callings, and it is suggested that greater attention to the establishment of more comfortable conditions of working will be necessary.

Men must not be called on to do work which can be effectively accomplished by machines, and more attention must be paid to the ventilation and lighting of the boiler-room. The underfeed stoker has proved of very great advantage in the conditions of last year, since it permits of very high rates of firing, enabling the output of the boiler to be increased in continuous running to 2¾ times the normal rating. Since additional boiler capacity has been practically unobtainable it has been necessary to take overloads by forcing the boilers, and underfeed stokers are now being used with fuels for which the chain grate type was previously considered essential. This has led to much trouble from clinker, but the dilemma before the station management was the adoption of a stoker which could at need work at four times its normal rating, but was liable to form troublesome clinker, or to use another type which gave little trouble in this regard, but could not be forced much beyond its normal working capacity.

The clinker troubles have been aggravated by the necessity of using coals containing as much as 25 per cent. to 35 per cent. of ash and by the high temperatures resulting from the intense forced firing. As a result, ash pits have often proved of insufficient capacity, and with exits smaller than the lumps of clinker to be removed. The size of these lumps has been a source of much trouble. They are not easy to break, and the work is unpleasant. Mechanical ash conveyors which were formerly satisfactory have proved unequal to the new conditions. Moreover, there is much more trouble nowadays in the final disposal of furnace refuse. It is being found profitable to increase greatly the number of instruments in use in the boiler-room. The demand for CO_2 recorders, steam and water meters, is unprecedented, and steps are being taken for the more careful instruction of the staff in their maintenance and use.

Kingston.—At the meeting of the City Council it was decided to purchase engines to supplement the power supply for their street railway system. It was anticipated that a ten-minute service can now be given.

ELECTRICITY FOR THE BRITISH NATION

ONE of the most far-reaching suggestions towards national reconstruction is set forth in an interim report made to the British Ministry of Reconstruction by the Coal Conservation Sub-Committee. The report is now issued to the public with the following preface by Dr. Addison:—

"Minstry of Reconstruction.

"This report, which was presented to the Reconstruction Committee, is issued for the information of the public, and in the hope that the very important matters with which it deals may receive adequate consideration at the hands of all those likely to be affected by its proposals.

"It will be observed that important issues affecting municipalities and public bodies are raised in the report, and they will be explored in all respects by the Government before any action is proposed to Parliament upon the subject. In its legislative aspect the whole matter is being investigated by a Committee appointed by the Board of Trade, and presided over by Sir A. Williamson, M.P.

"(Signed) C. Addison."

The Sub-Committee proposes briefly, to supply all our industries with electrical power generated at big "superpower stations," not more than 16 in number for the whole country, and to eliminate or combine all smaller stations.

The primary object of the scheme is to economise our coal supplies. The amount of coal used in the United Kingdom for the production of power is 80,000,000 tons, at a cost of, say, £40,000,000 at the pithead. The Committee confidently states that, by an up-to-date and national scheme of electrification, 55,000,000 tons of this (£27,000,000 a year) could be saved. This, with a saving of the by-products now wasted by the burning of coal in open grates and boiler furnaces would effect a national economy of £100,000,000 a year.

Economy Possibilities

The most economical way of obtaining power from coal on a large scale is by generating electricity from it. The coal now used, says the Committee, would, if used economically, produce at least three times the present amount of power. An increased use of power is of the highest importance to the future prosperity of the country. It is the best way to increase the net output per head and, therefore, the prosperity of the worker. "The best cure for low wages is more motive power."

In the United States the amount of power used per worker is half as much again as in the United Kingdom. Leaving out of consideration workers in trades where the use of power is small or even impossible, it is probably nearly double what it is here.

It has been settled conclusively during the past 15 years that the most economical means of applying power to industry is the electric motor. In the factories put down for the production of munitions during the war, 95 per cent. of the machinery is driven by electricity, and it is only a question of time for all power to be applied in this way. The problem is not how to apply electric power but how best to generate it.

The development of electricity in this country has been hindered by the numerousness and the smallness of the electrical undertakings. At the present time the supply of electricity in Great Britain is split up among about 600 companies and municipal undertakings. The average generating capacity of such of these undertakings as possess power stations is only 5,000 horse-power, or about one-fourth of the capacity of one single generating machine of economical size, and about one-thirtieth of that of a power station of economical size. Technically and commercially the big generating station is admittedly the best.

Proposed Reform Scheme

The reform proposed by the Committee is to supersede all these small undertakings by laying down throughout Great Britain main trunk lines to be fed by some 16 "superpower stations."

The generating machines in these stations should be of large size, not less than 20,000 horse-power each. In more important industrial districts machines of as much as 50,000 horse-power might be used with even greater advantage. The generating station s should be on large sites with ample coal and water transport facilities. It is contemplated that at each generating station by-products might be extracted from the coal before it is used for the production of power, and that various electro-chemical processes which are essential for this country should be carried on near by. The sites for the stations must be outside, not inside towns. This would improve the health of the great industrial centres by the reduction of smoke, and would relieve the congestion of the railway lines in their neighborhood by practically abolishing the carriage of coal.

Various forms of electricity supply authority, both public and private, are considered. but the committee, on the whole, favors private enterprise. They are "impressed with the special need for initiative and resource in the management of the business of power supply, and they are of opinion that the freedom of range and keenness which are distinctive of private enterprise will be found to be in a high degree conducive to the fullest measure of success."

The 16 great power authorities, whether private companies or public bodies, would be controlled by a National Board of Electricity Commissioners. Existing plants would be handed over on equitable terms to the new authorities. In addition to the main generating stations, subsidiary generating plants would be set up wherever there was surplus gas or waste heat, as at blast furnaces and coke ovens, and the electricity so generated would be fed into the main-trunk system. In the same way, waste coal, which is not at present worth the cost of carriage, and is, therefore, left at the pits, could be used on the spot.

Existing Examples

There already exists in this country a practical example of centralised production of electricity for a large area. The north-east coast district, rather larger in area than Lancashire, is served by a group of power companies from one inter-connected electrical system. The population of this area is less than that of Lancashire, and the area is, therefore, less advantageous for electrical supply. But, whereas in Lancashire, with its multiplicity of electrical undertakings, the price per unit for electric power varies from a penny to twopence or more, the average price paid in the north-east coast district is less than a halfpenny a unit, and the use of electric power per head of population is three times as great. A great saving of coal and reduction of smoke has resulted. Apart from the electric-power companies' consumption, practically no coal is burnt on the Tyne for power purposes, except by the railways and some collieries. The Tyne shipyards may be said to have adopted electricity to the exclusion of all other forms of power. As a result of the adoption of electric traction on the suburban railways, the traffic facilities of the district are greater than those of any other district of similar size. New industries have been established in the district, solely on account of the cheap electric power available. Waste heat and gases have been extensively used for the production of electricity, so that electric power is produced as a by-product of two of the largest local industries —the making of pig-iron and coke. These local generating stations are commonly called "waste-heat stations." The first was erected in 1905, and there are now 11 at work.

The committee foresees, as a result of a national system of electric-power supply, a great increase of the use of electricity for all purposes, with many advantageous results. Factory chimneys would gradually disappear. Railways would be electrified, even for the haulage of goods trains. Smoke would disappear from our towns and coal waggons need run no farther than to the electric-power stations. Electric light would be cheap enough for the poorest, and there would be a large increase in the use of electric heat and power for household purposes.

Extreme Importance

As showing the importance of the scheme the report says: "It is scarcely possible to exaggerate the national importance of a technically sound system of electricity supply, because it is essentially one with the problem of the industrial development of the country."

"The development of such a power system may be likened to the development of the railways of a country, and it is just as impossible to secure economical power generation and supply by each municipal area working independently (which is the position to-day) as it would be to have an efficient railway system if each municipal area owned its own lines

The MacLean Publishing Company
LIMITED
(ESTABLISHED 1888)

JOHN BAYNE MACLEAN - - - - - - - President
H. T. HUNTER - - - - - - - - - Vice-President
H. V. TYRRELL - - - - - - - - General Manager

PUBLISHERS OF

POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air, and Water Power, and to the design and operation of Refrigerating Machinery.

B. G. NEWTON, Manager.
J. M. WILSON, Editor. A. R. KENNEDY, Asst. Editor.
Associate Editors:
A. G. WEBSTER J. H. RODGERS (Montreal) W. F. SUTHERLAND

OFFICES

CANADA—
Montreal—Southam Building, 128 Bleury St., Telephone Main 1004.
Toronto—143-153 University Ave., Telephone Main 7324.
Winnipeg—1207 Union Trust Building, Telephone Main 3449.
Eastern Representative—E. M. Pattison.
Ontario Representative—S. S. Moore.

Toronto and Hamilton Representative, J. N. Robinson.

UNITED STATES—
New York—R. B. Huestis, 111 Broadway, New York, Telephone 8971 Rector.
Chicago—A. H. Byrne, 900 Lytton Bldg., 14 E. Jackson Street. Phone Harrison 1147.
Boston—C. L. Morton, Room 733, Old South Bldg., Telephone Main 1024.

GREAT BRITAIN—
London—The MacLean Company of Great Britain, Limited, 88 Fleet Street, E.C., E. J. Dodd, Director, Telephone Central 11960. Address: Atabek, London, England.

SUBSCRIPTION RATE

Canada, $1.00; United States, $1.50; Great Britain, Australia and other colonies, 4s. d., per year; other countries, $1.50. Advertising rates on request.

Subscribers, who are not receiving their paper regularly, will confer a favor by telling us. We should be notified at once of any change in address giving both old and new.

Office of Publication, 143-153 University Avenue, Toronto, Ontario.

Vol. XI. APRIL, 1918 No. 4

PRINCIPAL CONTENTS

Electricity as a Factor in Modern Rolling Mill Operation 87-91

Electricity and Hydraulics 92-95
Principles and Operation of Modern Electrical Equipment II.....Searchings for Buried Shells....Electric Power by Wind....Electrical Porcelain....Full Wave Magnetic Rectifier High Power....Single-runner Francis Turbine.

Notes on the Design and Testing of Air Lift Pumps II..... 97-100

General 100
Air Lift Pumps....Warming by Heated Air....Machinery Market in Brazil.

Steam and Its Generation 101-103
Pipe Fitting....Modern Practice in Applying Gas Firing to Steam Boilers.

General 103-105
High Efficiencies Shown by Motor Driven Waterworks Pumps....Tendencies in Boiler Room Practice....Electricity for the British Nation.

Editorial 106
Business on an Honorable Basis....Buying Real Coal.

Association and Personal 107

The Operators' Point of View 108-112
Union vs. C.A.S.E.....Hints on Making Water Tube Joints on Steam Boilers....A Single Tank for Oil Storage....Oxygen and Perpetual Motion....Suction Pipe Kink....Gravity Boiler Feed....Does it Really Matter?....Alcohol as a Motor Fuel....Convicted Chemistry....Readers' Query Regarding Flue Gas Analysis.

Operators' Instruction Course 113
Selected Market Quotations 114
Trade Gossip—Catalogues (Advt. Section) 46-48

BUSINESS ON AN HONORABLE BASIS

THE "greasing" method of doing business is not dead. It's been killed as many times as the Turk cruiser "Goeben" has been sunk, and as many executions have been performed on it as are registered up against the iniquitous practice of political patronage.

But it has a powerful come-back. Its recovery is always a little better than its recoil.

When one man or class of men are ready to drop it, there's bound to be another set coming along to pick the old thing up.

However you look at it, it's a poor way to do business. An article that can't travel on its merits is expensive at any price.

The system of paying a man to get a certain line of goods used or introduced into a factory where he occupies a responsible position is a miserable subterfuge for clean methods.

Sooner or later the thing will play out. The straw and wood will burn up and your greased organization will go down in such a heap that its knees will be driven up to its chin. After that the old cripple can never be straightened out again.

Whether you are selling, buying or manufacturing, go it clean. Get your business methods up level with your head where you can look them straight in the face. Make certain that your business is done in such a way that you won't have a brown tongue the day after.

Don't make the mistake of thinking that a little bit of temporary success can be worth as much as a permanent organization, built on legitimate and honorable lines.

And don't forget that there are very, very few firms who want to do business on the "grease" plan. They want to spend a dollar and get a dollar's worth of real value in return. That, and nothing else, is the real basis for successful and lasting business relationships.

BUYING REAL COAL

A BILL is now in the Ontario Legislature to force dealers to weigh coal on municipal scales or by municipal officials. J. A. Pinard of East Ottawa is sponsor for the measure, and it has been advanced to its second reading.

The chief objection will come from dealers who will not want to cart their coal to civic scales when delivery is to be made in an entirely different section of the city. It will not be practicable to have a civic official to check up the weight at the scales of each individual dealer.

There is a great deal more point and purpose to an announcement contained in the United States Official Bulletin of March 9. The drift of this is that bituminous coal must be mined clean or sold for less than the fixed price.

H. A. Garfield, United States Coal Administrator, has given very wide powers to the district representatives of the fuel administration. In fact, it looks as though they had really been constituted a court of last resort by the fuel administrator. Where the coal in any part of the mine is found to be naturally of such character as to be unfit for market, judging from the usual standard of the district, the district representative may order the mining suspended in said part or parts of a mine until or unless proper cleaning methods be adopted.

Not only so, but the inspectors are authorized to condemn at the mines "any coal loaded in railroad cars which in their judgment is not properly prepared. . . . If the district representative approves the inspection report he shall so notify the operator at once; in which case, unless the operator unloads and reprepares the rejected coal, the consignee shall be permitted to deduct 50 cents per ton from the authorized price for the grade of coal." Of course, the consignee, if he wishes, may go ahead and pay the full price, although this looks like a long chance once the fuel inspector has condemned the coal.

The fuel scarcity that Canada has passed through has brought to many a Canadian home a quality of coal that never could get past in ordinary seasons. This, of course, refers particularly to anthracite coal.

Association and Personal

Howard Taylor, who for some years has been chief electrical and mechanical engineer of the Spanish River Pulp and Paper Co.'s plants, with headquarters at the Soo, has resigned to become consulting engineer with the Dayton-Wright Aeroplane Co., at Dayton, Ohio.

C. N. Schrag, of the Bawden Machine Co., is leaving there the 1st of May, to go into partnership with O. W. Meissner, manufacturers' agent, Montreal, handling a line of railroad, pulp mill, marine and engineering supplies. Mr. Schrag will open a Toronto office in the Royal Bank Building.

James M. Smith has arrived at Fort William to take charge of the shipbuilding and of the plant of the Canadian Car and Foundry Company, which is under contract to turn out twelve trawlers for the French Government before the close of navigation. Most of the steel for their construction has been assembled at the works, and the building in which they will be built is almost completed.

Frederick Field, engineer superintendent of the city filtration plant, has written to the Montreal Board of Control asking for indefinite leave of absence so that his services may be available for the United States Government. In his letter he says that he has received a request from the chief engineer of the Housing Department of the U.S. Shipping Board to accept a position in Washington.

W. H. Winterrowd, formerly assistant chief mechanical engineer of the Canadian Pacific Railway, has been appointed chief mechanical engineer in place of W. E. Woodhouse, who has asked to be relieved of that position. Mr. Winterrowd had a university training in addition to practical experience in the shops and in various branches of the mechnical departments of the Pennsylvania and New York Central railroads before he joined the Canadian Pacific Railway six years ago. He was brought to Montreal by H. H. Vaughan, now vice-president and general manager of the Dominion Bridge Co. It is an interesting coincidence that Mr. Vaughan was exactly the same age, namely, thirty-six, when he himself was appointed chief mechanical engineer of the Canadian Pacific Railway.

J. B. Brophy, C.E., who was chief engineer of Cape Breton section of the Intercolonial Railway from Grand Narrows to Sydney during the construction in 1889 and 1900, and who was resident engineer for the past two years of reconstruction of St. Peter's Canal, and lately engineer of railways and canals at Cornwall, died after a short illness of pneumonia at Ottawa. The late Mr. Brophy was married at Sydney to Ella, eldest daughter of the late J. H. Hearn, K.C., who predeceased him four years ago. He leaves two daughters. The late Mr. Brophy never fully recovered from the loss of his son, Lieut. "Don" Brophy, of the Royal Flying Corps, who was killed while on duty on the east coast of England at Christmas in 1916. Col. Bob Low is a brother-in-law of the late Mr. Brophy.

THE PASSING OF GERMAN INDUSTRIES

By C. T.

ACCORDING to authoritative information which has filtered through from Germany, with much weight behind it, there is much of interest in the condition of Germany's engineering and allied industries. The manufacture of an innumerable list of machine tools is being slighted and thus other industries are gradually going by the board. The manufacture of rails and railway equipment is below requirements so the magnificent net of German railways is going into a state of magnificent ill repair. The fabrication of shrapnel has replaced the manufacture of lace machines and looms. The fabrication of submarine parts has replaced the manufacture of locomotives, typewriters and sewing machines. The fabrication of shells and cannon has cut down the manufacture of agricultural implements. All the strength of the factory and forge is being sucked into the never-satisfied munitions business, the tentacles of which, furthermore, are continually drawing away the life-blood of other varied industries.

The steel industry has become a thorough-going war industry, one feature of which is the continued manufacture of imperatively needed staples. This industry has been so terribly pushed by the primary demands of the gigantic war business of the Central Empires and Turkey that it has not been found possible to produce sufficient rails and rolling stock for the railways, important as are these battle nerves of Germany in her efficient game of war. The Krupp people have established branch furnaces and forges in all parts of the country, likely with the idea of minimizing enemy opportunity for crippling the shell and cannon production. Furnaces have been operated for the Krupp works in France, Belgium and Asia Minor. Asia Minor is being developed into a metal treasure-trove for Germany and many millions of marks have been, and are being expended in the building up of mining properties there.

There is no longer a scarcity of metals in Germany. Copper is plentiful. Nickel mines in Anatolia are yielding considerable outputs. Serbia, Rumania, and Anatolia are now furnishing large supplies of copper.

Before the conquest of Serbia the metal outlook in Germany was dark and dreary. They stripped the roofs of large buildings and factories of their copper and conducted a painful house to house survey of the copper and nickel stores of the Empire. Ornaments, kitchen utensils, heirlooms, statues and bells, all went into the munition melting pots; and the kitchenware, at least, was replaced by coarse pottery.

The whole metal industry of Germany is concentrated on war, on the output of shells, bullets, armor plate, cannon, submarine parts. Every other business interest of the Empire is subservient to the demands of this industry. It is maintaining an atmosphere of hopeless hectic rush, and its activity and prosperity are surely ruining the country.

OPERATOR ORGANIZATIONS

British Columbia Association of Stationary Engineers, Vancouver.—Subordinate Lodges at Vancouver, Victoria, New Westminster, Cumberland, Merritt, and Fernie.

North-West Association of Stationary Engineers, Edmonton, Alta.

Manitoba Association of Stationary Engineers, Winnipeg.

Canadian Association of Stationary Engineers, Hamilton, Ont.—Subordinate Lodges at Montreal, Toronto, Hamilton, Ottawa, Brantford, Guelph, Kitchener, Chatham, Ont.; St. John, N.B.; Owen Sound, London, Stratford, Belleville, Kingston, Sudbury, St. Thomas, North Bay, Port Arthur, Sarnia, and Windsor, Ont. The executive officers of the C.A.S.E. Grand Lodge are as follows:—

Past President—W. G. Forbes, Montreal, Que.
President—R. F. Gofton, Kitchener, Ont.
Vice-President—Wm. Cooke, Belleville, Ont.
Treasurer.—A. W. Heath, Hamilton, Ont.
Conductor—S. Balmfirth, Toronto, Ont.
Doorkeeper—George Moll, London, Ont.
Secretary.—John H. Hale, Hamilton, Ont.

The first test of shrapnel was made in England 112 years ago, when a committee of British army men reported favorably on the invention of a fellow officer, Henry Shrapnel. Shrapnel was .rst employed in warfare in 1806 and fully demonstrated its explosive usefulness.

The Operators' Point of View

UNION VS. C. A. S. E.

By R. S Wright.

IN the following article it is far from my intention to condemn any organization, because they may be right and I wrong.

It is one of the greatest fallacies of man at the present day that the individual believes himself right and every other person wrong. One of the greatest wonders of creation is that no two persons are alike in this world, and before condemning our brother's views we ought to pause and consider the merits and demerits on either side.

My object in writing is because I have been informed that the Stationary Engineers' Union condemns or despises the C. A. S. E., and I beg to be permitted through this medium to set forth some facts of my experience with the Amalgamated Society of Engineers in the Old Country.

For a start, I believe that every branch of industry ought to be organized; union is strength, but we may be united for peace or we may be united for war, and I am proud to say that the C. A. S. E. are united for peace, peace and harmony between master and man. We are desirous of educating ourselves to make us better men to our employer and show him we are worthy of consideration. That this is appreciated by a vast number of employers throughout Ontario is proved by the fact that they are honorary members of the C. A. S. E.

I will now endeavor to give an account of the union for war. It was connected with the Amalgamated Society of Engineers in the Old Country some years ago. The engineers in Belfast, Ireland, demanded an increase of a farthing an hour (about 5c per day). This demand was refused by the employers because work or contracts were not so plentiful as might have appeared on the surface, so the engineers in Belfast declared a strike. Now, as we were all in the same union we had to come out all over the British Isles (coercion) whether we wanted to or not. Now, an engineer there must belong to the union before he can get employment (coercion again), and an employer is not allowed to employ a blackleg (coercion).

As I have already stated the employers were in a good position to withstand a strike and any pressing orders they may have had on hand were handed over to Germany and completed there. The money we paid Germany on that occasion and on various other occasions helped to make guns and ammunition to blow our brains out.

How the Community Have to Pay for the Fear of Strikes

An employer continually under the threat of a strike must be prepared for that contingency and in consequence must charge more for his contracts, which the strikers as well as others of the community have to pay for indirectly.

He must pay the standard society wage to the inferior employee as well as to the efficient employee, so therefore the man who does the work gets no more pay than he whose only thought is stopping time.

But the worst feature is yet to come. We remained on strike for nine weeks, during which time our society funds got exhausted; our homes were reduced to beggary, and I had seen poor mothers going round the scrap barrels in the wealthy localities to see if they could procure a crust of bread for their starving children. Such a strike affects not engineers alone but also much unskilled labor which has no society funds to depend on.

Now, at the end of the nine weeks we resumed work at the same wages we were receiving before the strike, and a great many of our members did not get work at all, so this ends a chapter of my career I never wish to experience again.

It does not avail an employee to kick against his employer; it is certainly kicking against the pricks and the workman generally gets the worst of it in the end. Also, if for instance the railway employees go on strike the community have to suffer for it in the form of increased tariffs, etc., and the striker in the end must pay his share of that higher tariff rate in the form of a higher cost of living. It all comes back on the working man in the end.

Now, the much better way is to join a society, say the C. A. S. E., who will educate you to a high state of efficiency and make you a person your employer does not want to part with, then the wages will come automatically.

In conclusion, I will state I don't believe any sensible employer will refuse a good man the wages he is worth. So look to your own defects first. Then you can pack all your troubles in an old kit bag and smile, smile, smile.

HINTS ON MAKING WATER TUBE JOINTS ON STEAM BOILERS

By S. Balmfirth

ONE of the disadvantages of water-tube boilers is the number of joints that have to be cleaned and remade each time the boiler is cleaned and overhauled. The writer offers the following suggestions for shortening the time used in doing this job.

To grind the faces of the caps the writer had an arbor made, to fit the drill press with the end turned to a short stumpy cone. This cone gave sufficient

FIG. 1. ARBOR USED FOR TRUEING UP THE FACE OF THE NUTS.

friction to turn the cap on the emery cloth laid on a faced plate on the drill press table. To avoid using too much emery cloth oil and emery powder were placed on the cloth. The use of the cloth, emery powder and oil made a quicker job than the emery powder and oil which were first used alone on the faced plate. If the cone is made short enough it can be used for grinding both face and back of the cap.

To grind the face of the nut a box wrench was made out of a pipe coupling and a bushing was screwed in one end

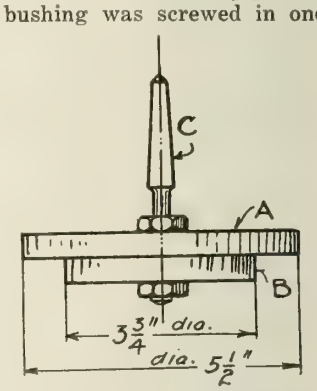


FIG. 2. ARBOR USED FOR GRINDING AND TRUEING HEADER CAPS.

for mounting on an arbor made for a drill press.

To clean the bolt thread, a revolving steel wire brush is used. This cleans off all scale and dirt and saves running a die over the threads.

If it is necessary to take a cut off the face, an arbor made as shown in fig. 1 saves considerable time. A is a jamb nut run up to the end of the thread and then faced up. To use this arbor the back of the cap is faced up in the lathe and then put on the arbor and held back against A with another nut.

The above hints are all intended for B and W boilers.

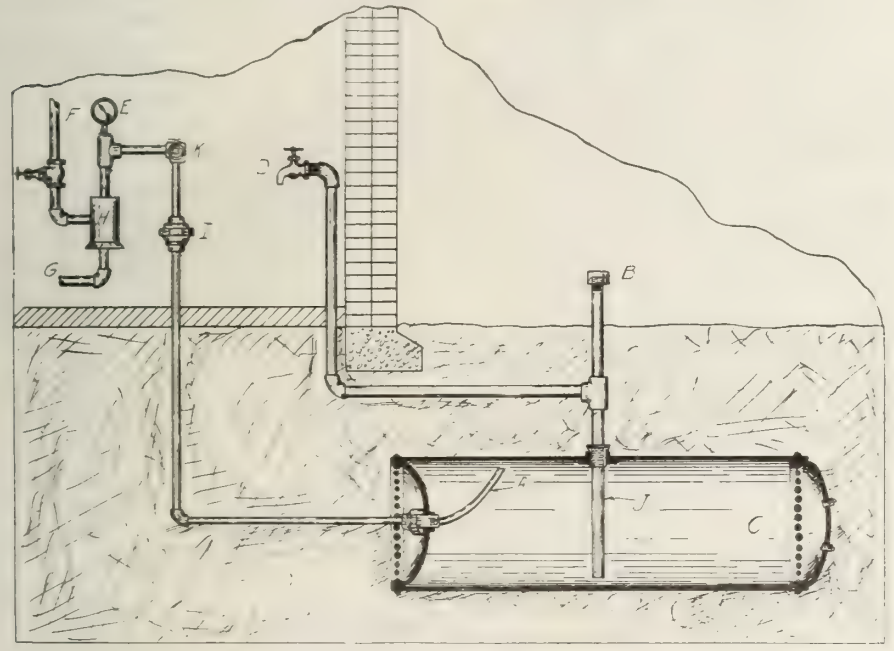
Another idea which saved considerable time was used in cleaning the tube holes in the headers. Fig. 2 shows a disc made big enough to cover the tube, B is made to go inside and C is a small bolt, the outer end having a square tapered shank for a brace. By loosening the nut emery cloth can be placed between A and B and revolved on the tube end to clean it. Emery and oil may also be used with advantage on the cloth. Of course there are the advertised motor driven cleaners for tube ends but these cost real money.

I have sometimes, although I do not recommend the idea, used paper gaskets on the B & W caps but am inclined to think it not very good engineering.

A SINGLE TANK FOR OIL STORAGE

By James E. Noble.

A SIMPLE easily installed outfit for storing gasoline, coal oil, signal oil or other inflammable or light oils or liquids is shown in the accompanying sketch. It will prove useful around large office, manufacturing and apartment buildings,



OIL STORAGE SYSTEM USING SINGLE TANKS.

where they have frequent occasion to use benzine and various other oils and liquids.

Referring to the sketch, C is a 100-gallon galvanized iron range boiler, J is a ¾-in. pipe screwed into the inside of a 1-in. by ¾-in. bushing, B is the filler pipe, D is the draw-off cock.

A piece of ¼-in. pipe is bent and screwed into a nipple, which in turn screws into a bushing in the boiler crown. Care should be taken to have the pipe bend towards the top, as shown, when the nipple is screwed in.

A reducing socket makes connection to a pipe leading to the automatic air compressor H. This air pump is similar to the kind used on beer outfits in hotels. There should be many second-hand ones soon thrown on the market for sale. F is a ⅜-in. city water supply pipe, and G is the waste pipe. The waste water can be run to the boiler room hot well and used in the boilers, thus making the operation of the pump free of cost. E is a pressure gauge, and I a ¼-in. union.

The tank may be filled by removing the plug from the elbow K and pouring in the oil at B. The oil then replaces the air in the tank C, the plug is replaced, and by pumping air into the tank the oil is forced out.

If all underground pipes and fittings are galvanized and given a coat of tar the outfit should last for very many years without any trouble. In every description I have seen of outfits using compressed air a separate air tank is used, but by using the automatic air pump as here described no extra tank is necessary.

OYGEN AND PERPETUAL MOTION

WITH reference to the letter of Mr. S. Bamfirth's in your issue of March 28, in which he expresses strong doubts on the possibilities of using oxygen as a motive force in engines because it is not combustible, I would ask Mr. S. Bamfirth since when have we been dependent on combustibles for use in engines as a motive force? Steam and compressed air are not combustibles, neither is gasoline until mixed with air, that is nitrogen and oxygen. Judging from Mr. Bamfirth's letter I presume he is not an engineer, or perhaps he has not given the matter about which he writes much attention; the following remarks may be of interest to him and be the means of removing some of his doubts.

Oxygen forms about one-fifth of the atmosphere and can be reduced to a liquid state. Hydrogen can also be reduced to a liquid state; both these elements expanded like steam would drive an engine in the same way. Oxygen mixed with hydrogen is an explosive, and, I presume Mr. Gallacher, the inventor of the machine for extracting oxygen from the air, would use it much in the same way as gasoline is used, combining hydrogen with oxygen by an intake arrangement similar to a carburettor, in doing which he would only be following in the footsteps of other experimenters. It is a simple matter to drive an engine by this means, the real difficulty is to harness these elements to make the use of them safe. Expansion is too rapid, and the difficulty of admitting only what would be a safe quantity of gas into a cylinder has not been overcome; until this has been done, the experimenter is in greater danger of blowing his head off than he is of failing to obtain power. Similar reasons have retarded the use of acetylene gas. In conclusion I might point out that oxygen and nitrogen, "another element of the atmosphere," are the active elements of the most powerful explosives, including nitro-glycerine. Yes, there is plenty of push behind oxygen used as a base like gasolene.

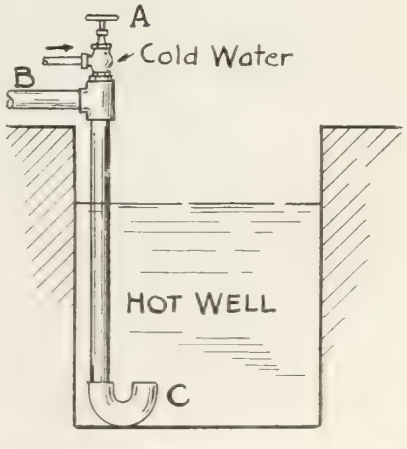
UNION ENGINEER.

Labor Temple, Toronto.

SUCTION PIPE KINK

By J. E. Noble.

The hot well is still in use in many small plants and when the returns are very hot the pump will refuse to pick up the water on account of the steam. The way one man overcame the trouble is shown in Fig. 1. A ¼-inch cold water pipe was connected to the pump suction pipe, this pipe with a ¼ angle valve is shown at A. The pipe C is the suction pipe from the pump. When the returns are very hot, say 190 deg. Fahr., the ¼ angle valve is opened a turn and the



HOT WELL SUCTION ARRANGEMENT.

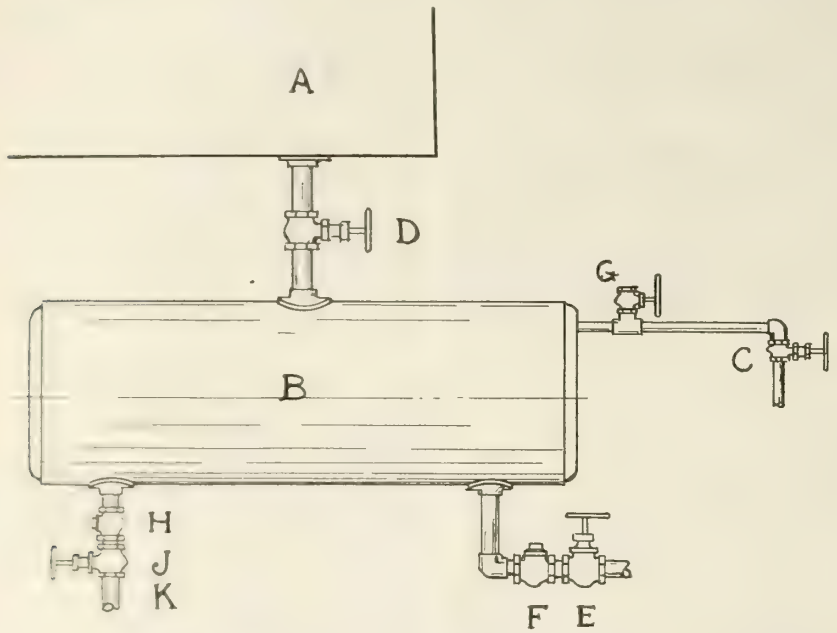
pump works like a charm. Sometimes dirt will collect at the bottom of a hot well. It is a good plan to place return bend on the end of the suction pipe, as shown at B. A strainer can be added if desired, but is hardly necessary. The bend also provides a good support for the upright pipe. The ¼-inch cold water pipe idea can also be used where metering heaters, or where ordinary exhaust steam water heaters are in use, as it is quite possible that the same trouble will be found here, especially if the heaters are on a lower level than the pump.

A GRAVITY BOILER FEED

By J. E. Noble

I HAVE heard it said that the arrangement shown was often used as a boiler feed in the old days, and that in some remote "wilderness" plants it is not unknown at the present time.

The tank B is placed several feet above the steam boiler. Tank A is supplied by rain caught from roofs; when this supply fails it is carried up or pulled up with a rope and tackle arrangement, or supplied in some other way. C is a steam supply from the boiler, a check valve and globe valve are shown at E and F, which is the supply to the boiler.



METHOD OF FEEDING BOILER BY GRAVITY.

To fill the tank B, close C, open air valve G, and valve D. When the tank is full close G and D and open C and the quantity of water required for the boiler supply can be regulated by the valve E.

By running pipe K to the hot well and attaching check valve H and valve J, water can be drawn from the well to the tank by first filling the tank with steam and then closing all valves except J, as the steam condenses a vacuum will be caused and the water will rise; valve J can be left open all the time.

DOES IT REALLY MATTER?

By W. H. A.

DOES it matter much if a piston does stop or not at reversal and why all this talk on the matter anyway? Any pistons I have ever had anything to do with were too busy doing useful work to bother about stopping at any part of the stroke. There has been more energy, time and space wasted in discussion over this matter than the engine itself expends in getting over either center.

Let's stop all this discussion about this matter and expend that useful energy in a more important way.

For instance, could not we derive more real benefit by using the space for the discussion of the economical use of fuel and thereby keep that much-talked of piston everlastingly on the move? Among engineers this fuel conservation is a serious matter and is getting more serious.

Dont let the chief do all the figuring as to haw to get all the good out of our coal that there is in it. There are many things that he could give his attention to in the betterment of conditions generally if he were assured that there were conscientious men near at hand.

There are many ways in which we could accomplish much in the saving of fuel. For instance, you and I, both assistants perhaps in different plants, are possibly never called upon to wheel or shovel coal and perhaps we look no further than to see if there is a sufficient supply on hand to last over a limited length of time, say until the end of our shift.

To be sure there is no great art in wheeling coal or shovelling it into the furnace. Where the art comes in is in putting it into the right place at the right time.

Different plants require different methods. There are as many different methods as there as plants, nearly, but all methods are, or should be, used to come to a reasonable conclusion, that of delivering at the end of the line the highest possible percentage output. Try to keep that space between output and input as short as possible.

There is a way I've found to work to my advantage, that is to cultivate the acquaintance of your coal wheeler and fireman. Let them know that any effort on their part to secure results is appreciated. I don't mean to hug them after every fire, but just let them see that they are as necessary around the plant as you are.

I have noticed in some plants that there is such a thing as class distinction; that may be all right as to different classes of work, but each class of work is necessary to the other, the coal passer, fireman, oiler, assistant and chief engineer are all necessary to each other and a man can work more satisfactorily all around if he be taught a system derived from the use of reason and common sense.

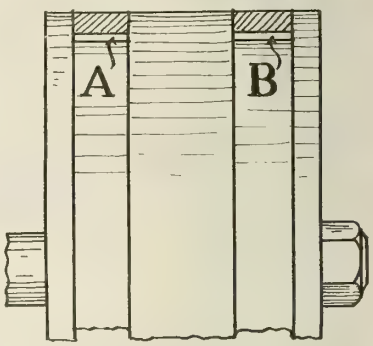
Show them how to do it, why they should do it, and when results come let them share them. This is one way, I think, to save coal. Be sure you know yourself and then teach others the right way. Useful knowledge is that knowledge which you are willing to impart to others.

CLICKING PISTON RINGS

By John Ford

A DISAGREEABLE noise developed in a steam engine, and after careful examination it was decided that the trouble was in the piston rings. These rings were of the snap style on a solid piston with turned ring grooves.

There were no facilities for securing a new ring and a temporary repair was attempted. The old rings were removed and a thin strip of tin placed around the grooves at A and B as shown in the accompanying illustration. The rings were placed over these strips and the piston replaced. No further trouble developed and the noise was removed.



METHOD OF REMEDYING PISTON RING TROUBLE.

ALCOHOL AS A MOTOR FUEL—II.

By J. E. MacCormick.

I have before me some material prepared a few years ago, after considerable study of the subject. Leaving out the "whereases" and the "findings" having the least bearing on the cost of production, together with the various references to literature substantiating the claims made, I quote in part:

1.—In many cases the grain or roots would, if sold, buy gasoline enough to produce as much power as could be obtained from all the alcohol which could be produced from the said grain or roots.

II.—That in some cases the coal required during the process of distillation would, if used in a producer gas plant, yield as much power as could be produced

by the alcohol that same coal would be sufficient distillery fuel for.

III.—That the combination of raw material values as in finding I. and the fuel cost as in finding II. make the production of alcohol for power purposes commercially impracticable except possibly from sugar beets and artichokes (which will be considered later), and in these two instances the value of the resulting pulp as a fertilizer if returned to the soil is probably the strongest claim in favor of the community-still industrial-alcohol proposition.

IV.—That an average ton of sugar beets will run about 14 per cent. sugar, or 280 lbs. of sugar content per ton, and that this amount yields only 17½ (Imperial) gallons, or one gallon of alcohol for each 16 pounds of sugar content, and that, therefore, 1¼ cents per lb. for the sugar = 20 cents per gal. for the alcohol if the expense of refining are the same in each case. Thus, 2½ cents per lb. on the sugar represents 40 cents per gal. on the alcohol possible to obtain therefrom.

V.—That in ordinary gasoline engines one-half more alcohol is required for a given power than is required of gasoline for the same power, while with a specially-devised engine for each they are about equal for power, gallon for gallon.

VI.—That this result is in part due to the economy of B.t.u. owing to the higher compression possible with the alcohol without causing pre-ignition.

XII.—That, considering findings III. and IV. (and choosing from among Canadian products), artichokes alone are a possible commercially practicable source of alcohol for motor fuel in competition with other forms of fuel.

The remaining findings refer to the artichoke phase of the question, which can perhaps be more briefly outlined by quoting from an attached memo. slip. This slip refers to a potato distillery employing two laborers and a foreman and having a capacity for handling 8,000 pounds (4 tons) of potatoes per day. It requires 1 ton of soft coal per day to operate it, and the assumption is that, owing to the similarity in the nature of the roots, it will, if working on artichokes, handle the same weight of raw material, use the same amount of coal, employ the same men, and produce 19 gallons of alcohol per ton of roots, or 76 gallons per day.

Running ten months per year, it will thus require 260 tons of coal and produce 19,760 gallons of alcohol.

The cost of fuel will be 1.316/1000 cents per gallon of alcohol for each dollar per ton the coal costs. Thus, if coal were to go to ten dollars per ton the cost per gallon would be 13 1/6 cents.

The following table, though fragmentary, should be of interest:

TABLE No. 3.

Assumed price of coal per ton	Total cost of coal	Value of 19,760 gals. at 25c	Balance from $4,960 after paying for coal	Assuming said balance is all devoted to paying for the roots	
				Rate per ton	Rate per bushel (60 lbs.)
$10.00	$2,600	$4,940	$2,340	$2.25	6¾ cents
6.00	1,560	4,940	3,380	3.25	9¾ cents
4.80	1,240	4,940	3,692	3.50	10½ cents

worth more than that for pig feed, for instance, especially when there is such a demand for bacon as at the present time. It must be remembered that (a) in the above table no expense except that for coal has been considered; (b) that distillery equipment is expensive, involving a large outlay and large necessary allowance for interest, depreciation, taxes, insurance, etc.; (c) and that wages must also be paid. In fact, when all expenses are paid, the above 7, 10 and 11 cents per bushel, though small already, will be brought materially lower. I think it would be much better to save the money otherwise invested in the plant, and unless these roots were wanted for some other use, let the land be used for some other crop, for some other purpose, say, for instance, wheat to be ground into flour.

If the above 25c per gal. looks below the retail price of gasoline remember that the distillery will be expected to meet wholesale prices.

In the above no allowance has been made for market value of the pulp or slops. Bulletin 410 devotes a few pages to this phase of the subject, which, however, I can not think will turn the scale very much. Distillery men are now "onto" the value of these, and if they saw money in the alcohol motor fuel proposition it's a safe bet they would go into it; but does anyone suppose these men are going to put denatured alcohol onto the market at a price which will compete with gasoline so long as they can get two or three times that amount for it as denatured alcohol for use in the arts?

The article on page 9 of the January POWER HOUSE suggests that if potatoes were sold at 21½ cents per bushel there would be greater profit to the farmer than in growing wheat. The cost of raising potatoes during 1917 was nearer to a dollar than to 22 cents, but be that as it may, no matter what the cost of production may be, is any farmer, individual, merchant or company going to of his or its own free will sell potatoes to a distillery for 22 cents per bushel when he or they could by putting them on the market for human consumption receive a $1.50 per bag for them, as is the case this winter? It's an easy question to answer.

As for the remark about idle tractors owing to the high price of gasoline, this condition did prevail for a time a few years ago, but with the raise in the price of wheat, the advent of the new motor spirits onto the market, and the introduction of devices making it possible to operate successfully and more economically on kerosene—using the gasoline for starting only—this class of tractor has been rapidly coming into its own again, and I am doubtful of there having been many serviceable tractors idle during this last summer. The time has not arrived, nor will it for some while yet, when alcohol can universally compete with gasoline as a motor fuel. That time will not arrive until the prices of denatured alcohol and of gasoline or motor spirit naturally equalize on the open market. When that time comes, if it ever does, men have the data and equipment necessary for meeting the conditions and producing both the alcohol and engines suitable for using it in. Until then we can, I think, better afford to give our attention to other problems.

But, says one, you've forgotten about the sawdust we read so much about. We have got you now! Well! let's see. Ordinary wood alcohol, also called methyl alcohol, is unsuitable for use in engines. Its chemical formula is CH_3OH, sometimes written CH_4O. It is the kind of alcohol normally obtained from wood or from sawdust, although it is also possible to obtain the ethyl or "grain" alcohol from sawdust. The ethyl alcohol is the kind used in engines. Its chemical formula is C_2H_5OH, sometimes written C_2H_6O. Alexander Classen was, I believe, the first to successfully manufacture ethyl alcohol from sawdust on a practical commercial basis. By his method the raw material passed through several processes, involving some hours before the fermentation and distillery stages were reached. As to the yield of spirit, I quote from the "Canada Lumberman," August, 1903, issue:

Wood vs. Corn

"The Classen process, it is claimed, makes at least fifty gallons proof alcohol from a long ton of dry sawdust. About four and a half gallons can be made from a bushel of corn. Reduced to gallons of alcohol, one proof gallon is made from about two-ninths of a bushel, or 12.4 pounds of corn. It can also be made at no greater and probably a little less expense for the process from forty-five pounds of sawdust. . . . The Classen process is owned in the United States. . . ."

How much progress has been made in this line to date I do not know, but the same questions as regards marketing apply to this as to that of denatured ethyl alcohol made from grain or roots.

Peanut oil has, by way of experiment, been successfully used in a Diesel engine. The industry is, of course, out of the question so far as Canadian growing of the nuts is concerned. Some thirty-five years ago there were at least four peanut oil mills in the Southern States. The nuts raised there yielded 42 per cent. of oil. This was used chiefly for lubricating spinning and other light machinery. The trade, however, fell into decay. Probably the price at which oil from nuts grown in Africa and India could be obtained in America proved a handicap to the American peanut oil industry. In general I believe the nuts yield 80 to 120 bushels per acre and 38 to 50 per cent. of oil. It may be that the peanut proposition could yield a motor fuel with less expense per gallon than would be the case with the alcohol, but I do not believe the real solution of the problem lies

in this commodity either. I do believe, however, that clever chemists are working along lines which, if they do not produce a cheap and abundant liquid fuel for motors, will at least postpone indefinitely the day when we will be forced to pay alcohol prices for our motor fuel.

I know that if printed this will be read by men who want to be up-to-date and who subscribe to the POWER HOUSE in order to keep themselves so. By way of apology for submitting to these men quotations from works printed upwards of ten years ago I will add that since then the crop yields, grain and root analysis, and proportion of raw material required per gallon of alcohol produced have not noticeably changed. The chemical laws involved have not changed; and, although the prices of equipment, raw material, labor, and finished product have all increased, the relative values of each to the other, when figured on a percentage basis, have not changed so much as one might naturally suppose. Therefore, in general the data given is just as true to-day as it ever was.

CONVICTED CHEMISTRY

By R. M.

NOTHING appears to provide greater stimulus to the development and promotion of industrial and chemical science than the prosecution of a war, and this becomes additionally emphasized when the operations are on the tremendous scale of present world activities. For nearly sixty years scientific research and learning have been supported and encouraged, and institutions for its advancement have been in receipt of liberal financial endowments. In many instances community and government funds have been lavishly supplied for educational and experimental purposes. In the hope of attaining to a higher civilization men have been protesting and striving to eliminate the dominating feature of brute force that has periodically or spasmodically been manifest in the warring actions of the human race. Blinded in the belief that university investigations and scientific research have been of a constructive character—and in many respects they have—we are to-day confronted with the appalling results of the advancements of so-called civilization.

Burns has said that "man's inhumanity to man makes countless thousands mourn," but the inhumanity of the present day, particularly in relation to the prosecution of a modern war, made possible by the "advancements" of science, counts the mourners by the millions. To-day the nations of the earth stand horror-stricken before the evidence of brutalities practised by the various belligerents. The art of destruction has attained a high state of efficiency, and the scientific but odious weapons of torture, decimation and death are exemplifications of what can be achieved through a misdirected utilization of scientific learning.

In the promotion of modern civilization (so called), crimes are being committed that makes the days of savagery look like play in comparison. Poison gases, air-bombs and liquid fire are among the many achievements that vie with each other for the destruction of mankind, not as individuals but as entire battalions. Chemistry, a name that should be the key to set humanity free, stands before the bar of history convicted of the most revolting crimes that have ever been perpetrated from the very dawn of the world.

The destructive power of chemistry has created more blind men, has ruined the health of greater numbers, has maimed and destroyed the vitality of more human beings during the past three years than the curative powers of the said science can hope to prevent or safeguard during the next generation. Mars himself must surely be shocked by the perfection with which war is carried on at the present time. Instead of chemistry concentrating her efforts for the uplift of the human race the past three years has apparently demonstrated that in place of a guardian over the welfare of men she has become a trainer for this ghastly monster that threatens to completely destroy the equilibrium of the peace of the world. The present devastation should serve as a serious lesson for the development of the future, so that in some measure redemption may be possible for the loathsome acts that have resulted from chemical and other scientific achievements. This redemption can only be realized when the students of chemistry recognize their obligations to their fellows and utilize their knowledge and ability for the construction of a better and higher civilization than that which dominates the world at the present time.

READER'S QUERY REGARDING FLUE GAS ANALYSIS

IT HAS been requested that comment be made regarding a gas analysis, the results of which are as follows:

CO, carbon monoxide	10 per cent.
CO_2, carbon dioxide	25 " "
N, nitrogen	52 " "
H, hydrogen	10 " "
Hydro carbons, principally CH_4 marsh gas	3 " "

The question has arisen as to what became of the nitrogen of which ordinary air contains 79 per cent., the remaining 21 per cent. being oxygen.

The gas analysis given above is incorrect in several particulars and is impossible in actual practice when proper care is taken in the analyzing of the gas. To make this clear an example will be given showing how the proportions of the final products compare with those of the air before combustion takes place.

Let us suppose we have sufficient coal in the form of pure carbon to consume all the oxygen in 100 cubic feet of air and suppose that the final gaseous products are brought to exactly the same temperature and pressure as was the air at the beginning.

A fundamental law of physics states that equal volumes of gases of whatever kind contain equal numbers of molecules when the gases are at equal temperatures and pressures. Now one molecule of oxygen contains two atoms of oxygen and the symbol, strictly speaking, for oxygen is O_2, which shows the above fact. If carbon be burned to unite with the oxygen the resulting gas will be carbon dioxide represented in chemistry by the symbol CO_2, which symbol shows that the oxygen has taken up one atom of carbon, and the new molecule will have one atom of carbon and two atoms of oxygen in its make-up.

Since equal volumes of gases contain equal numbers of molecules at equal temperatures and pressures the resulting volume of carbon dioxide gas will be no greater than the volume of oxygen with which the carbon combined and thus the original percentages of gases will be unaltered; that is, there will be 79 per cent. nitrogen and 21 per cent. carbon dioxide in the new mixture. This is of course on the understanding that all of the carbon has been burned to carbon dioxide and that there is no water vapor or other gases to dilute the mixture.

The percentage of carbon dioxide just found is the maximum theoretical amount possible and it may be stated that such a percentage is never obtained in actual practice, usually a percentage of 14 or 15 is considered to be very good.

If now, the carbon is not all burnt to carbon dioxide another fact will present itself, and it will now be supposed that it is all burnt to carbon monoxide instead.

Carbon monoxide has the formula CO, which shows that one atom of carbon has united with one atom of oxygen thus splitting up our original oxygen molecule, O_2, into two parts. The equation representing this change may be written:

$$_2C+O_2=CO+CO \text{ or } 2CO.$$

This splitting up of the oxygen molecule affects the volume of the resulting products of combustion, for each molecule of oxygen has split up and each of the atoms of oxygen of which it was composed has united with an atom of carbon, thus doubling the number of molecules. A little reflection, bearing in mind the law above stated, will show that the volume of the gases will be doubled and the original 100 cubic feet of gas will have grown and will have the following proportions:

Nitrogen, 79 cubic feet; carbon monoxide, 42 feet, or the carbon monoxide will have a percentage of $[42\div(79+42)]\times100=34.6$ nearly.

It may be of interest to note that the total volumes of CO, CO_2 and O, in the flue gases when added together will always, if the analysis be correct, bear a certain relation to the total volume of the flue gas. One-half the volume of CO added to the volumes of CO_2 and O present, should never equal more than 21 per cent. of the total volume and this only if no hydrogen, methane or water-vapor be present, which is a condition needless to say never met with in practice.

The amount of hydrogen, 10 per cent., given in the analysis commented upon, is extremely large and it is improbable that the amount given was found.

Operators' Instruction Course

EDUCATION PAPER—VII.

IF you were installing an 8-in. steam main, 100 ft. long, carrying 100 lbs. pressure, how much expansion would you allow for?

The coefficient of expansion of a steel pipe per degree Fah. is .000,007. We will assume the initial temperature at which the pipe was installed to be 60° Fah. and the final temperature at 100 lbs. steam pressure will be 338° Fah.

The total expansion will then be $(338 - 60) \times .000{,}007 \times 100 = .1946$ ft., or 2.4 inches nearly.

* * *

How much water will a tank hold if it is 12 ft. in diameter and 10 ft. high, and if it has six 4-in. tubes running through it vertically?

The area of a circle 12 ft. in diameter is 113.09 sq. ft. The cubical contents of the tank neglecting tubes is $113.09 \times 10 = 1130.9$ cubic ft.

The area of each tube is .087 sq. ft. The volume taken up by the tubes is $.087 \times 10 \times 6 = 5.22$.

Therefore the net cubical contents is $1130.9 - 5.22 = 1125.78$ cubic feet.

* * *

What H. P. will be required to deliver 500 imp. gallons per minute against a pressure of 80 lbs. per sq. in. with a suction lift of 20 ft. and allowing for 20 per cent. friction, one lb. pressure being equal to a head of 2.31 ft.?

The equivalent head of 80 lbs. pressure per sq. in. is $80 \times 2.31 = 184.8$ ft. The total head pumped against will be $184.8 + 20 = 204.8$ ft. The weight of 500 imp. gallons of water is $500 \times 10 = 5000$ lbs. and the number of foot lbs. required to raise the water will be $5000 \times 204.8 = 1{,}204{,}000$ ft. lbs. In addition to this there is a friction load of 20 per cent. which will require 20/100 of $1{,}024{,}000 = 204{,}800$ ft. lbs. Therefore the total number of ft. lbs. will be $1{,}024{,}000 + 204{,}800 = 1{,}228{,}800$ ft. lbs.

Since one horsepower is equivalent to 33,000 ft. lbs. of work in one minute, the horsepower required is $1{,}228{,}800 \div 33{,}000 = 37.2$.

* * *

What will be the piston speed of an engine 12 in. by 17.7 in. stroke operating at 375 revs. per min.?

The piston speed will be $17.7 \times 2 \times 375 \div 12 = 1{,}106.2$ ft. per min.

* * *

What will be the speed of an engine belt if the fly wheel has a diameter of 25 ft. and the engine runs at 60 revs. per min.?

The circumference of the fly wheel is $25 \times 3.1416 = 78.54$ ft. The peripheral speed and also the speed of the engine belt will be $78.54 \times 60 = 4712.4$ ft. per min.

How much water will a duplex pump 10 in. by 12 in. deliver, running 50 strokes per minute? The pump will have to work against a pressure of 120 lbs. per sq. in. and has a friction load of 12 per cent., suction lift 8 ft. What will the H. P. be required to do the work?

The volume of water pumped will be given by the area of the plungers multiplied by the length of stroke multiplied by the number of single strokes per min. In this case the volume will be $545 \times 1 \times 50 \times 2 = 54.5$ cu. ft. or $54.5 \times 6.25 = 340.6$ imp. gallons.

The head pumped against will be $120 \times 2.31 + 8 = 285.2$ ft. The number of ft. lbs. per min. required to raise the water will be $285.2 \times 54.5 \times 62.5 = 971{,}400$ ft. lbs. The total work done including friction will be 971,400 ft. lbs. + 12 per cent. of $971{,}400 = 1{,}086{,}968$ ft. lbs. The horsepower required will be $1{,}086{,}968 \div 33{,}000 = 33$.

* * *

How should a boiler be fed?

A boiler should be fed continuously as far as possible. The water should enter at the coldest part of the boiler and the entering stream should be so directed as not to come in contact with the hot metal of the boiler.

* * *

What is meant by the term priming and what is the cause of priming or foaming as it is sometimes called?

Priming is the carrying over in the steam of water and is caused by oils or organic and vegetable substances introduced with the feedwater.

* * *

Would you fire a water-tube boiler the same as you would a fire-tube boiler?

The water-tube boiler contains considerably less water in proportion to its rated capacity than does the fire-tube boiler and thus it is considerably more sensitive to changes in firing conditions. The general laws governing efficient firing, needless to say, apply in both cases.

* * *

Why do we often see boiler fronts broken and cracked?

Boiler fronts are exposed to extreme heat conditions, having an excessively high temperature on the one side and room temperature on the other. This with the fluctuations in temperature and the unequal expansion of different parts sets up excessive local stresses in the metal and often cracks result. Another cause of cracking arises from the unequal expansion of the fronts and of the brickwork setting.

* * *

How are handholes and manholes cut in boilers?

Handholes and manholes are always elliptical in shape for two reasons. The elliptical shape permits the removal of the cover from the interior of the boiler. Also, when the manhole is situated on the circumference of the boiler the long way of the ellipse runs with the circumference and never longitudinally. This is done on account of the fact that the stresses set up in the boiler shell are twice as great circumferentially as longitudinally and the placing of the manhole in the manner indicated weakens the shell considerably less than if placed the other way.

* * *

How should the stop-valve be attached to the boiler?

The stop valve should be attached to the boiler in such a manner that no water of condensation will collect over the valve when closed or if this is impossible the steam-line should be trapped.

THERE has recently appeared on the commercial market an anti-friction alloy which is made by impregnating praphite with molten metal under hydraulic pressure. By this method the high lubricating nature of graphite is combined with the mechanical strength of the metal used, and the resulting alloy has been found to possess many desirable properties which tend to give a very promising future in the realm of mechanics. Whilst bearings made of this substance must of necessity be restricted to a limited size their manufacture forms a practical and noteworthy achievement in the great field of scientific endeavor. This substance has become known as graphalloy.

IN a paper read before the Society of Automobile Engineers by E. H. Sherbondy some interesting facts relating to the design of aeroplane engines were brought forth. The number of cubic feet of mixture which they will handle per minute is recognized as being one of the most important features of design. The mean effective pressure arrived at in the Sunbeam engines is within 15 per cent. of the theoretical maximum that is possible, while there may be some improvement secured in the future in the matter of horse-power weight efficiency by further refinement in the mechanical construction. The author believes that it is now necessary to make some change in the cycle of operation. This should be a splendid opportunity to try out super-compression and super-charging schemes of one sort or another. Possibly the two-stroke cycle engine, with its maze of new problems, stands as an opportunity, says the author.

SELECTED MARKET QUOTATIONS

A Record of Prices Current on Raw, Semi-finished, and Finished Materials Entering Into the Manufacture and Operation of Power Plant Equipment

BOILER TUBES

Size	Seamless	Lap-welded
1 in.	$36 00	$.....
1¼ in.	40 00	.....
1½ in.	43 00	36 00
1¾ in.	43 00	36 00
2 in.	50 00	36 00
2¼ in.	53 00	38 00
2½ in.	55 00	42 00
3 in.	64 00	50 00
3¼ in.	.....	58 00
3½ in.	77 00	60 00
4 in.	90 00	75 00

Prices per 100 feet, Montreal and Toronto.

PLATES

	Montreal	Toronto
Plates, ¼ to ½	$10 00	$9 00
Heads	10 30	9 25
Tank plates, 3-16 in.	10 10	9 10

WROUGHT PIPE

Effective Jan. 7, 1918.
Standard Buttweld.

Size	Black Per 100 feet	Galvanized Per 100 feet
⅛ in.	$ 6 00	$ 8 00
¼ in.	5 16	7 29
⅜ in.	5 16	7 29
½ in.	6 55	8 12
¾ in.	8 28	10 41
1 in.	12 24	15 39
1¼ in.	16 56	20 82
1½ in.	19 80	24 89
2 in.	26 64	33 49
2½ in.	42 72	53 53
3 in.	55 85	70 00
3½ in.	70 84	87 86
4 in.	83 93	104 10
Standard Lapweld		
2 in.	29 60	36 08
2½ in.	44 46	54 70
3 in.	58 14	71 53
3½ in.	72 68	90 62
4 in.	86 11	107 37
4½ in.	97 79	122 56
5 in.	114 00	142 82
6 in.	147 80	185 28
7 in.	192 80	241 57
8L in.	202 50	253 75
8 in.	233 30	292 32
9 in.	279 50	350 18
10L in.	259 20	324 80
[illegible]	[illegible]	[illegible]

Prices—Ontario, Quebec and Maritime Provinces

WROUGHT NIPPLES

4" and under, 45%.
4½" and larger, 40%.
4" and under, running thread, 25%.
Standard couplings, 4" and under, 35%.
4½" and larger, 15%.

IRON PIPE FITTINGS

Malleable fittings, class A, 20% on list; class B and C, net list. Cast iron fittings, 25% off list. Malleable bushings, 25 and 7½%; [illegible] plugs, 20% off list. Net prices malleable fittings: Class B black, 24½c lb.; Class C black, 15¾c lb.; galvanized, Class B, 34c lb.; Class C, 24½c lb. F.O.B. Toronto.

COLD ROLLED SHAFTING.

At mill	net plus 40%
At warehouse	list plus 50%

Discounts off new list. Warehouse price at Montreal and Toronto.

FINISHED IRON AND STEEL

Per lb. to Large Buyers	Cents
Iron bars, base, Toronto	$5 25
Steel bars, base, Toronto	5 50
Steel bars, 2" to 4" base	6 00
Iron bars, base, Montreal	5 25
Steel bars, base, Montreal	5 50
Reinforcing bars, base	4 ½
Small shapes	5 75

SHEETS

	Montreal	Toronto
Sheets, Black, No. 28	$ 8 00	$ 8 25
Sheets, Black, No. 10	10 00	9 50
Canada plates, dull, 52 sheets	9 00	8 65
Canada plates, all bright	9 50	9 50
Apollo brand, 10¾ oz. galvanized	....	....
Queen's Head, 28 B.W.G.	....	....
Fleur-de-Lis, 28 B.W.G.		
Gorbal"s Best, No. 28.		
Colborne Crown, No. 28	....	....
Premier, No. 28 U.S.	....	8 95
Premier, 10¾ oz.	....	9 25

PROOF COIL CHAIN

¼ in.	$12 00
5-16 in.	11 50
⅜ in.	11 15
7-16 in.	10 90
½ in.	10 70
9-16 in.	10 70
⅝ in.	10 50
¾ in.	10 40
⅞ in.	10 25
1 in.	10 10
Extra for B.B. Chain	1 20
Extra for E.B.B. Chain	1 80

ELECTRIC WELD COIL CHAIN B.B.

⅛ in.	$15 50
3-16 in.	11 70
¼ in.	8 40
5-16 in.	7 40
⅜ in.	6 35
7-16 in.	6 35
½ in.	6 35
⅝ in.	6 35
¾ in.	6 35

Prices per 100 lbs.

FILES AND RASPS

	Per Cent.
Great Western, American	50
Kearney & Foot, Arcade	50
J. Barton Smith, Eagle	50
McClelland, Globe	50
Whitman & Barnes	50
Black Diamond	37½
Delta Files	37½
Nicholson	37½
Globe	50
Vulcan	50
Disston	50
P.H. and Imperial	50

OILS AND COMPOUNDS

Castor oil, per lb.	....
Royalite, per gal., bulk	18
Palacine	21
Machine oil, per gal.	26½
Black oil, per gal.	15
Cylinder oil, Capital	45½
Cylinder oil, Acme	36½
Standard cutting compound, per lb.	06
Lard oil, per gal.	2 50
Union thread cutting oil anti-[illegible]	88
Acme cutting oil, antiseptic	37½
Imperial quenching oil	39½
Petroleum fuel oil	13½

BELTING—No. 1 OAK TANNED.

Extra heavy, single and double	30-5%
Standard	40%
Cut leather lacing, No. 1	$1 95
Leather in sides	1 75

COAL AND COKE.

Solvay Foundry Coke	.....
Connelsville Foundry Coke	.....
Steam Lump Coal	.....
Best Slack	.....

Net ton f.o.b. Toronto.

BOLTS, NUTS AND SCREWS

	Per Cent.
Coach and lag screws	25
Stove bolts	55
Plate washers...list plus	20
Machine bolts, 7-16 and over	net
Machine bolts, ⅜ and less	10
Blank bolts	net
Bolt ends	net
Machine screws, fl. and rd. hd., steel	27½
Machine screws, o. and fil. hd., steel	10
Machine screws, fl. and rd. hd., brass ...add	20
Machine screws, o. and fil. hd., brass ...add	25
Nuts, square blank ...add	$1 50
Nuts, square, tapped...add	1 75
Nuts, hex. blank ...add	1 75
Nuts, hex. tapped ...add	2 00
Copper rivets and burrs, list plus	30
Burrs only list plus	50
Iron rivets and burrs	15
Boiler rivets, base ¾" and larger ...$8	50
Structural rivets, as above	8 40
Wood screws, flat, bright	72½
Wood screws, O. & R., bright	67½
Wood screws, flat, brass	37½
Wood screws, O. & R., brass	32½
Wood screws, flat, bronze	27½
Wood screws, O. & R., bronze	25

MISCELLANEOUS.

Solder, strictly	0 47
Solder, guaranteed	0 50
Babbitt metals ...18 to	70
Soldering coppers, 3 to 6 lbs.	0 64
Putty, 100-lb. drums	4 55
White lead, pure, cwt.	15 20
Red dry lead, 100-lb kegs, per cwt. ...15	50
Glue, English	0 35
Gasoline, per gal., bulk	0 31½
Benzine, per gal., bulk	0 30½
Pure turpentine, single bbls., gal.	0 74
Linseed oil, raw, single bbls.	1 36
Linseed oil, boiled, single bbls.	1 39
Lead wool, per lb.	0 15
Plumbers' oakum, per cwt.	9 00
Sandpaper, B. & A...list plus	20
Emery Cloth...list plus	20
Sal Soda	0 03½
Sulphur, rolls	0 05
Sulphur, commercial	0 04½
Rosin "D," per lb.	0 03
Rosin "G," per lb.	0 03½
Borax crystal and granula.	0 13
Wood alcohol, per gallon	1 80
Whiting, plain, per 100 lbs.	2 20

COPPER PRODUCTS

	Montreal	Toronto
Bars, ½ to 2 in.	$42 50	$43 00
Plain sheets, base 16 oz. and heavier	46 00	44 00
Copper sheet, tinned, 14x60 in., 14 oz.	48 00	48 00
Copper sheet, planished, base 16 oz. and heavier	57 00	45 00
Braziers' in. sheets, 6x4 base	45 00	44 00
Tubing T.P.S., base ¾ in. up to 3 in.	60 00	60 00

Above prices are full sheets and bars. Cut sheets and bars are 5c per lb. higher.

BRASS PRODUCTS.

Brass rods, base ½" to 1" rd.	$0 43
Sheets 24 oz. and heavier base	0 48
Brass tubing, seamless	0 55
Tubin, I.P.S., 1" base	0 55

POLISHED DRILL ROD.

Discount off list, Montreal and Toronto	Net

RUBBER BELTING

Standard	10%
Best grades	15%

WASTE

White.	Cents per lb.
XXX Extra	21
Peerless	21
Grand	19¾
Superior	19¾
X L C R	18½
Atlas	18½
X Empire	17¼
Ideal	17¼
X press	16
Colored.	
Lion	15
Standard	13½
No. 1	13½
Popular	12
Keen	10½
Wool Packing	
Arrow	25
Axle	20
Anvil	15
Anchor	11
Washed Wipers	
Select White	11
Mixed colored	10
Dark colored	09

This list subject to trade discount for quantity

MILLED PRODUCTS

	Per Cent.
Set screws	25
Sq. & Hex., Head Cap Screws	20
Rd. & Fil Head Cap Screws	Net
Flat & But. Hd. Cap Screws plus	Net
Fin. & Semi-fin. nuts up to 1 in.	25
Fin. and semi-fin. nuts, over 1 in., up to 1½ in.	20
Fin. and semi-fin. nuts, over 1½ in., up to 2 in., list plus	10
Studs	20
Taper pins	40
Coupling bolts, pins	10
Planer head bolts, without fillets ...list plus	10
Planer head bolts, with fillet list plus 10 and	10
Planer head bolt nuts, same as finished nuts.	
Planer bolt washers	net
Hollow set screws..list plus	20
Collar screws...list plus 30,	10
Thumb screws	20
Thumb nuts	65
Patch bolts ...add 40,	10
Cold pressed nuts to 1½ in. ...add	$4 50
Cold pressed nuts over 1½ in. ...add	$7 00

METALS

	Montreal	Toronto
Lake copper	$30 00	$28 00
Electro copper	30 00	28 50
Castings, copper	29 00	28 00
Tin	98 00	99 00
Spelter	10 50	10 00
Lead	10 00	9 00
Antimony	17 50	16 00
Aluminum	55 00	50 00

Prices per 100 lbs...

ROPES AND PACKING

Packing, square braided	0 34
Packing, No. 1 Italian	0 40
Packing, No. 2 Italian	0 32
Pure Manila rope	0 39
Transmission rope, Manila	0 45
Drilling cables, Manila	0 41

LEAD SHEETS

	Montreal	Toronto
Sheets, 3 lbs. sq. ft. lb.	$12 00	$13 25
Sheets, 3½ lbs.	12 00	13 25
Sheets, 4 to 6 lbs.	13 00	12 50

Cut sheets, ¾c per lb. extra.
Cuts sheets to size, 1c per lb. extra.

TWIN STRAINERS

A type for every condition

The requirements for strainers are so wide and varied that no one type will meet all conditions, but from the many types of Twin Strainers, some one type can be selected that is particularly suited for any condition.

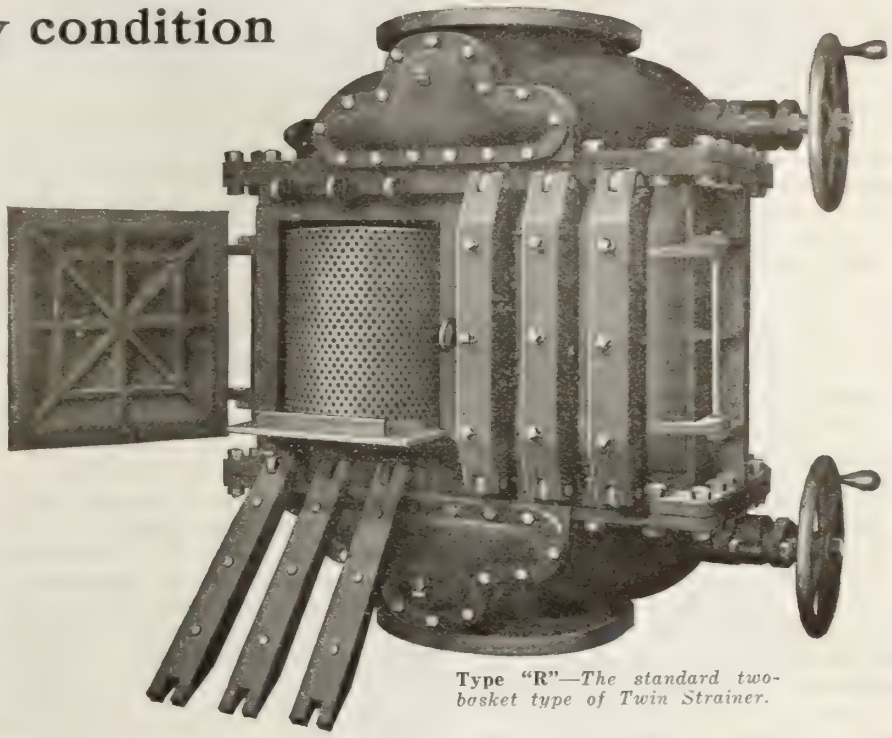
The main principle of all types of Twin Strainers is the Twin (two-in-one) feature. This feature means that when one side of the strainer is being cleaned, the other side is ready to take its place. Just move two valves—and the clean strainer replaces the dirty one—dirty because it's been doing its duty, collecting solid matter from the liquid passing through the strainer.

Twin Strainers will handle water, oil, or any other liquid, and can be installed anywhere—wherever it is most convenient.

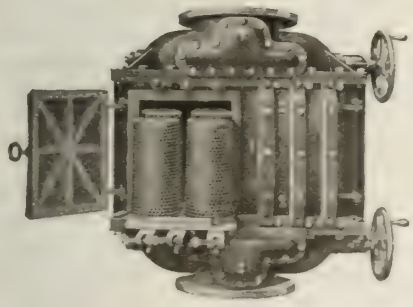
Write for Bulletin "A."

ELLIOTT COMPANY

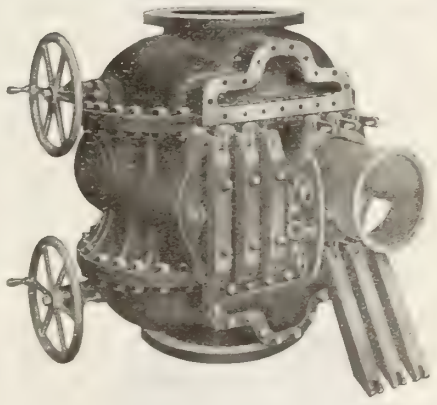
6902 Susquehanna Street
Pittsburgh, Pa.



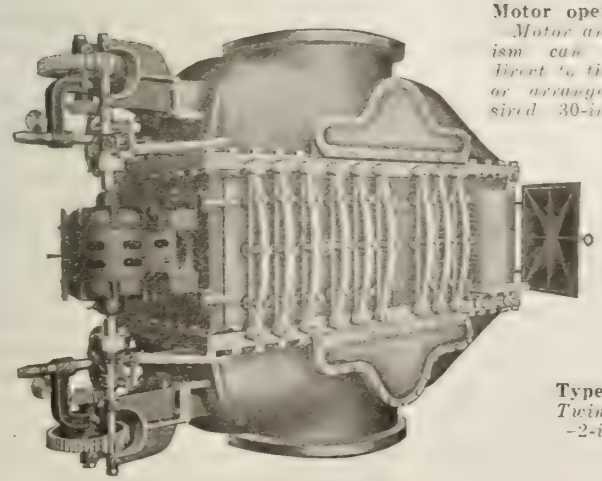
Type "R"—*The standard two-basket type of Twin Strainer.*



Type "S"—*(on the left) Suitable for use where the liquid to be strained contains large quantities of solid matter, or where it is desirable to use baskets with fine perforations.*



Type "T" — *(on the right) A special type of Twin Strainer for 150-lb. working pressure—16, 20 and 24-inch sizes.*



Motor operated Twin Strainer
Motor and operating mechanism can either be attached direct to the Strainer as shown, or arranged overhead, as desired 30-inch and larger sizes.

Type "U"—*A special type of Twin Strainer for straining oil—2-inch and smaller sizes.*

TRADE GOSSIP

Alliston, Ont.—The Town Council have decided to install a triplex plunger pump at the waterworks plant.

Windsor, Ont.—The Board of Control has awarded contracts for sludge pumps, motors, etc., for the sewage disposal works to Noble & Rich.

Summerland, B.C.—The City Council have decided to purchase a 6-inch centrifugal pump for the Trout Creek Point pumping station.

Toronto, Ont.—The A. B. Ormsby Co. have been awarded contracts for steel sash, tin-clad doors, skylights, etc., for the Bond Engineering Co's. new foundry at Ashbridge's Bay industrial district.

Strathroy, Ont.—By-law has been passed appropriating $5,000 for the purchase of a motor-driven turbine pump to be installed in waterworks system for fire protection.

Brantford, Ont.—The depleting of the Onondaga gas field to the south of Brantford is shown by the announcement that the Standard Gas Co., which had a charter for operating in this field, will apply on April 15 to have its charter cancelled. The playing out of this field cut off the supply of pure gas to this city.

The Unilectric Co. of Canada has been incorporated with head office at Edmonton, with capital stock of $25,000, to carry on business as mechanical and electrical engineers, contractors, etc. The incorporators are C. McMann, J. R. Ulery, G. B. O'Connor, G. H. Beaudry and B. Simmerman.

Matheson, Ont.—The town of Matheson is passing a by-law to provide for the borrowing of $40,000 for the purpose of building a system of waterworks and sewerage. The equipment needed comprises a concrete pump house, well, oil engine, plunger pump suction and discharge pipe, reservoir and water mains, etc. H. George Ginn is the clerk of Matheson.

To Make Steel.—Canada Western Steel Co., Calgary, are putting in an open hearth plant at Redcliffe, Alta. This is a unit plant of 220 tons capacity and is being built so that other units may be added in order to make a battery. They will make all grades of open hearth steel. It is expected the plant will be ready for operation in July or August. George A. MacKenzie is the managing director.

Chatham, Ont.—Use of chemicals in increased quantities in the treatment of the civic water supply is recommended in a letter received by the water board from Engineer Willis Chipman, of Toronto, following an investigation made into local conditions recently. It is stated that the quantity of sulphate of alumina could safely be doubled and an increase of 25 per cent. made in hypochlorite. Tests of the city water show that it contains bacteria of intestinal origin.

Niagara Falls, Ont.—A deposit of coal has been found by the engineers of the Hydro constructing the Chippewa-Queenston Hydro Power Canal. Excavations of 170 feet are necessary to construct the canal, and on Saturday the coal deposit was struck at a depth of about 150 feet, near the Whirlpool. The coal is of rough variety, being what is known as rock coal, but it is burnable, and if there are any quantities of it there this may prove a rich find for the Hydro and the province generally.

Tender for Power Plant Equipment.—Tenders for the following equipment for the Water Supply Department, Queensland, Australia, will be received until July 15, 1918:—1. Supply, delivery and erection of complete boiler-house equipment for an electric power-house in connection with the Inkerman irrigation area, near Townsville, North Queensland. 2. Supply, delivery and erection of steam-driven turbo-alternators to be installed for the Inkerman irrigation area, near Townsville, North Queensland. Tenders to be addressed to the Under Secretary, the Treasury, Brisbane, Queensland.

Montreal, Que.—W. C. Hawkins, president of the Southern Canada Power Co. was in the city recently in conference with the other officials and engineers of the company in connection with the completion of the plans for the company's hydro-electric development at Drummondville, Que. This development will have an ultimate capacity of 17,000 to 20,000 h.p., but the electrical equipment to be installed now will be about 10,000 h.p., the remaining equipment to be installed as the demand warrants. The installation will be completed within a year or 15 months.

Coal Prices Firm.—While there has been a reduction in United States points on coal during the past few days, values in Canada for the most part remain the same as during the past winter. Toronto dealers are asking $9.75 and $10 for egg and nut. They claim that the freight and lake rates have been increased and that it is costing them more to take care of the business. Under the new regulations a person who burns over six tons of coal during a winter comes under the restrictions. Such a person can get seventy per cent. of the amount he requires. That means that a person who burned ten tons could purchase seven until such time as the order is rescinded by the provincial fuel controller.

Comparative Tests of Six Sizes of Illinois Coal on a Milkado Locomotive.—Bulletin No. 101 contains data covering a series of tests to determine the value of different sizes of coal as conducted by the Engineering Experiment Station of the University of Illinois under a co-operative agreement with the International Railway Fuel Association and the U.S. Bureau of Mines. A Mikado locomotive weighing 142 tons belonging to the B. & O. R. R. was used, the tests being made in the locomotive laboratory at Urbana. The results are published in above bulletin No. 101 by E. C. Schmidt, J. M. Snodgrass, and O. S. Beyer, Jr. Copies may be had without charge by addressing the Engineering Experiment Station, Urbana, Illinois.

To Make Fuel.—The Dominion Government has fallen in with the recommendation of the Advisory Council for Scientific and Industrial Research for the manufacture of a domestic fuel from Saskatchewan's supply of lignite. A sum of $400,000 has been provided for this purpose. In this undertaking the Dominion Government is acting in co-operation with the governments of the provinces of Saskatchewan and Manitoba. The council has received a request from the Ontario Government asking that that R. A. Ross, C.E., one of the members of the council, be appointed to act with Arthur Cole, C.E., as a committee to take immediate steps for the development of the peat bogs of Ontario, and the production from them of a merchantable fuel. The Research Council has concurred in these appointments and the investigation will be proceeded with.

Ottawa.—Sealed tenders will be received until noon, April 23, 1918, for electric conduit and fittings required in the reconstruction of the Parliament Buildings, Ottawa. All tenders to be based on the supplying and delivering on the site of the quantities of the schedule of material for electric conduit and fittings, in strict conformity with the specifications and the samples submitted and to the satisfaction of the architects. Deliveries to commence so far as possible immediately after the signing of the contract and to continue as directed in such quantities as to ensure complete delivery by June 1, 1918. The schedule of material, specification and any other information required can be obtained at the office of the P. Lyall and Sons Construction Company, Limited, Ottawa; John A. Pearson, architect; J. O. Marchand, associate, Centre Block, Parliament Hill, Ottawa.

Garbage Fuel.—"When the coal shortage was most acute and manufactured fuel was being advocated," says the Hamilton "Times," a good deal was said about the success of a garbage fuel plant in Colorado City, which was said to be a great success. To-day the "Times" received a letter from E. F. McGowan, of Denver, Col., president of the Minequa Coal Company, who writes as one of those who went into the garbage fuel project. Mr. McGowan says he has read in the "Times," the report of the proceedings in Hamilton, and the account of the success of the plant referred to. He adds: "We have spent over $51,000 on this plant. It is first class in every way, as near automatic as possible. We have shut down everything and have boarded up the windows. A little later we are going to sell the machinery for what we can get for it." He declares that the project is not a success and advises any city which contemplates going into it to go and see the plant or get in touch with him.

Kingston Civic Plants.—The Public Utilities Commission at the present time are installing a 5,000,000 gallon De

Laval motor-driven pump at the local water works pump house. This will give the commission two independent sources of supply—5,000,000 gallons electrically, and 7,000,000 gallons in the steam pumps, there being one Inglis engine of 4,000,000 gallon capacity and one Killey engine of 3,000,000 gallons. The power for the new electric pump will be furnished by an independent three phase feeder line over a separate line of poles running from the main power house, which is used jointly with the Hydro-Electric Power Commission as their new sub-station. In addition to the alterations at the pump house the commission have purchased a 300 k.w. and one 150 k.w. motor generator set to operate the local street railway; these machines to replace the present 350 k.w. engine-driven generator now in operation. The main power house at the corner of King and Queen streets has been completely overhauled. Transformers capable of looking after 1,000 h.p. have already been installed and in addition to the above a supply of power is furnished by the Gananoque Electric Light & Water Supply Company at Kingston Mills, over a 13,200 volt transmission line. The local commission are considering extensive alterations to the different plants during the present year, among them being the erection of a 300,000 cub. ft. gas holder recently purchased from the Davis & Farnum Manufacturing Co., Waltham, Mass.

CATALOGUES

New Line of Torches.—The Canadian Welding Works, Montreal, P.Q., are placing a new line of cutting and welding torches on the market. The torches are of special design and incorporate a number of special features that increase the efficiency of the appliance.

Cochrane Multiport Valves, a new bulletin issued by the Harrison Safety Boiler Works, Philadelphia, Pa., contains information covering the principal features of the Cochrane multiport valves. Copies may be obtained on application from the exclusive Canadian agents, Canadian Allis-Chalmers, Ltd., Toronto.

The Smooth-On Mfg. Co., Jersey City, N.J., have issued a sixteen-page circular containing extracts from Smooth-On instruction book No. 16. One particular feature of this circular is that it contains the standard sizes of Smooth-On coated corrugated gaskets for flanged pipes from 2-inch up to 26-inch. Copies of the booklet will be gladly sent on application.

The Darling Digest is the title of a new house organ to be issued monthly by Darling Bros., Ltd., Montreal. The first March edition has been distributed. It is the intention of the company to make the publication interesting, helpful and instructive, and to give each month information of a reliable nature regarding their products and doings and to bring their customers and friends into closer personal touch with the organization. The bulletin will also from time to time contain interesting technical talks on the manipulation of heating systems, steam specialties, pumps and products generally.

New Safety Switch Bulletin.—Safety auto-lock switches are described and illustrated in some detail in special publication No. 1585-A, just issued by the Krantz Mfg. Co., Inc., of Brooklyn, N.Y. These switches are designed for use on circuits wherever the ordinary knife switch may be applied. They are especially designed for safety, it being absolutely impossible to touch the live parts regardless of the position of the switch or of the door. They are particularly adapted for use in steel mills, factories, mines and other similar locations where men are employed who have no practical knowledge of electricity.

Electrical Heating Publication.—Of interest to everybody connected with the heating of baking, drying, and japanning ovens is a reprint just issued by the Westinghouse Electric and Mfg. Co., of East Pittsburgh, Pa. This includes an article, "Electrically Heated Japanning Ovens," by C. F. Hirshfield, reprinted from the N.E.L.A. Bulletin, and "Heat Calculation for Baking and Drying Ovens," by W. S. Scott, reprinted from the "Electric Journal." Thus there are grouped under a single cover an article giving general considerations in favor of electrical heating for this purpose and an article giving the detailed method of calculation for the amount of heat required to raise the temperature of the work, of the supporting and carrying parts, such as trucks, and of the ventilating air. How to compute the losses from the external surface of the oven and the heat required to raise the temperature of the oven walls, etc., are also given. This publication should be of much value to central station solicitors, who are endeavoring to interest their customers in the electrical heating of ovens, as well as to present and prospective users of such equipment. Copies will be furnished on application to any Westinghouse Electric branch office for Reprint 66.

SOME NOTES ON THE HISTORY OF ARTIFICIAL FLIGHT

While the history and development of the aeroplane and the dirigible may be said to be confined almost entirely to the present century, there were a few venturesome pioneers in the past ages who speculated with optimism upon the possibility of man's conquering the realms of the air.

Aviation

Aeronautics is divisible into two main branches—aerostatics, dealing properly with machines which are lighter than air, and aviation, dealing with the problem of artificial flight by means of flying machines, which, like birds, are heavier than air, and also with attempts of human beings to fly by the aid of wings fitted to their limbs.

As might be expected the fitting of artificial wings, being the most natural means of locomotion to suggest itself, would first appeal to the imaginations of men, and so Greek mythology and Egyptian bas-reliefs

Thrift is the Surest Rudder in This Time of National Peril

Save Fuel

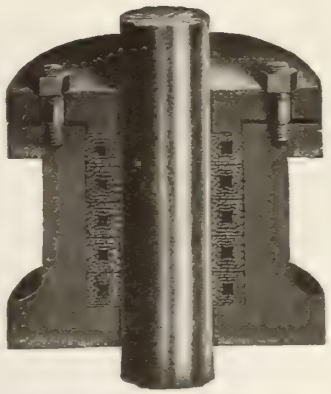
Our Book, "Steam Condensation," tells how this can be accomplished.

Fuel Saved is Fuel Made

May one of our Experts visit your plant? At least write us your troubles.

Geo. W. Cole, Limited
2002-4 Dundas St. W., Toronto, Ont.

Belmont Hollow Center Packing



Style No. 19

This shows Belmont Style No. 19 Packing as used in stuffing box under gland pressure.

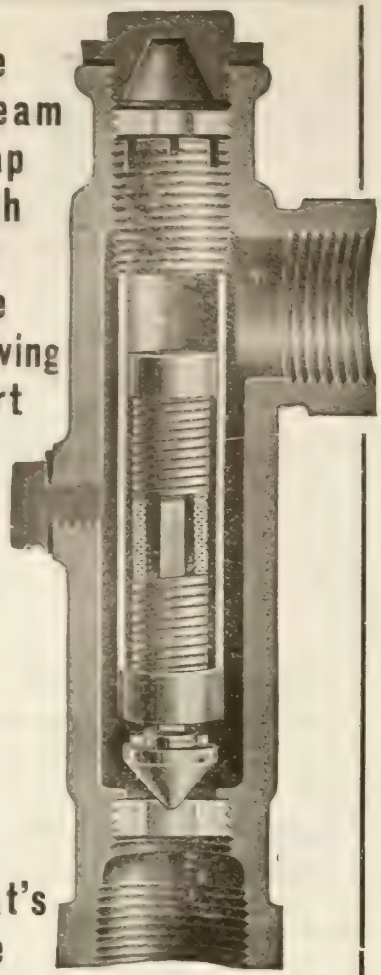
For Plunger Elevators, Deep Mine and Slush, Inside or Outside Packed Plunger Pumps.

For Hydraulic Pumps, Steam Hammers, Lifts, Rams, Cranes, Cylinders, Draw Benches, etc.

Try it. Your initial order will be filled with a positive guarantee to **give you satisfaction or no pay.**

WILLIAM C. WILSON & CO.
TORONTO, ONTARIO, CANADA

The Steam Trap with but One Moving Part



That's the

SARCO

You can replace bucket or float non-return traps with the Sarco. When you do, you throw out of service trouble makers with joints, floats, levers, toggles, etc., etc., and replace them with a steam trap with but one moving part, operated hydraulically and absolutely reliable. You save in first cost, save in repair cost and save in worry cost.

Send for Special List No. J-6

Sarco Company Inc.

Woolworth Building, New York City

Ellicott Square, Buffalo.
New Telegraph Bldg., Detroit.
Drexel Bldg., Philadelphia.
Monadnock Bldg., Chicago.
Williamson Bldg., Cleveland.
and representatives in all principal cities.
Canada: Peacock Brothers, Montreal.

both suggest this means of locomotion.

John Wilkins, one of the founders of the Royal Society, discussed the possibility of flying to the moon and cites several myths or fables, to him true, of men who had succeeded in flying by means of wings. One of these, a monk, living in Edward the Confessor's time, was said to have flown a distance of about a furlong.

Francis Bacon likewise in his Natural History discussed the possibilities of artificial flight, but in a manner obscure and somewhat confused.

Leonardi Da Vinci

One of the most versatile men of any age, Leonardi Da Vinci, who was painter, sculptor, architect, musician, mechanician, engineer and philosopher, devoted some of his time and inexhaustible genius to the study of artificial flight. He excelled in all of these and in engineering and scientific subjects was in many instances a pioneer.

For one living in the fifteenth century his knowledge of science in general was remarkably complete and accurate, and in one of his sketches he pictures a machine so closely approaching to the modern aeroplane in design that had it been fitted with the proper motive power it might conceivably have flown.

The Flight of Birds

The impossibility of man's flying by means of wings and unaided by any external motive power was first clearly pointed out by G. A. Borelli in 1680. By means of an examination of the flight muscles of birds and calculations as to their enormous power he clearly pointed out the impossibility of man's being able to suspend himself in the air by means of his muscular strength alone.

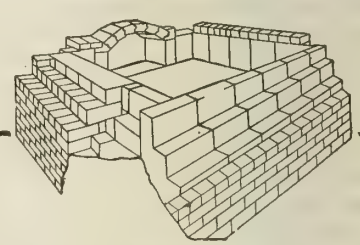
Many attempts have been made to devise means of flight patterned after the wings of birds and provided with motive power for effecting the flapping of the wing members, and while the principles underlying bird flight are well understood and while excellent models have been made which have flown considerable distances, no device sufficiently large enough to sustain a man has as yet been constructed, possibly because of the many disadvantages and constructional difficulties inherent in this type of machine.

Dr. Johnson and Aeronautics

The great English lexicographer, Dr. Johnson, was perhaps the first to state with accuracy the principle involved in any successful effort with "heavier-than-air" machines. How it happened that he, who had but a casual acquaintance with the science of his time, directed his attention to this matter, it is now impossible to say.

In 1759, to raise money for payment of charges consequent upon the death of his mother, he wrote "Rasselas, Prince of Abyssinia," a remarkable book telling of a quest for happiness. The story relates that before starting on his travels with this object, the prince, amongst other devices to relieve ennui, had consorted with men of learning and skilled exponents of various arts; amongst these, a mechanical genius, referred to as the "artist," who, to provide amusement for his patron, suggested an attempt at flight, and in discussing the matter says: "He that can swim needs not despair to fly; to swim is to fly in a grosser fluid, and to fly is to swim in a subtler.' Then follows this enunciation of principles: "We are only to proportion our power of resistance to the different density of matter through which we are to pass. You will be necessarily upborne by the air, if you can renew any impulse upon it faster than the air can recede from the pressure." This is a remarkable statement having regard to the state of knowledge at the time—159 years since. It correctly defines the principle underlying "heavier-than-air" aviation.

Dr. Johnson's was a mind extraordinarily active, and not to be deterred from addressing himself to a strange subject by its strangeness merely, so that no great surprise need be felt that he should consider this, but only that he should have made so illuminating a pronouncement with respect to a branch of study alien to his usual pursuits. By a Newton it would have been stated with more of mathematical precision and effect, but not more truly. It is not improbable that Johnson, mingling with the intellectuals of his time, got the idea, expressed so well, from one of these, but there is no evidence of this, and we need not question but that his naturally vigorous intellect was well able to go straight to the root of such a matter, even though it might be on ground unfamiliar to him.



Gates Boiler Furnace

Patented 1916

Will last three times as long as ordinary good grade Fire Brick. These blocks are inter-locking, and made so that any handy man or fireman can renew them without disturbing any of the other brick work.

WRITE FOR PARTICULARS.

John W. Gates 2 St. James St., MONTREAL, QUE.

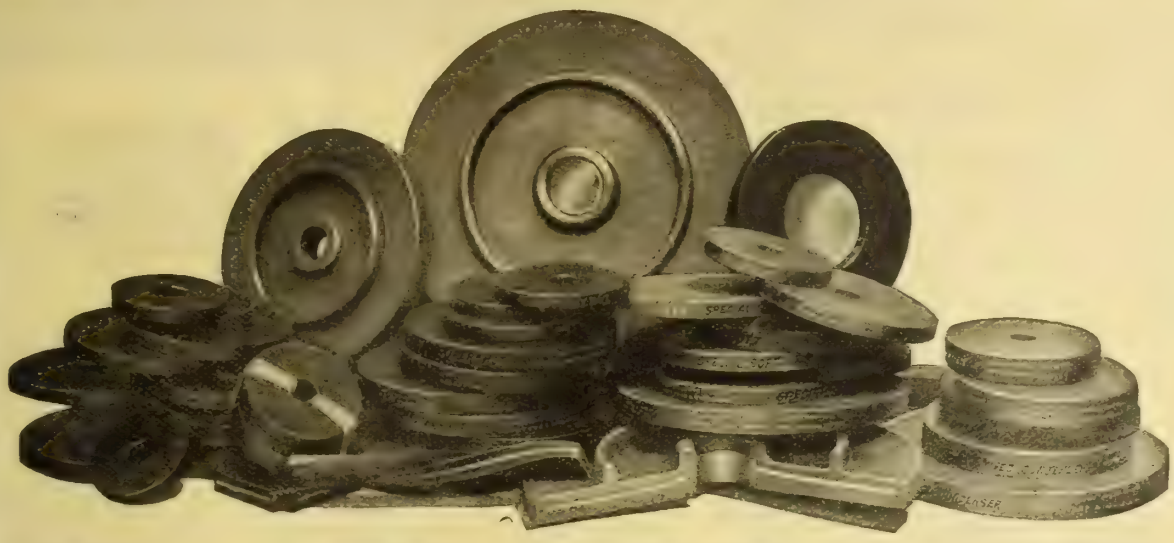
MONCRIEFF'S "UNIFIC" WATER GAUGE GLASSES

Stand in a Class by Themselves for Quality, Efficiency and Economy
A trial will convince you. Write for Catalog

W. J. WALL, 134-136 BLEURY ST., MONTREAL

(Canadian Representative)

THE CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED



STANDARD SUPER-HOT SPECIAL SOFT RED CONDENSER

Rub-Steel Valves

"THE VALVE WITH A BACKBONE"

WHAT IS IT? The Rub-Steel Valve is a valve made by a combination of rubber and steel.

THE CONSTRUCTION The construction consists of a plate of high grade steel placed in the center of the valve with a specially tough and lasting rubber composition on each side and edge, attached securely and lastingly to the metal by the Elchemo process, which chemically unites the rubber and steel.

THE PURPOSE The steel plate gives such strength to the valve that the highest pressure cannot warp, twist or in any way get it out of shape, while the rubber surfaces afford the proper seating qualities. **"Better than Metal Because of the Rubber—Better than Rubber Because of the Metal."**

WHAT IT ACCOMPLISHES It gives the valve a rigidity of form. It keeps the surface of the valve in its normal true position and insures a better seating quality. It prevents the high pressure from forcing the valve through the grating. It prevents the rubber from breaking up and the pieces causing trouble. It holds the surface of the valve in shape, so that when one side becomes worn the valve can be reversed without dressing. It is thinner and therefore gives greater efficiency to the pump. It permits the use of a softer valve for hot water, thus securing a better seat on worn or uneven "grids." It ensures an even distribution of the pressure, preventing "dishing" and the consequent cutting of the valve.

WHY YOU WANT IT **Because** its ultimate cost is less than that of ordinary type valves. **Because** it will last longer than other valves. **Because** it saves time and annoyance of replacement. **Because** its construction at once appeals to you as practical and sensible.

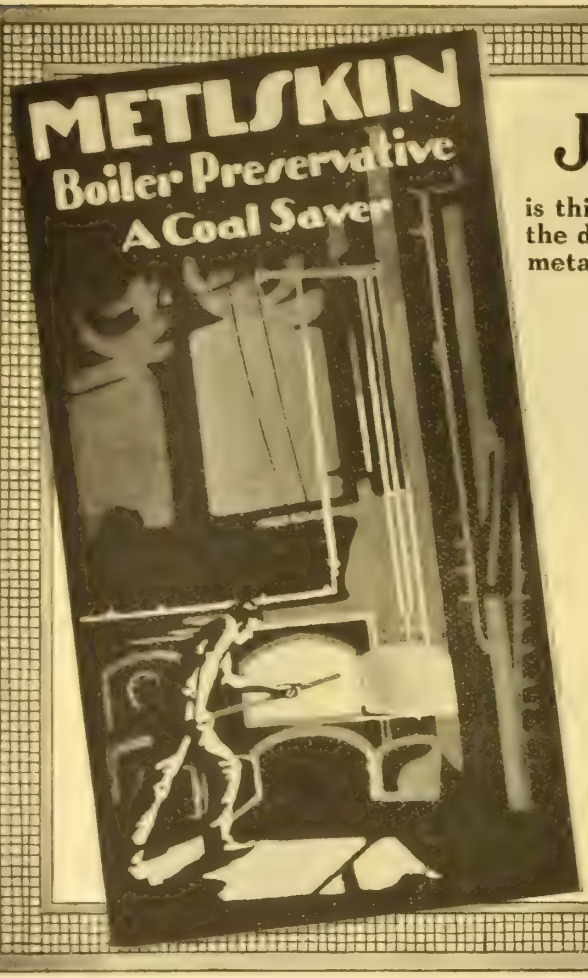
SOLE CANADIAN AGENTS

The Canadian Fairbanks-Morse Co., Limited

St. John, Montreal, Quebec, Ottawa, Toronto, Hamilton, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS



Just off the press

is this interesting little illustrated booklet. It explains the difference between a "compound" and a boiler-metal treatment. It shows a reproduction of the Guarantee Bond that backs

METLSKIN BOILER PRESERVATIVE

Neither "Compound" nor "Cure-all"

This booklet states details of the 60 day Trial Offer, by which you can give METLSKIN a thorough Test, and see results first, before the question of payment is considered. Both Guarantee Bond and Trial Order are so worded as to make your decision final.

METLSKIN absolutely will not contaminate steam

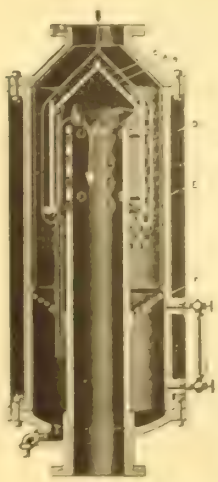
Write our nearest branch for booklet

The CANADIAN FAIRBANKS-MORSE CO., Limited

Montreal Quebec Ottawa St. John Toronto Hamilton Windsor
Winnipeg Vancouver Victoria Calgary Saskatoon

III IMPORTANT THINGS

TO CONSIDER ABOUT A SEPARATOR.



I. THE PLAN—Is it sensible, will it work, no matter how large the Separator or how well made?

II. THE SIZE—Is it big enough regardless of plan, will it hold a good dose of water?

III. THE CONSTRUCTION—Is it strong enough, are flanges heavy, how will it look by the side of a nicely finished engine? Send for catalog and note these points in

Sweet's Separators

DIRECT SEPARATOR COMPANY

820 Geddes Street - SYRACUSE, N.Y.

General Sales Agents:

Canadian Fairbanks Morse Company, Limited

St. John, Montreal, Quebec, Ottawa, Toronto, Hamilton, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria

PRATT P&C CO &CADY

VALVES and ASBESTOS PACKED COCKS

TO SUIT ALL PURPOSES AND PRESSURES

For the past forty years engineers of wide experience have conceded their superiority. Write for catalog and get fully acquainted with their possibilities in your plant.

PRATT & CADY CO., Inc.

HARTFORD, CONN.

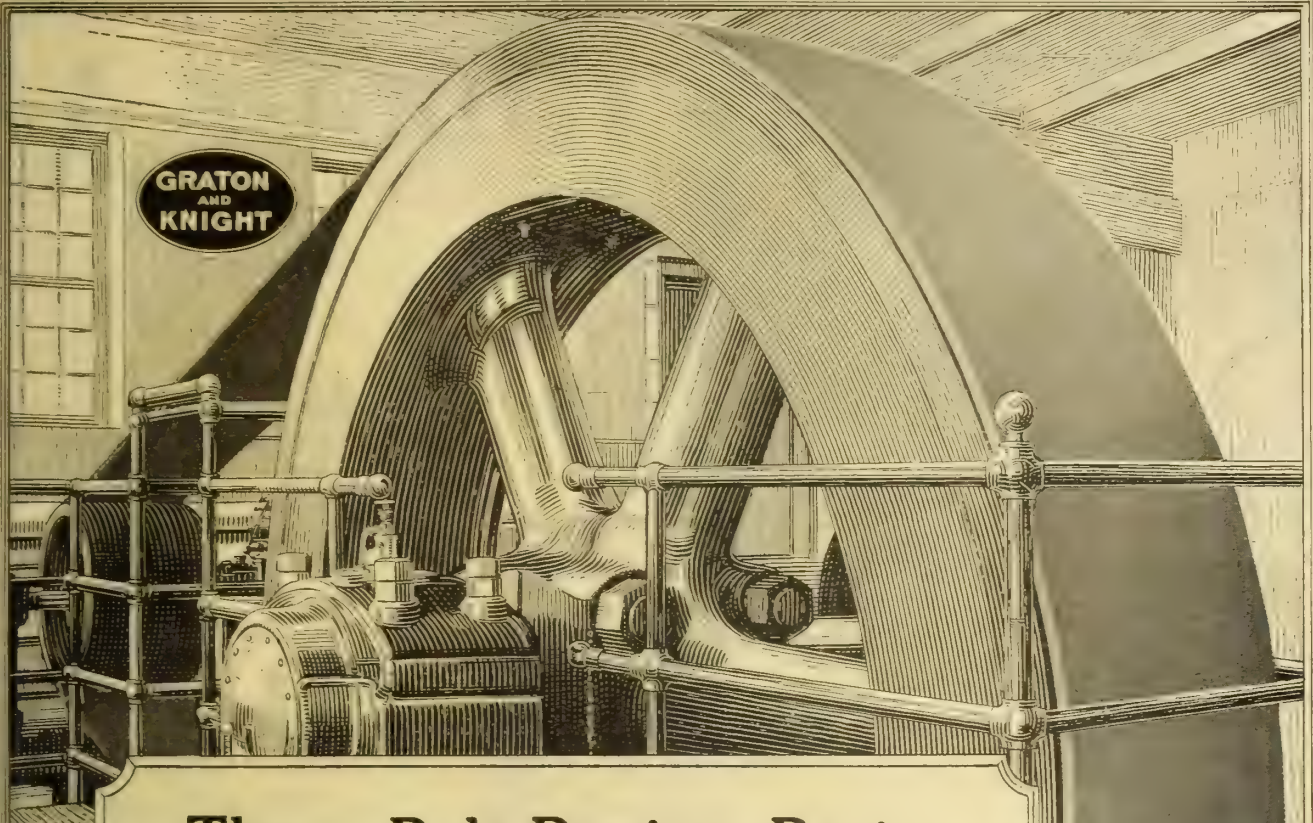
General Sales Agents

THE CANADIAN FAIRBANKS-MORSE CO.

Montreal, Toronto, St. John, Quebec, Ottawa, Hamilton, Winnipeg, Saskatoon, Calgary, Edmonton, Vancouver, Victoria.

THE CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED.

CANADA'S REPAIR PARTS STORE FOR MACHINERY OF EVERY DESCRIPTION



Three Belt-Buying Basics

LEATHER

Of all belting materials, leather is pre-eminent for long wear under hard usage; for frictional grip on pulleys; for standing the strain of main drives and the side-slap of shifters; for ease of repair and splicing; for minimum power-leakage; for that **light-weight** pliability, firmness, and elasticity which good belting must possess.

TANNAGE

Belting leather requires a special tannage. We tan nearly 300,000 hides a year for belting use, giving you two great advantages: All our belts are of leather of the best possible quality for belting requirements. Our enormous stock of hides enables us to maintain a uniformity throughout our product that can be assured in no other way.

STANDARDIZATION

Power transmission needs fall into comparatively few classes For each one there is a Graton & Knight Standardized Belt. That means a belt which is scientifically built for exactly the class of duty to be performed. It is kept uniform. It pays us to make it standard for quality, because it pays mill-owners to make it standard for use.

Many of the best belted plants ask us to specify the belting for every pulley. Try the plan yourself. Then, when buying call for "Graton & Knight——Brand or equal." This won't commit you to buying our belts. It will put your buying on the one basic consideration—**the work to be done.**

Write for information about Standardization as applied to Belting.

The Graton & Knight Mfg. Company, Worcester, Massachusetts, U.S.A.

Oak Leather Tanners, Makers of Leather Belting, Lace Leather, Leather Packings, and Specialties

BRANCHES AND DISTRIBUTORS IN PRINCIPAL CITIES

Canadian Representatives; The Canadian Fairbanks-Morse Co., Ltd., St. John, Montreal Ottawa, Toronto, Hamilton, Quebec, Calgary, Saskatoon, Vancouver, Windsor, Winnipeg, Victoria

24" Spartan Double Leather Belt on Motor Drive at Bosch Magneto Co., Springfield, Mass.

GRATON & KNIGHT

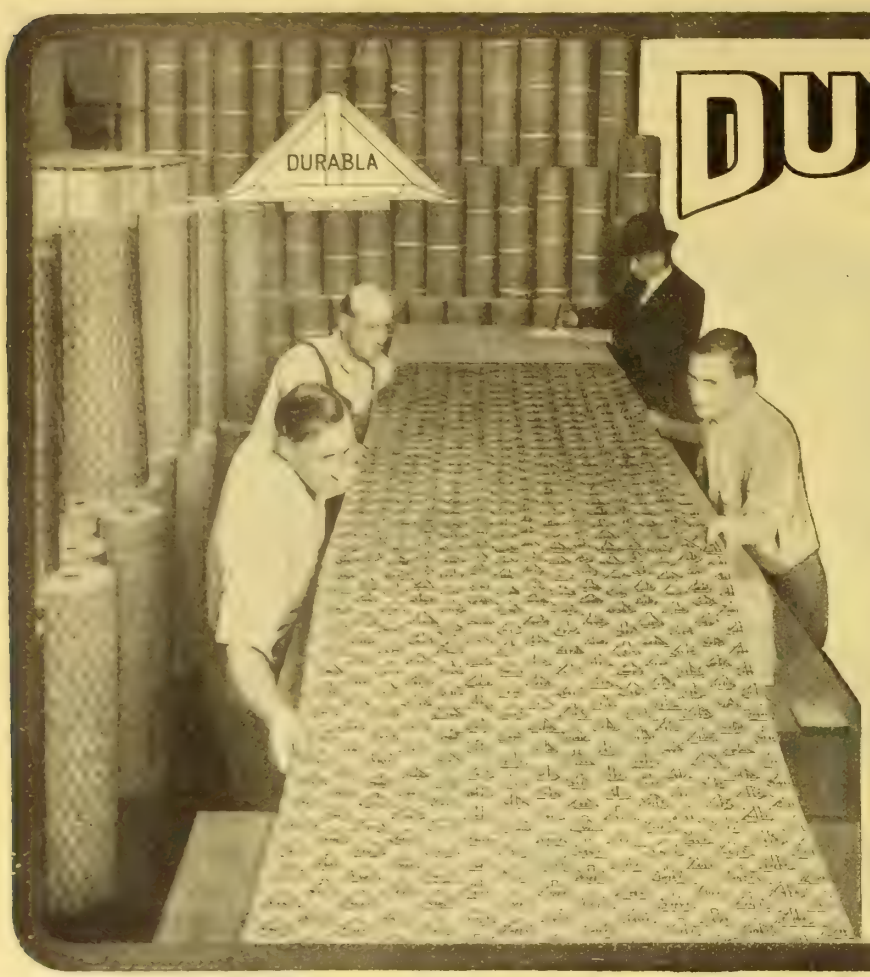
Standardized Series

LEATHER BELTING

Tanned by us for belting use

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS



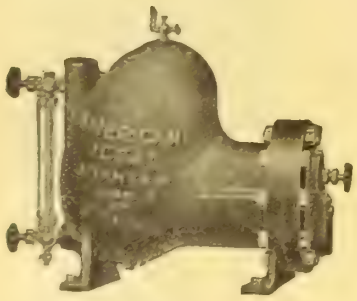
DURABLA

No defects in manufacture pass these men, who inspect every sheet.

The Durabla sheet is a quality sheet, and we guarantee every gasket cut from it to make a permanently tight joint.

Only quality promotes Efficiency. Only standardizing on the best proves true economy.

Durabla Mfg. Co.
NEW YORK
Distributors for Canada:
The Canadian Fairbanks-Morse Co., Limited



What is Steam Trap Service?

It consists of operation, day in, day out, year in and year out, without leakage of steam and without the necessity of constant attention of steam fitter.

Such is the service given by

The American Ideal Steam Trap

Let us help you select the proper size for your needs.

Canadian Agents: CANADIAN FAIRBANKS-MORSE CO., Limited
Montreal, Quebec, St. John, Calgary

AMERICAN STEAM GAUGE AND VALVE MFG. CO.
New York Chicago BOSTON Atlanta Pittsburgh

FOR Steam or Air Drill, Pneumatic Tools, Boiler Flue Cleaning, Syphon Connections, Suction Lines.

For all kinds of Oil, Gasoline, Paints, Hydraulics, Gas.

"PENFLEX" METAL HOSE

INTERLOCKING

An all Metal Flexible Hose. Manufactured in Bronze or Galvanized Steel. Will withstand highest pressures. Is unsurpassed for durability and pressure resisting qualities.

Large Stock Carried in Canada

Pennsylvania Flexible Metallic Tubing Company - - Philadelphia, Pa.

Canadian Agents: The Canadian Fairbanks-Morse Co., Ltd., St. John, Quebec, Montreal, Ottawa, Toronto, Hamilton, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria.

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

Does Your Coal Pile Seem Small and Expensive?

Then the most necessary thing is ECONOMY, not only in its use, but of every pound of steam that your coal produces.
Avoid all leaking steam at the stuffing boxes, no matter how small, by using a rod packing that has great staying qualities.
You can depend upon

Working samples to prove quality. Send for them. No charge.

TRADE MARK
"PALMETTO" PACKING

because the materials of which it is made have the great tensile strength found only in first quality. The abundant lubricant in each single strand greatly adds to its life by keeping the rod constantly lubricated.

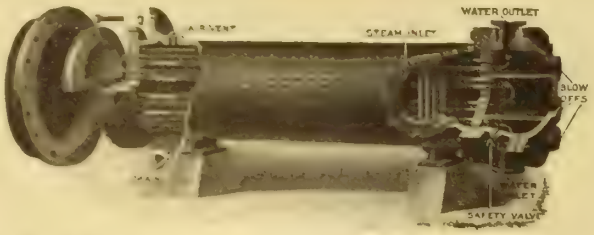
GREENE, TWEED & CO.
SOLE MANUFACTURERS

109 Duane Street, NEW YORK

Canadian Agents:
The Canadian Fairbanks-Morse Co., Limited, St. John, Toronto, Quebec, Hamilton, Montreal, Ottawa, Vancouver, Victoria.

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS



Alberger
Multi-Head Heater

Keeps water hot to supply all demands. It heats the water just as fast as it can be drawn.

The Multi-Head feature takes care of unequal expansion of hot and cold tubes—no trouble whatever from expansion strains.

The Alberger Heater will give you perfect service for years and the most economical. Made in horizontal and vertical types for all services.

Alberger Tubes **transmit 50% more heat** than plain tubes. Alberger tubes are small and corrugated: **Small** because usage shows that small tubes transmit a much greater quantity of heat per square foot of heating surface than large tubes; **Corrugated** because usage shows that corrugated tubes transmit over 50% more heat than plain tubes of the same size.

Alberger Tubes are pure copper, for the reason that pure copper tubes, unlike brass, are not subject to segregation of materials nor will they split under temperature changes.

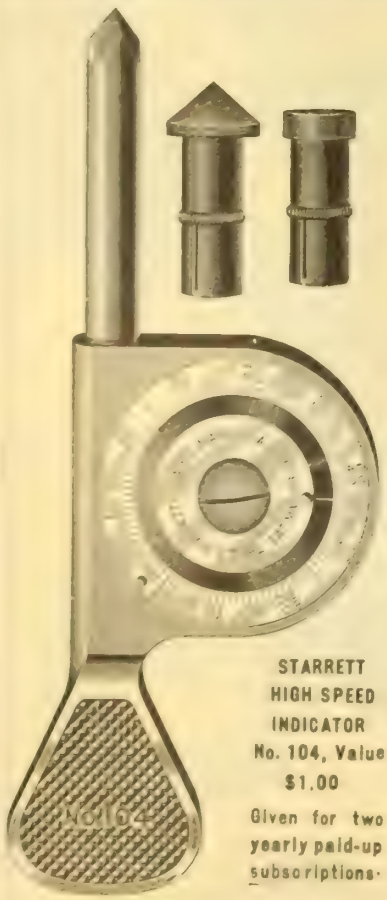
Write now for Catalog.

ALBERGER HEATER COMPANY

BUFFALO, N.Y. Manufacturers of Alberger Multi-Head Heaters

GENERAL SALES AGENTS:
CANADIAN FAIRBANKS-MORSE COMPANY, Limited

St. John, Montreal, Ottawa, Toronto, Hamilton, Quebec, Calgary, Edmonton, Vancouver, Winnipeg, Victoria.



STARRETT HIGH SPEED INDICATOR No. 104, Value $1.00

Given for two yearly paid-up subscriptions.

You May Have This Speed Indicator without Spending a Cent

if you are a subscriber to "POWER HOUSE." If you are not a subscriber, send in your own subscription together with two others, and the indicator you are entitled to will be mailed to you immediately.

To subscribers who send us two NEW yearly paid-up subscriptions we will send this $1.00 indicator.

"POWER HOUSE" is designed to give Canadian Engineers, Superintendents and Power Users all the latest and best information in the engineering field. A little work among your engineer friends and acquaintances will earn for you this handy indicator without any trouble. Try it and see how easy it will be.

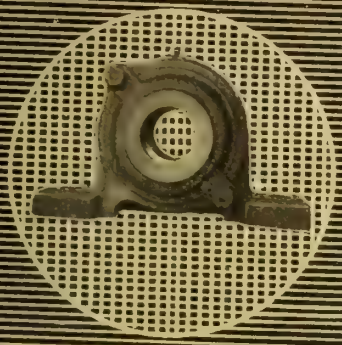
PUBLISHED MONTHLY AT $1.00 PER YEAR
Start in TO-DAY to earn one of these Handy Tools

POWER HOUSE 143 University Ave., **Toronto**

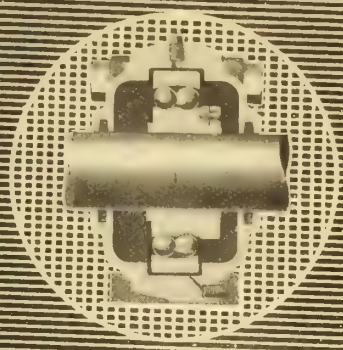
THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

SKF
BALL BEARINGS AND RIGID PILLOW BLOCKS



Full View of Rigid Pillow Block



Sectional View of Rigid Pillow Block

They Insure

1. Saving in Power. 2. Saving in Maintenance.
3. Saving in Lubrication. 4. Saving in Equipment.

How to Measure Transmission Losses

ELECTRICALLY EQUIPPED PLANT

First: Throw the belt off the motor driving the shaft to be tested and take proper reading for input to drive motor only.

Second: Put the belt back on the motor pulley and shift all belts on the main line to the idler pulleys on the counters. Take power reading. The difference between these two readings will show the net line shaft transmission loss.

STEAM PLANT

First: Ease the belt off the fly wheel or pulley of the engine, indicate the engine.

Second: Put the main driving belt back and run line shafting at normal speed with all belts driving loose pulleys only, indicate the engine. The difference between the indicated readings with the main belt off and on will show the net line shaft transmission loss.

It will then be a simple matter to figure out in dollars and cents the amount wasted annually in the friction loss of plain bearings, and it will be easy to determine if it is worth while to save 50% of this waste by the application of SKF Ball Bearing Hangers or Rigid Pillow Blocks.

Bulletin No. 78 Proves Facts

Canadian SKF Co., Limited, Toronto, Ontario

Sales Agents for SKF Transmission Bearing:

The Canadian Fairbanks-Morse Co., Limited

St. John, Quebec, Montreal, Ottawa, Toronto, Hamilton
Windsor, Winnipeg, Saskatoon, Calgary,
Vancouver, Victoria

H. G. WELLS

says in APRIL MACLEAN'S that peace is not going to be made in the old way—not by great moustached heroes, frowning and drawing lines with black soldierly thumb-nails across maps—not by bargaining and bullying and table-banging. All the essential terms he declares will be stated and accepted in the sight of all mankind before even an armistice occurs. A BIG ARTICLE—A GRIPPING ARTICLE, by the greatest of present-day writers, entitled:

"The League of Free Nations"

OTHER FEATURES OF THIS NUMBER ARE

John Bayne Maclean, in one of his sensational articles on the War, "Suppressing the Truth."

Robert W. Service, in a strong War poem, "The Blood-Red Fourragere."

Agnes C. Laut, in "Labor Will Unmask the Kaiser."

BRIGHT AND GRIPPING STORIES BY

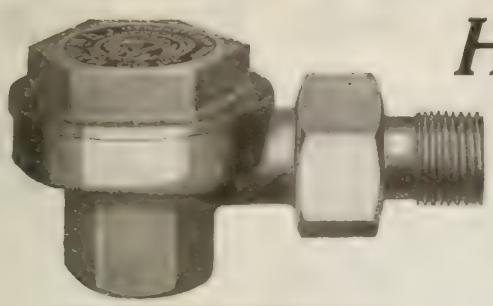
ARTHUR STRINGER
ALAN SULLIVAN
E. PHILLIPS OPPENHEIM
A. C. ALLENSON

APRIL
MACLEAN'S

"THE MOST TALKED-OF PUBLICATION IN CANADA"

20 Cents **At All News Stands**

If what you want is not advertised, consult our Buyers Directory and write advertisers listed under proper heading.



THE DUNHAM RADIATOR TRAP

How to Heat Buildings Quicker, Easier and More Economically

The Dunham Radiator Trap is a big coal saver because it gets every last bit of heat out of the coal. Besides it gives *you* the following advantages:—

It prohibits steam waste. Jet water at vacuum pump is not required.

Steam circulates easily through radiators and coils because air is eliminated.

You'd like to do that for the owner of your building, wouldn't you? Every engineer would.

All right! Here's the way to do it. Recommend that the radiators be equipped with Dunham Radiator Traps. Many of the largest buildings in Canada are so equipped. These buildings are being heated at a surprisingly low fuel cost because less fuel is required.

Let us tell you more about The Dunham Radiator Traps. Write us.

The DUNHAM HEATING SERVICE

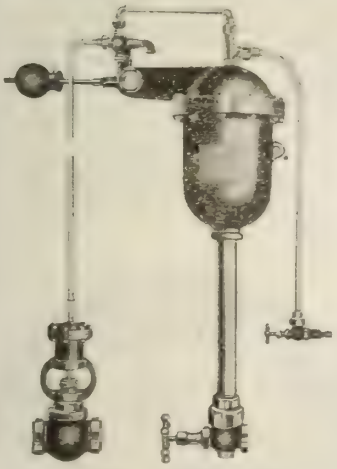
C. A. DUNHAM COMPANY, Ltd., Toronto, Canada

Branch Offices:
Halifax, Montreal, Ottawa, Winnipeg, Vancouver, Calgary

Branches in Principal Cities in U.S.

VIGILANT

WATER-FEED REGULATOR



"Two Birds with One Stone."

The old adage holds good with the *Vigilant Water Feed Regulator.*

It affords absolute protection from High and Low Water Accidents and saves from 3 to 17% on fuel costs.

Its fuel-saving ability is a decidedly important factor in these days of high prices, and thus the "Vigilant" quickly pays for itself. Yet it is not expensive.

It is constantly on the job and keeps the water within ¼" of Middle gauge. Works automatically.

You need the "Vigilant."

Write for illustrated catalog.

The Chaplin-Fulton Mfg. Co.

28-34 Penn Avenue, Pittsburgh, Penna.

Also Manufacturers of the Fulton Pump Governor

Are You Holding Back on Your Uncle Sam—

The Pressure Regulator

One of the Davis Steam Savers

by wasting coal? Wasting steam is throwing away coal and it's up to you to stop part of it by reducing your steam pressure to that demanded by the different units in your plant.

The Davis Pressure Regulator automatically reduces boiler pressure to any lower pressures that may be needed for efficient operation. It is built like a pair of balance scales. The steam pressure *inside* is balanced by weights on the *outside*—the action is just as visible and accurate as the action of a pair of balance scales. Simple and well built—positive in action.

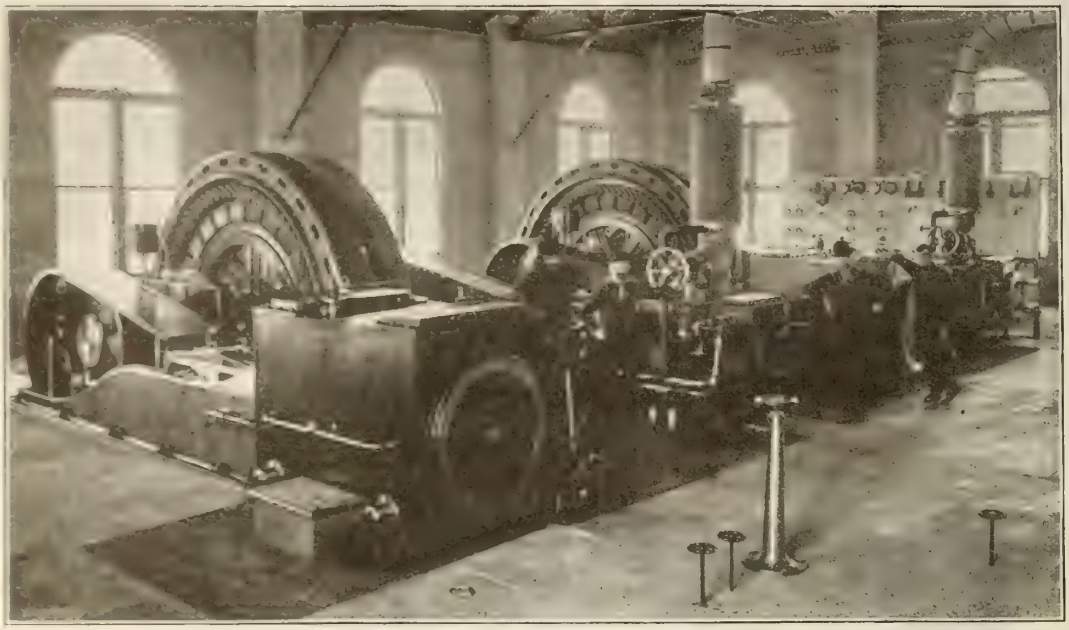
A new booklet has just been prepared giving some mighty interesting information about valves and piping. For a free copy, write the G. M. Davis Regulator Co., 434 Milwaukee Ave., Chicago, makers of many different valve specialties for factories and power plants.

Or Are You Helping Him Save Coal by Using—

DAVIS VALVE SPECIALTIES

STEAM SAVERS SINCE 1875

25 Cycle Engine Generator Sets For Sale



1—250 KW.
1—300 KW.

25 Cycle
3 phase
Westinghouse
Generators
Direct
connected to
McIntosh &
Seymour Cross
Compound
Gridiron Valve Engines 150 R.P.M.

These units were in use only seven months and are in first class condition.
Write for further particulars and quotations

Power Plant Equipment Co., Dominion Bank Building **Toronto, Ont.**

Use Flake Graphite for Cylinder Lubrication and Cut the Cost.

Dixon's Flake-Graphite forms a wonderfully smooth, anti-friction veneer over the interior of the cylinder.

It furnishes better lubrication than can possibly be obtained by oil alone.

DIXON'S Ticonderoga Flake Graphite

will restore cut and scored cylinders and valves to perfect smoothness. Sticking and groaning valves disappear entirely. Rod packings last indefinitely.

Write for Booklet No. 222-C, showing some of the types of engines on which Dixon's Flake Graphite is being used, and explaining method of successfully introducing it into the cylinder.

Made in Jersey City, N.J., by the

JOSEPH DIXON CRUCIBLE COMPANY

ESTABLISHED 1827

Sole Canadian Representative:
CANADIAN ASBESTOS CO.
Montreal, Que.

MacKINNON, HOLMES & Co.

Limited
MacKinnon Steel Co., Ltd.
SHERBROOKE QUEBEC

Engineers, Manufacturers and Erectors of Steel Structures

We Specialize in

Bridges, Buildings, Towers, Tanks, Penstocks, Roof Trusses, Columns, Smoke Flues and Stacks, Coal Bins, Ore Bins, Buckets, Refuse Burners, Stills, Air Receivers, etc.

WRITE FOR PRICES.

WALTER J. FRANCIS, C.E. M. Can. Soc. C.E. M. Am. Soc. C.E. M. Inst. C.E.
FREDERICK B. BROWN, M.Sc. M. Can. Soc. C.E. Mem. Am. Soc. M.E. Mem. A.I.E.E.

WALTER J. FRANCIS & COMPANY
CONSULTING ENGINEERS
Head Office, 232 St. James St., Montreal
Cable Address, "Walfran, Montreal"—W.U. Code.
Long Distance Telephone, Main 5643.

The function of lubricating oil is to give the greatest ease of motion to all parts of the engine, so that every possible atom of power may be transmitted to the machines. An oil that will do this will have effect on other divisions. Ease of operation would mean elimination of friction, no wear on the bearings, less oiling. Pure oil would be a decided labor-saving, cost-reducing, efficiency-promoting factor in the engine room. A great many Canadian manufacturers have pronounced our "Non-Corrosive Cylinder Oil" pure. We, who know its construction, pronounce it pure. Get in touch with us.

NON-CORROSIVE CYLINDER OIL
MANUFACTURED ONLY BY
E. H. KELLOGG & CO.
NOS. 242 TO 244 SOUTH ST. NEW YORK U.S.A.

VIM

Leatherbelt

MAXIMUM FLEXIBILITY

MAXIMUM TRACTIVE PROPERTIES

THAT BLACK BELT YOU HAVE HEARD ABOUT

MAXIMUM SPEED AND PRODUCTION

MAXIMUM ELASTICITY

MINIMUM BELT SLIP

MANUFACTURED IN CANADA BY

CANUCK SUPPLY CO., LIMITED

Toronto Montreal Winnipeg

EXCLUSIVE CANADIAN REPRESENTATIVES FOR

E. F. Houghton & Company

PHILADELPHIA

Economy!

IN THE STEAM PLANT

sation returned to the boilers as pure **Hot** steam. This is what the "Morehead System" will do, automatically and completely—thus saving many dollars' worth of fuel in the course of a year.

The "Morehead System" does more. It effects economy in operation, gives freedom [illegible] all steam pump troubles, and maintains an equally-controlled uniform temperature [illegible] out your plant

[illegible] cylinder lubrication, will not race or run away, [illegible] takes little space, requires no [illegible] and will handle water of any tem-

Requires practically no attention, needs no [illegible]

[illegible] SEND YOU SOME MORE FACTS ABOUT THE "MOREHEAD SYSTEM."

CANADIAN MOREHEAD MANUFACTURING CO., - - WOODSTOCK, ONT.

PACKING
FOR
CENTRIFUGAL PUMPS

Our style No. 270 is made specially for this work.

A braided cotton, lubricated and graphited.

Sample on Request.

Thomson-Gordon Limited

Hamilton, Ont.

Packings *Belting* *Engineer Supplies*

1918 1919 1920

"VULCABESTON" RED FIBRE STEAM STEEL SHEET PACKING

Buy "Annual" Economy in Packing

Per-year economy in packing, as contrasted with per-pound cheapness, saves you the loss of time and efficiency caused by inferior grades.

The long-fibre asbestos used as the base of VULCABESTON, is treated with a scientific composition that gives it:

—Efficiency in preventing leakage;
—Durability under hardest usage;
—Adaptability to every packing purpose;
—Resistance to all climatic conditions;
—Power to conform automatically to contracting or expanding metal.

These features of VULCABESTON establish it as the most reliable and economical packing you can buy.

TRADE MARK

VULCABESTON

REG. IN U. S. PAT. OFFICE

THE RED-FIBRE SHEET PACKING

Look for the triangular trade-mark—stamped thirteen times on each 40″ x 40″ sheet. Demand the genuine—others may disappoint.

Buy from our dealer nearest you.

The Johns-Pratt Company

Hartford, Conn., U.S.A.

Self-Lubricating

In Bulk

SAFETY PLASTIC

METALLIC PACKING

FOR STEAM, WATER, AIR, GAS, ETC.

Pat. Dec. 22, 1903 Highest Award World's Fair, St. Louis, 1904

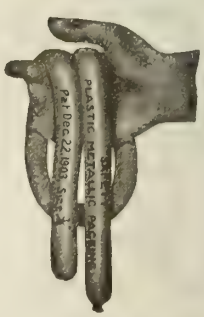
GUARANTEED TO LAST THREE YEARS

WITHOUT RENEWAL

Drop us a line and let us tell you all about this Remarkable Packing.

STEEL MILL PACKING CO., WINDSOR, ONT. Established 1899

Practically Frictionless



In Cotton Tubes

JOHNS-MANVILLE SERVICE
COVERS THE CONTINENT

JOHNS-MANVILLE

Behind the Power that Turns the Wheels of Your Life

YOUR food, your clothing, your equipment for life's work, come from the collective efforts of thousands of manufacturing plants, which in the struggle to meet your demands, compete in quality, in price and in service.

To do this, these manufacturers must operate their establishments at highest efficiency—must protect their plants against countless costly leaks such as waste heat, friction, wear and tear, and breakdowns.

Many American manufacturers rely on Johns-Manville maintenance materials to check these losses. For example, they improve the efficiency of pumps and engines by packing them with Johns-Manville Sea Rings, the packing that reduces friction to a minimum. The brick arches over the blazing boiler fires are protected from the flame's white heat by Johns-Manville Refractory Cements. Again, the valuable heat transferred through pipes, ducts and flues is conserved by Insulations made from Johns-Manville Asbestos and Magnesia. And in hundreds of other instances, Johns-Manville materials are employed to reach you with a better product at the lowest cost.

So that of all the ways—some direct, some devious—by which Johns-Manville serves the public, none is more important than this function of maintenance, this power economy at the very heart-center of industry.

The Canadian H. W. Johns-Manville Company, Limited

Montreal Toronto Vancouver Winnipeg

JOHNS-MANVILLE POWER PLANT MATERIALS

A variety of specially developed insulations, including: Asbesto-Sponge Felted Insulation, 85% Magnesia Insulation, Asbestocel Insulation.

Packing and other Power Plant specialties, such as.

Underground Insulation System for Pipes
The Johns-Manville Fire Extinguisher
The Johns-Manville Steam Trap
Asbesto-Metallic Brake Blocks
High Temperature Cements
The Johns-Manville Sea Ring
Universal Piston Packing
Mogul Valve Stem Packing
Kearsarge Boiler Gaskets
Service Sheet Packing
Seigelite Sheet Packing
Duplex Packing

A Johns-Manville Sea Ring

Waukesha Brewery, Waukesha, Wisconsin

Thoroughly Protected

A power house engineer never looked at a neater, cleaner plant than this one protected with

R.I.W. PROTECTIVE PRODUCTS

REMEMBER IT'S WATERPROOF — REG. U.S. PAT. OFF.

"R.I.W." Cement Filler and Cement Floor Paint (Patented as to Portland Cement, Feb. 27, 1906), make the floors impervious to water, oils and acids and prevent "dusting" and disintegration.

No. 232 "R.I.W." keeps the walls proof against dampness.

"R.I.W." Liquid Konkerit (patented as to Portland Cement, Feb. 27, 1906) further protects the walls and lends a pleasing and attractive finish.

"R.I.W." Hospital and Laboratory Enamel insures a sanitary and beautiful finish to the woodwork. Acid or alkali fumes cannot mar its fresh appearance.

No. 49 "R.I.W." guards the steel work against corrosion of all sorts. "R.I.W." Aluminum Bronze was used as a protective finish on other exposed metal.

"R.I.W." Flex-Sicco Ready Mixed Paint finishes this job of model protection by preserving the wainscoting of the engine room and brew house.

Write for valuable description of products. Address Dept. 59.

R.I.W. DAMP RESISTING PAINT CO.
TOCH BROTHERS

Gerrard St. and Carlaw Ave., Toronto, Ont.

Agents in—Vancouver, Winnipeg, Edmonton, Calgary, [illegible] Montreal, Quebec, St. John, N.B.

R.I.W.
REMEMBER ITS WATERPROOF
STEEL NEED NOT RUST!
WOOD NEED NOT ROT!
NOR CONCRETE DUST!
REG. U.S. PAT. OFF.

"John Crane" Flexible Metallic Packing is without a doubt the present

SENSATION

of the packing world.

It is "just what every engineer wants," and that is why we are receiving such an abundance of enthusiastic repeat orders from all over the world.

"John Crane" is made of sheet babbitt spirally and evenly wound from the center outward. It is NOT a mixture of babbitt and fabric. It is ALL babbitt.

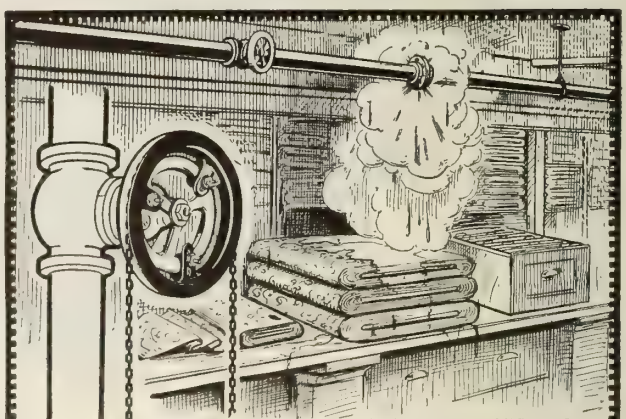
It makes an ideal packing for the same reasons that babbitt makes a good bearing. It is the only

Flexible Metallic Packing

that is based on scientific and practical principles. You can cut it with a knife just like fabric. You can bend it like fabric. You can form it to fit the box BETTER than fabric. And more important still, it resists EVERYTHING—steam, gas, oil, air, ammonia, water, etc. You needn't carry a dozen different kinds of packing in stock. Simply keep some "John Crane" handy and if the rod is a good one the packing won't wear out for years. We haven't room in this ad. to tell you about our many installations, but will gladly tell you all about "John Crane" on request.

You certainly want the best packing obtainable, and for that reason you should get in touch with us at once. Ask for Bulletin No. 1.

Crane Packing Company Box 241, Windsor, Ont.
General Office and Factory, Chicago, Ill.



WASTE WATER RUINS EXPENSIVE GOODS

WHILE YOU LOOK FOR THE LADDER SOME ONE FORGOT TO BRING BACK

If you had turned off the valve at once, it wouldn't have happened. The

Babbitt
—Adjustable—
SPROCKET RIM

makes it easy to operate a valve, no matter how difficult it may be to get at. Attached with three bolts in a few minutes.

At Your Dealer's, or we will mail you an Illustrated Booklet

Babbitt Steam Specialty Co.
NEW BEDFORD, MASS.

93 10

Manufactured in Canada, under Canadian Patents, exclusively by the Engineering Specialties Company, Limited, 1080 King St. W., Toronto, Ont.

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

DART UNIONS

Defy Time, Pressure, Corrosion Vibration and Expansion

Bronze to Bronze at the Joint

When the BRONZE FACES of Dart Unions are drawn together you have a joint that is practically everlasting in its efficiency.

The BRONZE FACES of Dart Unions never deteriorate, and their heavy iron parts is a guarantee against stretching or pulling apart.

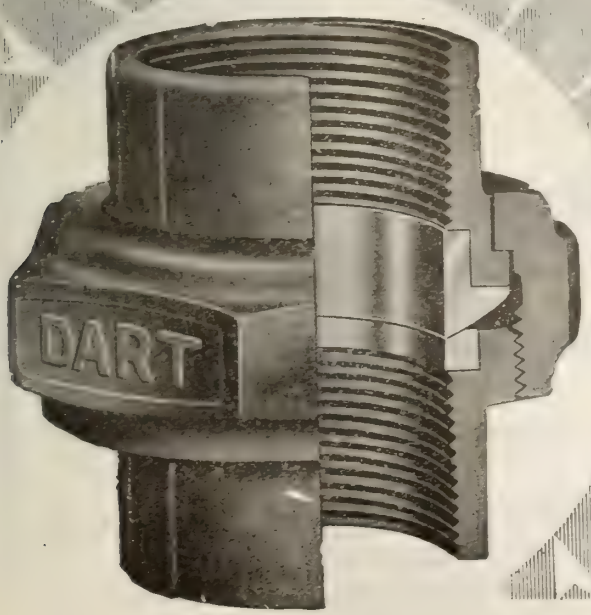
Absolutely no leaks—no upkeep cost—no replacement cost—easily connected.

The ball-shaped seat allows for an easily made and perfectly tight connection, whether pipes are in or out of alignment.

GET THEM FROM YOUR JOBBER.

DART UNION COMPANY, LIMITED
TORONTO, CANADA

BRONZE TO BRONZE AT THE JOINT



If any advertisement interests you, tear it out now and place with letters to be answered.

An Article Without Merit Will Not Endure.

THINK of some of your past experiences, your costly mistakes, and you will perhaps realize that the above statement is only too true.

Give us an opportunity to prove ***to you*** that our product has merit. ***We know it,*** but that does not satisfy us—***we want YOU to know it.***

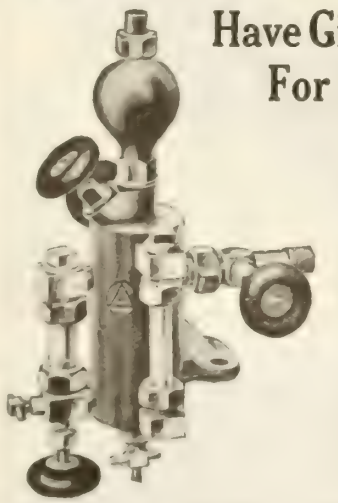
Pumps, Steam Appliances, Webster Heating System, Elevators

Darling Brothers, Limited, 120 Prince Street MONTREAL

TORONTO WINNIPEG

Detroit Lubricators

Have Given Satisfaction For Forty Years.



Built in a sufficient variety of styles to lubricate properly every type of steam engine, pump, gas engine, air compressor, etc.

Send to-day for catalog L 1. The information on lubricating devices contained in it will be valuable to you.

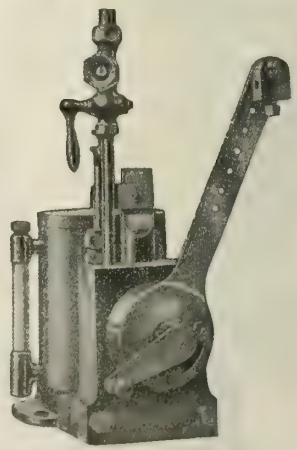
THEIR efficiency holds over half the world's trade.

Makers of Stewart Carburetors.

CANADIAN DETROIT LUBRICATOR COMPANY, LTD.

WALKERVILLE, ONT.

The Lubricator of Exceptional Merit



Clutch Drive Pattern

Becoming More and More Popular

The Rochester Lubricator

Manufactured by

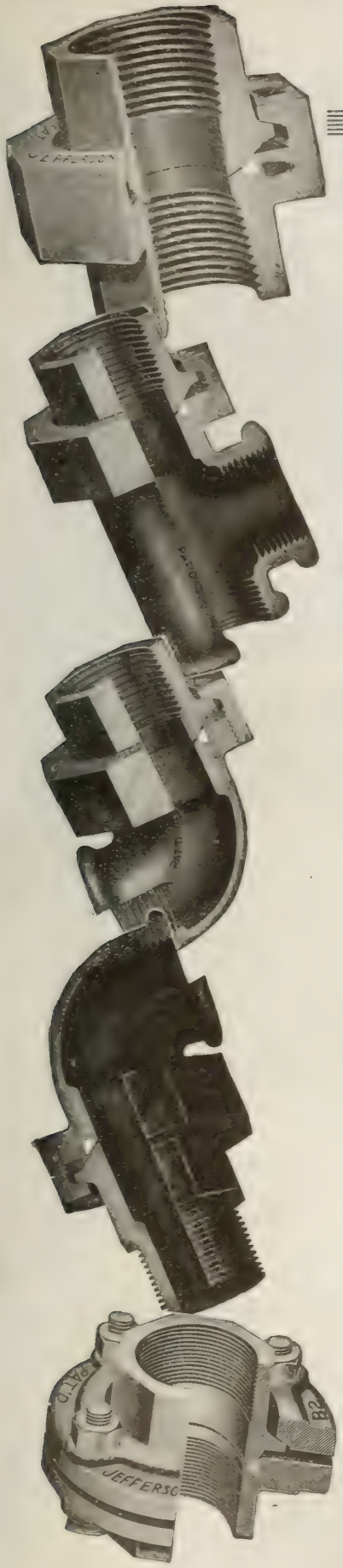
Greene Tweed Company, N.J.

Sole Agents for Canada

Darling Brothers, Limited

120 Prince Street, Montreal

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.



All Down the Line—

You'll find sizes and types of

Jefferson Unions

for every union need — why not standardize them and put an end to pipe line troubles throughout your plant?

The Jefferson feature of forcing the brass seat ring into a recess just back from the runway and contents of the pipe makes it corrosion-proof and at the same time much more durable than a bronze or brass seated union handled in any other way. Then the weight of a Jefferson is greater than any other union of similar class—another logical "reason why" they are most successful.

If your jobber can't supply Jeffersons, a line direct to us will bring you the name of our nearest dealer and the Jefferson Book "Unions" — a treatise on pipe line connections whch you'll enjoy reading.

Jefferson Union Features

Ground ball brass-to-iron or iron-to-iron joint ground with mate and never separated.

Sloping shoulder and large play in the ball end, which is of assistance in connecting piping out of line.

Standard pipe threads tapered to fit the pipe. Coarse nut threads for quick adjustment.

Heaviest of its class made and sold at reasonable prices.

The Jefferson Union Company

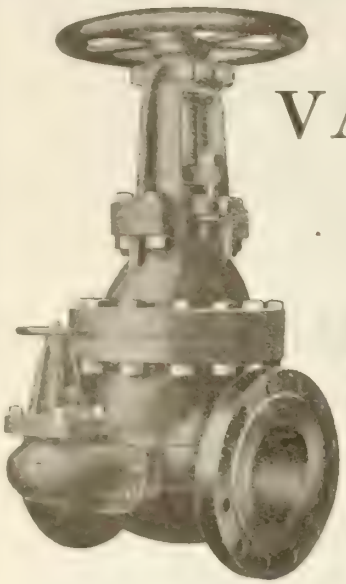
Lexington, Mass. U.S.A.

MAIL THIS HANDY COUPON FOR THE JEFFERSON BOOK "UNIONS"

Jefferson Union Co., Mass.
Lexington, Mass.
Please send me a copy of your New Catalog

Name .....
Firm Name .....
Address .....

"McAVITY"



VALVES

GLOBE
ANGLE
CHECK
GATE

WITH or WITHOUT
YOKE OR
BY-PASS

BRASS OR IRON

Screwed or Flanged

ALL SIZES AND STYLES
FOR ALL PURPOSES AND PRESSURES

FITTINGS

STRAIGHT
AND
REDUCING
FLANGES
BLANK, DRILLED
OR SPOT FACED

SPECIAL VALVES AND FITTINGS TO ORDER AT PROMPT NOTICE

T. McAVITY & SONS

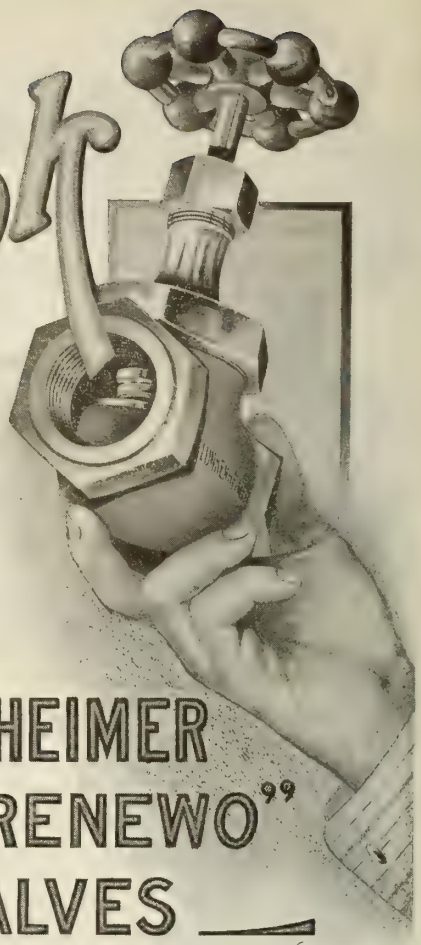
Limited

BRASS and IRON FOUNDERS
WHOLESALE and RETAIL HARDWARE

St. John, N. B.
CANADA

MONTREAL TORONTO WINNIPEG VANCOUVER
LONDON, England DURBAN, South Africa

Look



and satisfy yourself of the many advantageous features embodied in

LUNKENHEIMER "FERRENEWO" VALVES

Note the *seat ring* and *disc*,—both of which are made of Lunkenheimer "Valve-nickel," a material having exceptional wearing qualities; the regrindable seating surfaces; the renewability of all parts, including the *seat ring* and *disc;* the full areas through the body; union bonnet; special composition stem, which insures long life to the stem threads; deep stuffing box, etc. These features combined with Lunkenheimer "quality" materials and workmanship make the "FERRENEWO" *the* valve of exceptional merit.

Globe, Angle and Cross, and Horizontal and Angle Check Patterns, for working steam pressures up to 150 pounds.

Your local dealer can furnish them; if not, write us. Write for descriptive Booklet No. 567-DJ.

THE LUNKENHEIMER CO.

"QUALITY"

Largest Manufacturers of High Grade Engineering Specialties in the World

CINCINNATI, U.S.A.

New York Chicago Boston London

2-11-49

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

MUELLER

Globe and Angle Valves

BUILT from actual, practical experience. Made of the famous *MUELLER* steam metal and fully guaranteed against all defects in design and construction. Not a Valve, but *the* Valve.

¶ *MUELLER* globe and angle Valves can be repacked under pressure. The disc is so designed as to adjust itself to any position and still receive the thrust of the spindle on the center line; thus preventing any distortion to the seat or diaphragm. The pipe threads are full length, and are tapered to conform to I. P. Threads, insuring perfect joints.

¶ Full sized and unobstructed passages guarantee full service. The large Hexagons allow an excellent wrench grip and our design puts the strain where it belongs, so that there is no danger of distorting either the body or the bonnet. Furnished with enameled, Malleable iron wheel handles. Every *MUELLER* Valve tested to beyond unusual service conditions. Write for prices.

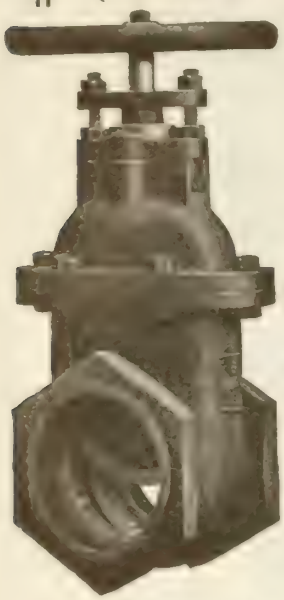
MUELLER gate and check valves, steam cocks, etc. rank highest in every branch of exacting service.

H. Mueller Mfg. Co., Limited

SARNIA, CANADA

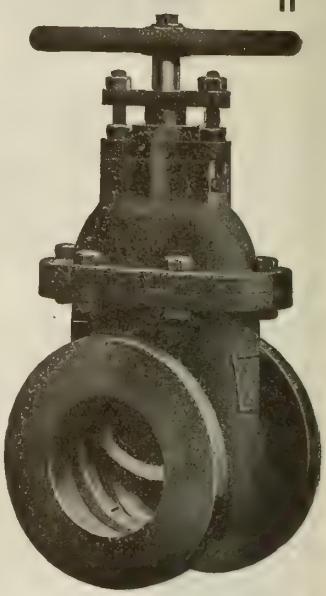
KERR

("New KEYSTONE" Pattern) GATE VALVES



If you have not used any of these New Pattern Valves, specify "KERR" in your next order. We want you to get acquainted with the most reliable valve on the market.

If you have been using them, we are confident that our satisfaction will bring us your repeat orders. These valves will never cause you or your customer the slightest trouble. Their high quality is consistent.



When you buy a "KERR" Valve you get a guaranteed article that is backed by a reliable firm. Many of the largest distributers of valves in Canada have sold "KERR" Valves for over 25 years, and are still recommending them as the "Best Valve." Write us for particulars.

Kerr Engine Co., Ltd., Valve Specialists **Walkerville, Ont.**

Homestead

QUARTER TURN

Valves

The Harder the Service the More their Merits are Appreciated

When you put **Homestead Valves** up against the hardest propositions in your plant it is then you realize their absolute safety and their superiority over all other valves. Strong and durable—constructed to stand greater pressure than that for which they are recommended.

Homestead Valves close with a quarter-turn and remain tight without dripping or leaking. Then they open with a

Direct and unrestrained flow with simplicity and ease of operation are conspicuous **Homestead** Features.

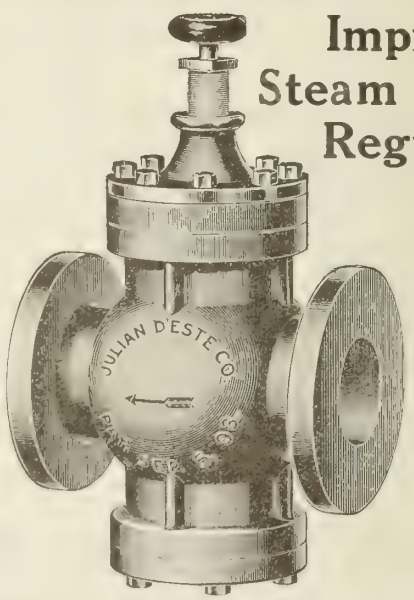
Elimination of waste and leakages soon pays for all **Homestead** valves. You should adopt them without delay.

Homestead Valve Mfg. Co.

Homestead, Penn.

CURTIS Engineering Specialties

Improved Steam Pressure Regulator



For Universal Application to all the varied and various conditions under which a reduced pressure of steam, water or other fluid is required, this Regulator (see illustration) has no equal. It is compact and self-contained, without levers, weights or projections.

No glands or packing; no drip or leak of steam or water. Suitable for any boiler pressure; made entirely of metal; is a lock valve, very simple and sensitive.

The universality of use of this Regulator is one of its best features, but it is in Steam Heating that its use is most common and obvious. Send for leaflet fully descriptive of this Regulator (contains price list) to the manufacturers.

MANUFACTURED BY THE

JULIAN D'ESTE COMPANY

Main Office, 26 Canal St., Boston, Mass.

Agencies: 216 FULTON ST., NEW YORK CITY; 174 N. MARKET, ST., CHICAGO, ILL.

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

JENKINS BROS.'

TYPE "K" BRASS GATE VALVES

EXCELL IN DESIGN AND CONSTRUCTION--ARE FIRST IN EFFICIENCY

FIG. 300

Catalogue No 8 Free on Request

JENKINS BROS.
LIMITED

Agencies in all the Principal
Countries of the World

TRADE JENKINS MARK
Jenkins Bros

TRADE JENKINS MARK
Jenkins Bros

Head Office and Works
103 ST. REMI STREET
MONTREAL, CANADA

European Branch
95 QUEEN VICTORIA STREET
LONDON, E.C. 4, ENG.

If any advertisement interests you, tear it out now and place with letters to be answered.

Canadian Association of Stationary Engineers

Incorporated May, 1887 Incorporated at Ottawa, June, 1917

An organization having as its aims and objects:—

To promote the knowledge of its members in the art and science of Steam Engineering.

The dissemination of information beneficial to the members of the association in the discharge of their calling.

To further and protect the interests of competent engineers, and receive such as members of this organization.

To secure, through proper legislation, the greatest security in operation of steam plants.

To assist unemployed members to secure positions.

To maintain freedom of action between employer and employee.

The members of the Association subscribe to the above in the full belief that ability and knowledge of one's profession are necessary to insure the highest degree of success.

Labor Study Energy

These three essentials have been responsible for the success of the world's greatest men. They are no less essential for yours. We cannot all become great, but this fact does not lessen the necessity for the exercise of these essentials in our individual occupations. Cool, calm, calculating judgment characterizes the successful power house operator of to-day. The demands on the engineer of to-day are many, and the obstacles in his path are great. To assist in the overcoming of these and help the accomplishment of great works, material, moral and educational, is the desire of all our members.

The benefits accruing from association with members of his fraternity, the opportunity to benefit by their experience, and the inspiration to greater effort by reason of their success render membership in this association indispensable to all progressive engineers.

If you are interested in such an organization and live where less than fifteen engineers are located, send for a copy of our constitution and application blanks for admission to nearest branch lodge. If there are more than fifteen engineers in your community, get together and send for particulars regarding formation of a branch lodge.

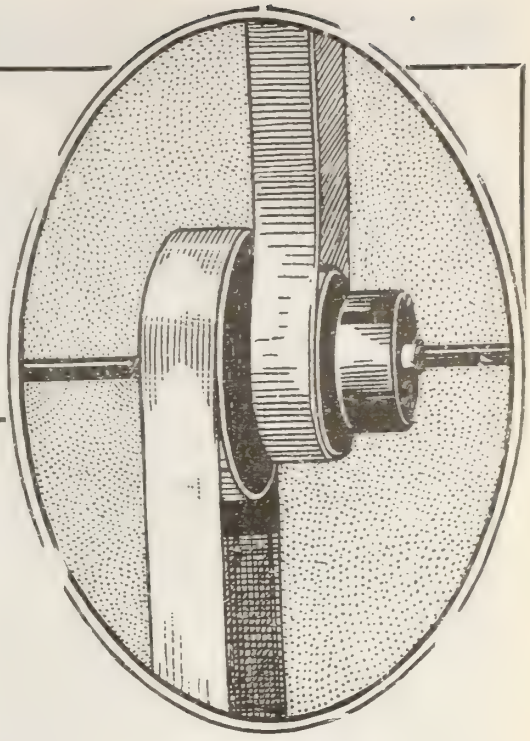
J. H. HALE, General Secretary, C.A.S.E.

230 Caroline Street Hamilton, Ont.

D. K. McLaren's

Genuine British Oak-Tanned

Leather Belting



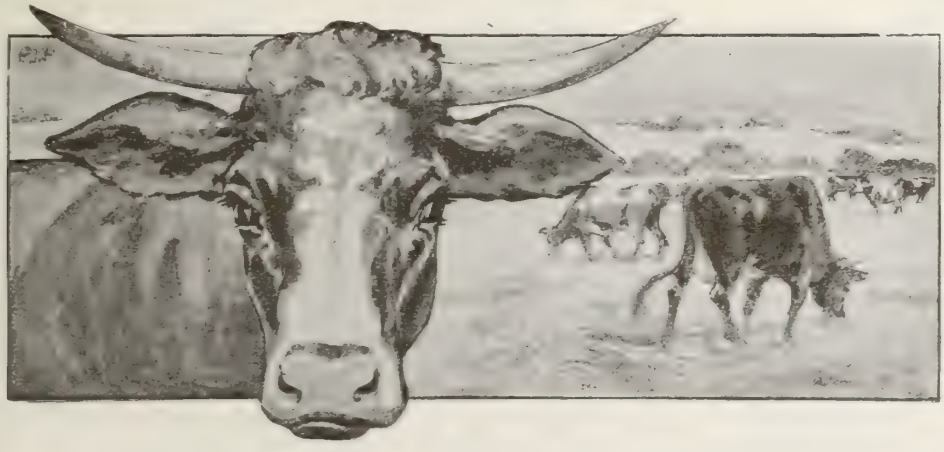
Better and More Economical Belting Service

Do you want to practice economy in your belting service? Specify D. K. McLaren's brand in your next order!

Belt slippage is reduced to a minimum by the use of D. K. McLaren's Leather Belting. It transmits all the power that any leather belt can possibly transmit.

Good quality makes it practically stretchless, and time, labor and attention are saved wherever it is used.

Best Selected Steers



Best Selected Hides

Here's where D. K. McLaren's Belting gets its serviceable qualities. Flawless back leather of the finest selected steers is used, coupled with the famous **British-Oak-Tanning** process of manufacture.

Many of Canada's largest industrial plants are users of D. K. McLaren's Belting. Pleased to put you in touch with some of them—let us hear from you.

GENUINE OAK

D·K·McLAREN LIMITED

GENUINE OAK

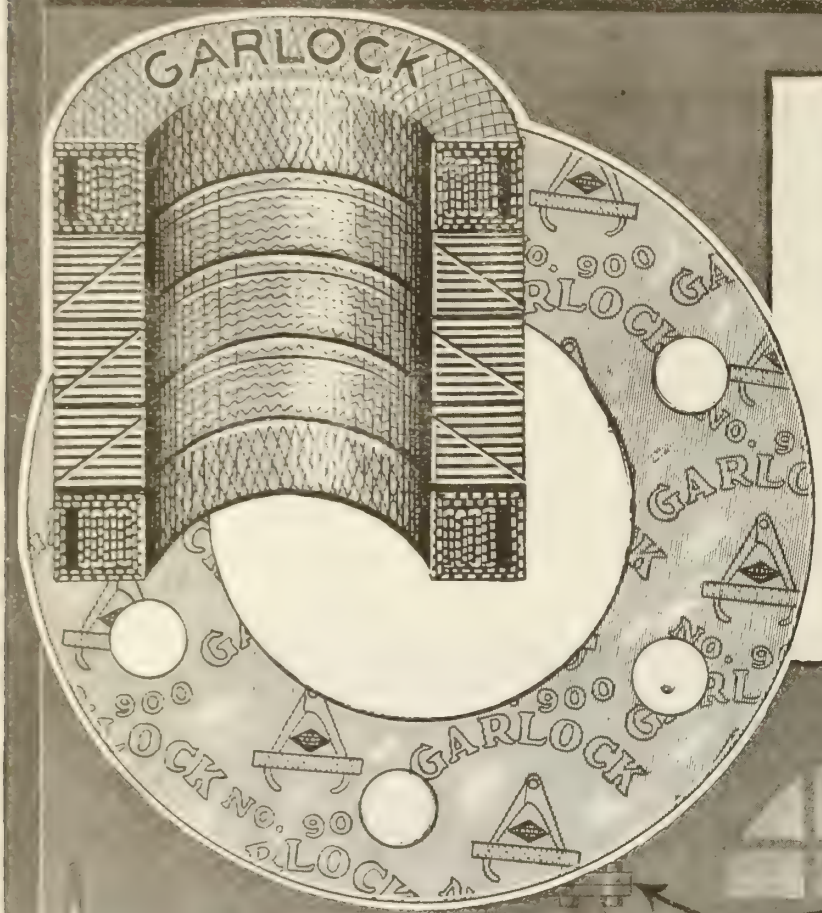
HEAD OFFICE AND FACTORY:

351 ST. JAMES STREET, MONTREAL, P.Q., CANADA

TORONTO, ONT.	ST. JOHN, N.B.	VANCOUVER, B.C.
194 King Street West	80 Germain Street	849 Beatty Street

If any advertisement interests you, tear it out now and place with letters to be answered.

GARLOCK PACKINGS



Pointers on a Well-Packed Engine

For high-pressure piston rods and valve stems, use Garlock No. 200.

For medium-pressure piston rods and valve stems, use Garlock No. 446.

For cylinder head, flange and other joints, use gaskets cut from Garlock No. 900 Sheet (No. 950).

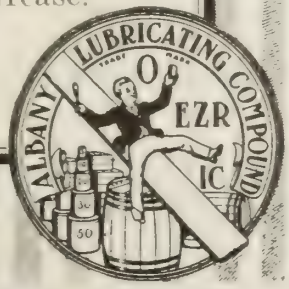
THE
Garlock Packing Co.
HAMILTON, ONTARIO
Branches in Principal Cities

"SPARE THE ROD"

ALBANY GREASE

for over 50 years has given a perfect lubrication service in power and industrial plants throughout the world. It is used by large industrial companies as well as small concerns equally successfully on their mechanical equipment. Albany Grease will keep all bearings and gears operating cool and easy at all times. Send for samples—now, if you are not using Albany Grease.

Albany Lubricating Co.
708-10 Washington Street
New York, U.S.A.
Established 1868

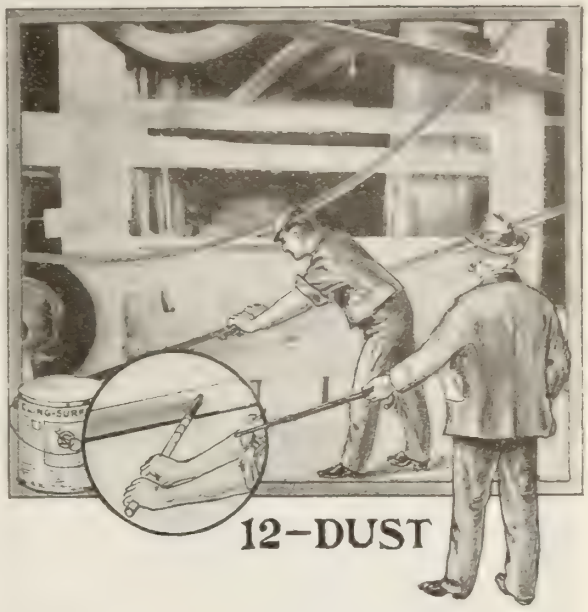


Bond Hangers

The next time you need shaft hangers get the Bond and you will have the best.
They cost no more than others, but for economical service they cannot be improved upon.
This efficient ring oiling device saves oil, yet provides ample lubrication at all times.
Let us tell you more about them.

Write for catalogue.

Canadian Bond Hanger & Coupling Co., Limited
ALEXANDRIA, ONTARIO



Dont Claim Exemption

—because the air is filled with dust,
—because this dust settles on the belts,
—because it makes a belt dressing "ball up"
are no reasons at all why your belts can't have the benefit of

CLING-SURFACE Belt Preservative

Just wipe the dust off first.

Then with the swab (as shown) treat the face of the belts **a little at a time.**

Your belts will absorb CLING-SURFACE very quickly, leaving a clean, **not sticky,** surface.

It will be smooth, velvety, and will not slip.

Nor will it hold the dust.

Your drives will last longer, do more work, cause no trouble, and can be run easy or slack under full loads.

They will never again have static electricity.

* * *

Results like these PAY.

Are you willing to try this treatment if such trial **costs you nothing?**

Then write to-day for the 25-pound can we have waiting for you.

Use it sixty days.

If you're satisfied, pay us for it. If not, we will take back what you have left, charge you nothing for what you've used, and pay the freight both ways.

ALL CHEERFULLY—no hard feelings!

Remember, use CLING-SURFACE and you won't need belt dressings.

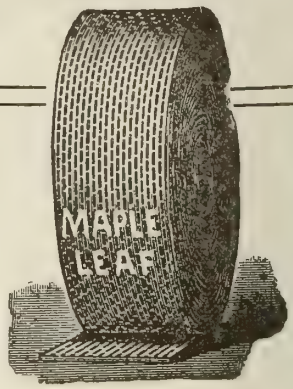
Cling-Surface Co
1057 Niagara Street
Buffalo New York
U S A

If any advertisement interests you, tear it out now and place with letters to be answered.

MAPLE LEAF BRAND

Stitched Cotton Duck

BELTING



Better and Cheaper Belting Service

In actual test Maple Leaf Brand Belting stood a breaking strain of 75% greater than leather, and 25% greater than rubber belting. It is sure grip, true running, and being waterproof, is not affected by dampness.

Maple Leaf Belt Dressing—The Best for all Kinds of Belts

Dominion Belting Co., Limited

HAMILTON, CANADA

Quebec Branch---51 Duluth Building, Montreal

NEARLY THREE SCORE YEARS

IF IT RUNS ANOTHER FIFTEEN YEARS

MORGANTOWN ICE COMPANY

Morgantown, W. Va., 3-14-17.

Magnolia Metal Co.,

Gentlemen:—

I have always ordered Magnolia Metal. We have the bearings of our ice machine lined with Magnolia Metal. This machine has been run day and night for 15 years with high side up to about 240 lbs., during the summer months; having run 24 hours a day for 8 months each year and 4 months day time. This machine sits where the hot sun shines on its bearings, and it never gives any trouble. It looks as if it was good for 15 years more.

Yours truly,

MORGANTOWN ICE COMPANY,

A. U. Wolfe, C.E.

PRACTICAL ENGINEER POCKET BOOK:

Over 600 pages. A valuable reference work imported from England and sold as an advertising medium at the low price of 40c post paid.

Address Montreal Office.

SOLD BY LEADING DEALERS EVERYWHERE OR BY

MAGNOLIA METAL CO.

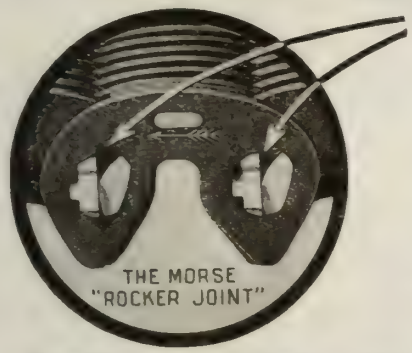
OFFICE AND FACTORY:

225 St. Ambroise St. MONTREAL

Morse Rocker-Joint Silent Chains

IN USE BY THE LARGEST POWER TRANSMISSION IN THE WORLD.

IN THE LEADING MINES, MILLS, POWER PLANTS, FACTORIES for EVERY SORT AND CONDITION OF DRIVE.



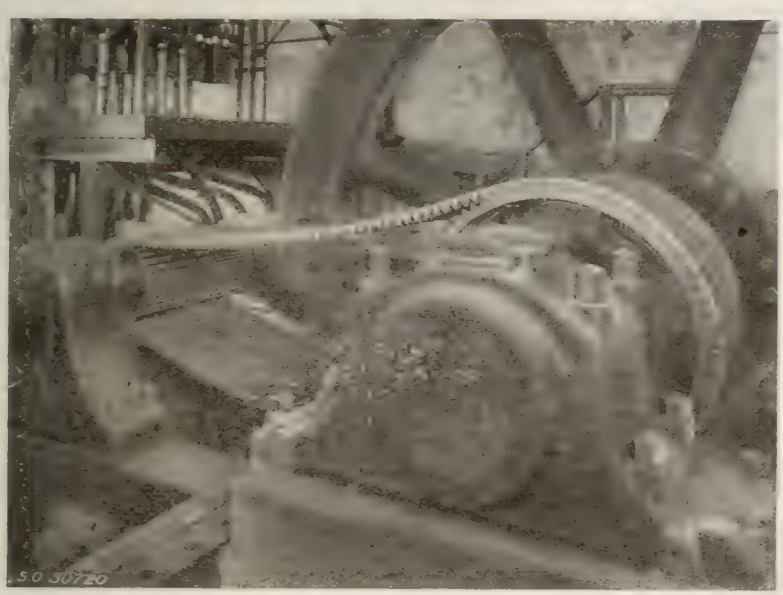
The Rocker Joint is the exclusive patented feature. There is no sliding friction. Depends on construction, not lubrication, for its life and durability.

WHY?

ASK THE BUYER & USER
about
99% EFFICIENCY EVENNESS
DURABILITY CLEANNESS
ECONOMY MAINTENANCE

Let MORSE Engineers Design Your New Drives.

Ox-bow, largest drive in the world.



POWER

Transmission Must be Figured In Terms of DOLLARS

Power Costs
Replacement Costs
Shut-Down Costs
Repair Costs
Time Lost Costs
Production Costs
Damaged Goods Losses
Shipping Losses

FIGURE IT OUT

Would you like to know?

WRITE

MORSE CHAIN COMPANY GENERAL OFFICE AND WORKS ITHACA, N.Y., U.S.A.

Boston	141 Milk St.
Chicago	Merchants' L. & T. Bldg.
Cleveland	421 Engineers' Bldg.
Detroit	1003 Woodward Ave.
Greensboro, N.C.	805 Ashboro St.
New York	50 Church St.
Pittsburgh	Westinghouse Bldg.
San Francisco	Monadnock Bldg.

REPRESENTATIVES

ATLANTA	Earl F. Scott, M.E., 702 Chandler Bldg.
KANSAS CITY, MO.	Morse Engineering Co., Chemical Bldg.
MINNEAPOLIS	Strong & Scott Mfg. Co., 413 Third St. S.
MONTREAL	Jones & Glassco, St. Nicholas Bldg.
TORONTO	Jones & Glassco, Traders Bank Bldg.
ST. LOUIS	Morse Engineering Co., Chemical Bldg.

If any advertisement interests you, tear it out now and place with letters to be answered.

HINTS TO BUYERS

DOMINION COAL COMPANY LIMITED

"Dominion" and "Springhill" BITUMINOUS STEAM and GAS COALS

GENERAL SALES OFFICE

112 St. James St. Montreal

NOTICE

TO

Stationary and Hoisting Engineers

Everyone operating a STATIONARY steam plant of 50 h.p. or over in the Province of Ontario must hold a Stationary Engineer's Certificate from the Board of Stationary and Hoisting Engineers. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary and Hoisting Engineers' Act.

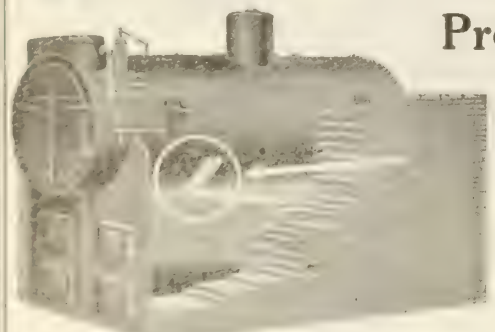
Everyone operating a HOISTING steam plant working at a pressure of 20 pounds or over, irrespective of horse power, and used for hoisting in structural operations or excavating purposes, in the Province of Ontario, must hold a Hoisting Engineer's Certificate from the Board of Stationary and Hoisting Engineers. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary and Hoisting Engineers' Act.

Application forms for obtaining STATIONARY or HOISTING Engineers' Certificates, may be had upon applying to the Chairman.

HON. F. G. MACDIARMID, Minister of Public Works and Highways. W. C. McGHIE, Chairman of Board.

W. A. RIDDELL, M. A; PH. D., Superintendent, Trades & Labour Branch.

NATIONAL BOILER SEAM Protector



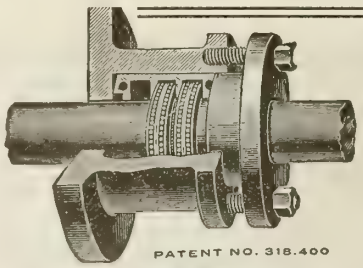
will save your boiler from mud cracks, fire cracks and blisters. Will stop all leakage at the seam. Attached by any one in 30 minutes.

Write to-day for Free Trial.

NATIONAL BOILER SEAM PROTECTOR CO. OF CANADA

Head Office: 910 New Birks Bldg., Montreal

Toronto Office: 568 Manning Ave., Toronto



PATENT NO. 318.400

PAT. NO.	500,899	PAT. NO.	829,118
" "	544,104	" "	830,530
" "	602,328	" "	856,103
" "	624,541	" "	878,238
" "	643,642	" "	894,537
" "	733,368	" "	895,791
" "	734,490	" "	898,068
" "	737,743	" "	905,103
" "	738,144	" "	931,629
" "	761,760	" "	979,206
" "	805,699	" "	1000,75

Why not Buy the Best, when in market for Packing?

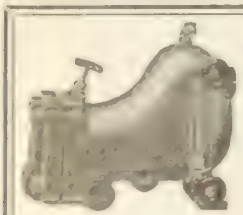
HOLMES' Metallic Packing

Is Guaranteed 3 Years

Lasts many times longer. 30 days' trial. Less oil. No cutting. Easily applied to any Steam Engine, Air Compressor or Gas Engine. Satisfaction or no pay. Write us.

HOLMES METALLIC PACKING CO., Wilkes-Barre, Pa.

Incorporated 1897



McDANIEL IMPROVED **STEAM TRAP**

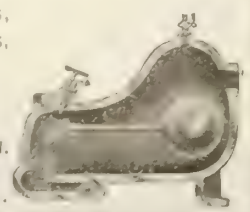
FOR HIGH OR LOW PRESSURE.

Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

MAY WE SEND ONE FOR TRIAL?

Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators.

SEND FOR CATALOGUE.



THE GARTH COMPANY

26 Craig Street MONTREAL, CAN.

WATSON & McDANIEL CO.

No. 146 N. 7th Street, PHILADELPHIA, Pa.

Water Turbines, Hydraulic Governors, Centrifugal Pumps

OUR LINDSAY WORKS

Boving Hydraulic & Engineering Co., Limited

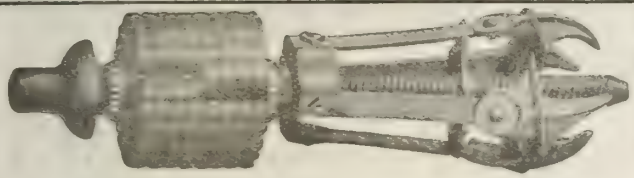
LINDSAY, ONTARIO

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

THE BEST IN PUMPING MACHINERY

The Smart-Turner Machine Co., Limited

HAMILTON, CANADA



Half the trouble of cleaning day is of your own making. To get the best results you must have an efficient tool. Next time you buy a flue cleaner, ask to see

Pilleys Combination Flue Brush and Scraper.

Examine it carefully. Note the design—material—workmanship. Then you will understand why it has satisfied discriminating engineers for more than 12 years.

For sale by leading Canadian Jobbers.

PILLEY PACKING & FLUE BRUSH MFG. CO.
623 South Third Street ST. LOUIS, MO.
Eastern Office: 71 Fulton St., New York.

BOILER INSPECTION

The Steam Boiler Act, Chapter 252 R.S.O., 1914 With Amendments Chapter 58—6, George V.

STEAM BOILERS.

All Steam boilers constructed for use in Ontario must be built from designs which have been approved and allotted a registration number by the Steam Boiler Branch.

Used boilers, boilers sold or exchanged, and unregistered boilers brought into the Province must be inspected prior to being put into operation.

Notice of repairs to steam boilers, stating the nature and extent of same, must be sent to the Steam Boiler Branch, and should such repairs be considered extensive by the Chief Boiler Inspector, the boilers will require to be inspected.

In each and every case the inspections must be made by Inspectors authorized to inspect boilers under the Steam Boilers Act, who are employed only by the Steam Boiler Branch of the Department of Public Works. Official certificates with the maximum working pressure stated thereon are issued to the owners of the boilers so inspected.

STEAM PIPING.

Drawings and Specifications of all high pressure steam piping must be approved and registered by the Steam Boiler Branch before any work of installation is commenced. The drawings submitted should show clearly the dimensions and layout of the main steam lines. Full particulars should be given as to the material used in the construction of the piping, and all valves and other fittings used in connection therewith must be of approved make.

Any deviation from the above requirements shall be deemed a violation of the Steam Boilers Act.

All communications in this respect should be addressed to the Steam Boiler Branch, Department of Public Works, Parliament Buildings, Toronto.

HON. F. G MACDIARMID, Minister of Public Works and Highways

W. A. RIDDELL, M.A. Ph.D., Supt. Trades & Labour Branch

D. M. MEDCALF,
Chief Inspector of Steam Boilers.

THE LADD VERTICAL WATER TUBE BOILER

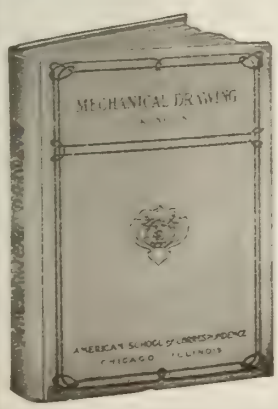
The Goldie-McCulloch Co., Ltd.
Galt, Ontario

Canadian licencees under patents 162401 and 162402 dated May 4, 1915.

The George T. Ladd Company,
Pittsburgh, Pa.

Owners and manufacturers for the United States.

Write for new Catalogue No. 17.



Mechanical Drawing

By Ervin Kenison, S.B.

Instructor in Mechanical Drawing, Massachusetts Institute of Technology

176 pp., 140 illus. Cloth binding. Gives a course of practical instruction in the art of Mechanical Drawing, based on methods that have stood the test of years of experience. Includes orthographic, isometric and oblique projections, shade lines, intersections and developments, lettering, etc., with abundant exercises and plates.

Price, $1.00

MacLean Publishing Co.
Technical Book Dept.
143-153 University Ave., Toronto

BOILER ACCESSORIES

By Walter S. Leland, S. B.

Formerly Assistant Professor of Naval Architecture, Mass. Institute of Technology, American Society Naval Architects and Marine Engineers. 144 pp., 72 illus. Cloth binding. A treatise giving complete descriptions of the various accessories of the boiler room and engine room essential to economical operation, such as evaporators, pumps, feed-water heaters, injectors, mechanical stokers, etc., with practical instruction in their use. **Price.....Postpaid $1.10**

STEAM TURBINES

By Walter S. Leland, S. B.

Assistant Professor of Naval Architecture, Massachusetts Institute of Technology, American Society of Naval Architects and Marine Engineers. 160 pp. 100 illus. Cloth binding. A reliable and up-to-date manual on the selection, construction, and operation of steam turbines, including the installation, performance and types of turbines; single-stage and compound turbines, such as De Laval, Riedler-Stumpf, Rateau, Hamilton-Holswarth, Terry, Parsons, Allis-Chalmers, etc., with a discussion of the use of low-pressure steam turbines with steam engines. **Price.....Postpaid $1.10**

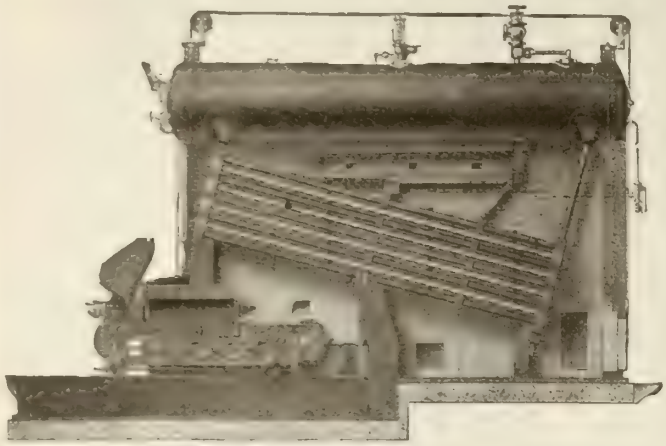
Write TECHNICAL BOOK DEPARTMENT

THE MACLEAN PUBLISHING COMPANY
143-153 University Avenue TORONTO

"ALL BRITISH"

"B.&W." PATENT WATER TUBE STEAM BOILERS

HIGHEST ECONOMY, SAFETY, DURABILITY. OVER 20,000,000 H.P. IN USE.



Babcock & Wilcox Patent Water Tube Steam Boiler, Superheater and Mechanical Stoker.

—ALSO—

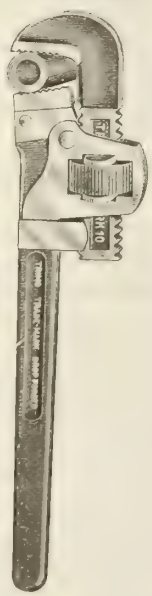
Steam Superheaters
Mechanical Stokers
Coal-Handling Machinery
Piping, Feed Water Heaters
Water Softeners and Purifiers
and **ELECTRIC CRANES**

BABCOCK & WILCOX, Limited

HEAD OFFICE FOR CANADA - COLLEGE ST. (ST. HENRY), MONTREAL
TORONTO OFFICE, TRADERS BANK BUILDING

The Wrench of 25% Greater Efficiency

TRIMO PIPE WRENCH



Two new features have been recently added to the Trimo Pipe Wrench, namely Nut-Guards, in all sizes, and unbreakable steel frames, in leading sizes.

The Nut-Guards prevent the accidental rotation of the nut while in use.

These improvements add 25% to the usefulness of the tool.

The Trimo Pipe Wrench is made with wood handles in 4 sizes, 6-in., 8-in., 10-in., 14-in. and in steel handles in all sizes, 6-in. to 48-in. inclusive.

All Trimo Pipe Wrench parts are interchangeable.

The inserted jaw in the handle can be readily replaced when worn, thus adding to the life of the tool.

Nut with Nut-Guards

Inquiries from Importers and Dealers Solicited. Send for Catalogue No. 55.

TRIMONT MANUFACTURING CO.

CableAddress: Triwrench
Code: Western Union

Roxbury (Boston) Mass., U.S.A.

POWER HOUSE BUYERS' DIRECTORY

If what you want is not listed here write us, and we will tell you where to get it. Let us suggest that you consult also the advertisers' index facing the inside back cover, after having secured advertisers' names from this directory. The information you desire may be found in the advertising pages. This department is maintained for the benefit and convenience of our readers. The insertion of our advertisers names under proper headings is gladly undertaken, but does not become part of an advertising contract.

AIR COCKS
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

AIR VALVES
Mueller Mfg. Co., H., Sarnia, Ont.

AMMETERS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. H. W. Johns-Manville Co., Toronto, Ont.

AMMONIA VALVES AND FITTINGS
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Frick Co., Waynesboro, Franklin Co., Pa.
Homestead Valve Mfg. Co., Pittsburgh, Pa.
York Mfg. Co., York, Pa.

AMMONIA PURIFIERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Mfg. Co., York, Pa.

AMMONIA TANKS
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford, Ont.

ARCHES, COMBUSTION CHAMBER
Canadian Fairbanks-Morse Co., Ltd. Montreal.

ASH CARRYING SYSTEMS
Babcock & Wilcox, Ltd. Montreal.
Waterous Engine Works Co., Brantford, Ont.

ASBESTOS SPECIALTIES
Durabla Mfg. Co., New York, N.Y.
Garlock Packing Co., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

AUTOMATIC ICE RECORDING DOORS AND CHUTES
Jamison Cold Storage Door Co., Hagerstown, Md.

BABBITT AND ANTI-FRICTION METAL
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Hoyt Metal Co., Toronto.
Magnolia Metal Co. Montreal.
Wm. C. Wilson & Co., Toronto.

BALL BEARINGS
Can. S K F Co., Toronto, Ont.

BALLCOCKS
D'Este Co., Julian, Boston, Mass.

BATTERIES AND ACCESSORIES
Can. H. W. Johns-Manville Co., Toronto, Ont.

BELT CEMENT
Graton & Knight Mfg. Co., Montreal.

BELT DRESSING
Cling Surface Co., Buffalo.
Jos. Dixon Crucible Co., Jersey City.
Dominion Belting Co., Hamilton, Ont.
Graton & Knight Mfg. Co., Montreal.

BELT LACING, LEATHER
Graton & Knight Mfg. Co., Montreal.

BELT TIGHTENERS
Waterous Engine Works Co., Brantford, Ont.

BELT PULLEYS
American Pulley Co., Philadelphia, Pa.
Waterous Engine Works Co., Brantford, Ont.

BELTING, BALATA
Federal Engineering Co., Toronto, Ont.

BELTING, LINK
Graton & Knight Mfg. Co., Montreal.
Waterous Engine Works Co., Brantford, Ont.

BELTING, STITCHED COTTON DUCK
Dominion Belting Co., Hamilton, Ont.

BELTING, LEATHER
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Garlock Packing Co., Hamilton, Ont.
Goodyear Tire & Rubber Co., Toronto.
Graton & Knight Mfg. Co., Montreal.
D. K. McLaren Ltd., Montreal.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

BELTING, RUBBER
Can. H. W. Johns-Manville Co., Toronto, Ont.
Goodyear Tire & Rubber Co., Toronto.
Jeffrey Manufacturing Co., Montreal.
Thomson-Gordon, Ltd., Hamilton, Ont.
United States Rubber Co., New York.

BELTING, WOVEN COTTON
Federal Engineering Co., Toronto, Ont.

BINS, COAL, COKE AND ORE
Jeffrey Manufacturing Co., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford, Ont.

BLOWERS
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Can. Sirocco Co., Windsor, Ont.
Coppus Eng. & Equip. Co., Worcester, Mass.

BOILER COMPOUNDS
Can. Economic Lubricant Co., Montreal, Que.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Metlskin Mfg. Co., Rochester, N.Y.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Wm. C. Wilson & Co., Toronto.

BOILER COMPOUND FEEDERS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Morehead Mfg. Co., Woodstock.
Lunkenheimer Co., Cincinnati, O.

BOILER FEED PUMPS
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Steam Boiler Equipment Co., Toronto, Ont.
Darling Bros., Ltd., Montreal, Que.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Laurie & Lamb, Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

BOILER FEED REGULATORS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Mason Regulator & Engineering Co., Montreal.

BOILER GRAPHITE
Joseph Dixon Crucible Co., Jersey City, N.J.

BOILER MOUNTINGS
Babcock & Wilcox, Ltd. Montreal.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Ltd., Montreal, Que.
Inglis Co., The John, Toronto, Ont.
Lunkenheimer Co., Cincinnati, O.
Mason Regulator & Engineering Co., Montreal.

BOILER PRESERVATIVES
Johns-Pratt Co., The, Hartford, Conn.

BOILER HOUSE ACCESSORIES
Babcock & Wilcox, Ltd. Montreal.
Canadian Griscom-Russell Co., Ltd., Montreal.
Cole, Ltd., Geo. W., Toronto.
Mason Regulator & Engineering Co., Montreal.

BOILER SEAM PROTECTOR
National Boiler Seam Protector Co., Montreal.

BOILER SETTINGS
Beveridge Paper Co., Montreal.
Gates, John W., St. James St., Montreal.

BOILER TUBE CLEANERS
Babcock & Wilcox, Ltd. Montreal.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Cole, Ltd., Geo. W., Toronto.
Garlock Packing Co., Hamilton, Ont.
Liberty Mfg. Co., Pittsburg.
Laurie & Lamb, Montreal.
Pilley Packing and Flue Brush Mfg. Co., St. Louis, Mo.

BOILERS, HORIZONTAL, RETURN, TUBULAR AND WATERTUBE
Babcock & Wilcox, Ltd. Montreal.
Cole, Ltd., Geo. W., Toronto.
Goldie & McCulloch Co., Galt.
Frick Co., Waynesboro, Franklin Co., Pa.
Inglis Co., The John, Toronto, Ont.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Jones Underfeed Stoker Co., Toronto.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Ladd, The Geo. T., Co., Pittsburgh, Pa.
McAvity, T., & Sons, Ltd., St. John, N.B.
Waterous Engine Works Co., Brantford, Ont.

BOILERS, MARINE, LOCOMOTIVE AND VERTICAL
Babcock & Wilcox, Ltd. Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Goldie & McCulloch Co., Galt.
Inglis Co., The John, Toronto, Ont.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
John McDougall Caledonian Iron Works, Montreal.
Waterous Engine Works Co., Brantford, Ont.

BOOKS
Audel & Co., Theo, New York, N.Y.
MacLean Publishing Co., Toronto.

BOXES, FUSE AND METER
Johns-Pratt Co., The, Hartford, Conn.

BRASS FOUNDERS
McAvity, T., & Sons, Ltd., St. John, N.B.
D'Este Co., Julian, Boston, Mass.
Mueller Mfg. Co., H., Sarnia, Ont.

BRINE COOLERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

BRINE TANKS
Frick Co., Waynesboro, Franklin Co., Pa.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford, Ont.
York Manufacturing Co., York, Pa.

BUSHINGS
Steel Mill Packing Co., Windsor, Ont.

CABLE
Wm. C. Wilson & Co., Toronto.

CALORIMETERS
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Taylor Instrument Co., Rochester, N.Y.

CANS, OILY WASTE
Jas. Morrison Brass Mfg. Co., Toronto.

CAST IRON FITTINGS
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.

CASTINGS, BRASS AND IRON
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Lunkenheimer Co., Cincinnati, O.
John McDougall Caledonian Iron Works Co., Ltd., Montreal.
McAvity, T., & Sons, Ltd., St. John, N.B.
Mueller Mfg. Co., H., Sarnia, Ont.
Waterous Engine Works Co., Brantford, Ont.

CELLAR DRAINERS
Morrison Brass Mfg. Co., James, Toronto, Ont.
Mueller Mfg. Co., H., Sarnia, Ont.

CEMENT, HIGH TEMPERATURE
Beveridge Paper Co., Montreal.
Gates, John W., St. James St., Montreal.

CEMENT, PIPE JOINT
Wm. C. Wilson & Co., Toronto.

CEMENT MACHINERY
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Waterous Engine Works Co., Brantford, Ont.

CHAIN DRIVES
Morse Chain Co., Ithaca, N.Y.

CHAIN WHEELS
Babbitt Steam Specialty Co., New Bedford, Mass.

CHIMNEYS, STEEL
Babcock & Wilcox, Ltd. Montreal
MacKinnon, Holmes & Co., Sherbrooke, Que.

CHUTES, COAL
Can. Allis-Chalmers, Ltd., Toronto, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.

CLOCKS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Foxboro Co., The, Foxboro, Mass.

CLOSETS
Mueller Mfg. Co., H., Sarnia, Ont.

CLUTCHES
Waterous Engine Works Co., Brantford, Ont.

COAL
Dom. Coal Co., Montreal

COAL AND ASH CONVEYORS
Babcock & Wilcox, Ltd. Montreal.
Jeffrey Manufacturing Co., Montreal.
Waterous Engine Works Co., Brantford, Ont.

COAL HANDLING MACHINERY
Babcock & Wilcox, Ltd. Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Jeffrey Manufacturing Co., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford, Ont.

COAL HOLE COVERS
Can. Allis-Chalmers, Ltd., Toronto, Ont.

COILS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

COLD STORAGE INSULATION
Armstrong Cork & Insulation Co., Montreal, Que.
Beveridge Paper Co., Ltd., Montreal, Que.

COMMUTATOR TRUING DEVICES
Jordan Bros., Inc., New York, N.Y.

CONDENSERS
Alberger Heater Co., Buffalo, N.Y.
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Toronto.
Belliss & Morcom, Birmingham, Eng.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Darling Bros., Ltd., Montreal, Que.
Goldie & McCulloch Co., Galt.
Laurie & Lamb, Montreal.
John McDougall Caledonian Iron Wks., Montreal.
Waterous Engine Works Co., Brantford.

CONDENSERS, AMMONIA AND STEAM
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

COLLECTORS, PNEUMATIC
Sturtevant Co. of Canada, B. F., Galt, Ont.

CONSULTING ENGINEERS
Walter J. Francis, Montreal.
Laurie & Lamb, Montreal.

COLD STORAGE DOORS AND WINDOWS
Jamison Cold Storage Door Co., Hagerstown, Md.

COMPRESSORS, AIR
American Steam Pump Co., Battle Creek, Mich.
Beliss & Morcom, Birmingham, Eng.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Darling Bros., Ltd., Montreal, Que.
Inglis Co., The John, Toronto, Ont.
Laurie & Lamb, Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Smart-Turner Machine Co., Ltd., Hamilton.
Taylor Instrument Co., Rochester, N.Y.

COMPRESSORS, GAS
Can. Allis-Chalmers, Ltd., Toronto, Ont.

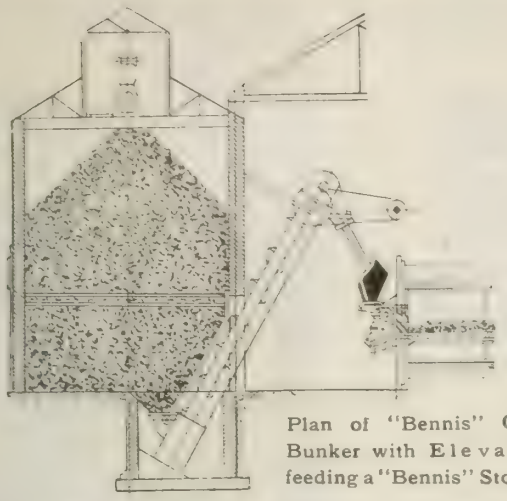
CONDUITS
Can. H. W. Johns-Manville Co., Toronto, Ont.

CONDENSATION RECEIVER
Cole, Ltd., Geo. W., Toronto.
G. M. Davis Regulator Co., Chicago.

CONNECTIONS, FLANGED
Jefferson Union Co., Lexington, Mass.
Dart Union Co., Ltd., Toronto, Ont.

CONCRETE HARDENER
Beveridge Paper Co., Montreal.

CONTRACTORS' STRUCTURAL STEEL
Canadian Fairbanks-Morse Co., Ltd. Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
CONVEYOR MACHINERY
Babcock & Wilcox, Ltd. Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Jeffrey Manufacturing Co., Montreal.
Waterous Engine Works Co., Brantford.
COOLER, DOORS
Jamison Cold Storage Door Co., Hagerstown, Md.
CORK INSULATION
Armstrong Cork & Insulation Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
COTTON HOSE
Garlock Packing Co., Hamilton, Ont.
COUNTERS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Foxboro Co., The, Foxboro, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
COUNTERSHAFTS
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
COUPLINGS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Jeffrey Manufacturing Co., Montreal.
McAvity & Sons, T., St. John, N.B.
COUPLINGS, BOILER, FLANGED PIPE, JOINT PIPE, UNION, STEAM PIPE
Jefferson Union Co., Lexington, Mass.
Dart Union Co., Ltd., Toronto, Ont.
COUPLINGS, SHAFT
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
CRANES, ALL KINDS
Babcock & Wilcox, Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
CRANES, ELECTRIC
Babcock & Wilcox, Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
CRANES, HAND POWER
Babcock & Wilcox, Ltd., Montreal.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Smart-Turner Machine Co., Ltd., Hamilton.
CRANES, OVERHEAD TRAVELLING
Babcock & Wilcox, Ltd., Montreal.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Smart-Turner Machine Co., Ltd., Hamilton.
CRANES, POST JIB
Babcock & Wilcox, Ltd., Montreal.
CRANES, SWING JIB
Babcock & Wilcox, Ltd., Montreal.
CRANES, WALL
Babcock & Wilcox, Ltd., Montreal.
CRANK AND CROSSHEAD PIN OILERS
Lunkenheimer Co., Cincinnati, O.
CRIMPS, LEATHER
Graton & Knight Mfg. Co., Montreal.
CRUSHING MACHINERY
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Jeffrey Mfg. Co., Columbus, Ohio.
CYLINDER OIL
E. H. Kellogg & Co., New York.
DAMPER REGULATORS
Babcock & Wilcox, Ltd., Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Darling Bros., Ltd., Montreal, Que.
G. M. Davis Regulator Co., Chicago.
D'Este Co., Julian, Boston, Mass.
Elliott Co., Pittsburgh, Pa.
Mason Regulator Co., Boston, Mass.
Jas. Morrison Brass Mfg. Co., Toronto.
DISCS, FIBRE
Beveridge Paper Co., Ltd., Montreal, Que.
Johns-Pratt Co., The, Hartford, Conn.
DISCS, LEATHER
Graton & Knight Mfg. Co., Montreal.
DISTILLING APPARATUS
Canadian Griscom-Russell Co., Ltd., Montreal.
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.
DOORS, COLD STORAGE AND FREEZER
Jamison Cold Storage Door Co., Hagerstown, Md.
DOUBLE PIPE CONDENSERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.
DRYING MACHINERY
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Sirocco Co., Windsor, Ont.
DUST SEPARATORS
Sturtevant Co. of Canada, B. F., Galt, Ont.
DYNAMOS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Sturtevant Co. of Canada, B. F., Galt, Ont.
ECONOMIZERS
Babcock & Wilcox, Ltd., Montreal.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Green Fuel Economizer Co., New York, N.Y.
EJECTORS
[illegible] Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.
Smart-Turner Machine Co., Ltd., Hamilton.
ELECTRICAL ACCESSORIES AND MACHINERY
Can. H. W. Johns-Manville Co., Toronto, Ont.
[illegible]
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Economy Fuse & Mfg. Co., Montreal, Que.
[illegible]
ELECTRICAL SUPPLIES
[illegible]
Can. H. W. Johns-Manville Co., Toronto, Ont.
ELEVATORS
MacKinnon, Holmes & Co., Sherbrooke, Ont.
[illegible]
ELEVATING MACHINERY
[illegible] Montreal
Gaiffe & McCulloch Co., Galt.
Jeffrey Manufacturing Co., Montreal.
Waterous Engine Works Co., Brantford.
ENAMELWARE
H. Mueller Mfg. Co., Sarnia, Ont.
ENGINEERS' SUPPLIES
Beveridge Paper Co., Ltd., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Ltd., Montreal, Que.
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.
Jas. Morrison Brass Mfg. Co., Toronto.
ENGINES, AUTOMATIC AND DROP VALVE
Frick Co., Waynesboro, Franklin Co., Pa.
Waterous Engine Works Co., Brantford.
ENGINES, CORLISS AND ROCKING VALVE
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Waterous Engine Works Co., Brantford.
ENGINES, DIESEL
Can. Allis-Chalmers, Ltd., Toronto, Ont.
ENGINES, GAS AND GASOLINE
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Laurie & Lamb, Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
ENGINES, STEAM
Belliss & Morcom, Birmingham, Eng.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Can. Sirocco Co., Windsor, Ont.
Goldie & McCulloch Co., Galt.
Inglis Co., The John, Toronto, Ont.
Laurie & Lamb, Montreal.
John MacDougall Caledonian Iron Works, Montreal.
Waterous Engine Works Co., Brantford.
ENGINES, HOISTING, LOGGING, CABLEWAY
Can. Allis-Chalmers, Ltd., Toronto, Ont.
ENGINES, MARINE
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
ENGINES, SAW MILL
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Laurie & Lamb, Montreal.
Waterous Engine Works Co., Brantford.
ENGINES, SINGLE COMPOUND AND TRIPLE EXPANSION
Canadian Griscom-Russell Co., Ltd., Montreal.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Laurie & Lamb, Montreal.
John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Kerr Engine Co., Walkerville.
Waterous Engine Works Co., Brantford.
ENGINES, VERTICAL
Laurie & Lamb, Montreal.
ENGINEERING BOOKS
MacLean Publishing Co., Toronto
EXHAUST HEADS
Can. Sirocco Co., Windsor, Ont.
Darling Bros., Ltd., Montreal, Que.
Direct Separator Co., Syracuse, N.Y.
Elliott Co., Pittsburgh, Pa.
Jas. Morrison Brass Mfg. Co., Toronto.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Watson & McDaniel Co., Philadelphia.
EXPANSION JOINTS
Alberger Heater Co., Buffalo, N.Y.
Direct Separator Co., Syracuse, N.Y.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B
FANS, VENTILATING
Can. Sirocco Co., Windsor, Ont.
C. T. Coe Co., 10 Johnson St., Newark, N.J.
Coppus Engr. & Equip. Co., Worcester, Mass.
Green Fuel Economizer Co., New York, N.Y.
Sturtevant Co. of Canada, B. F., Galt, Ont.
FEED WATER HEATERS
Alberger Heater Co., Buffalo, N.Y.
Babcock & Wilcox, Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Stewart Heater Co., Buffalo, N.Y.
Waterous Engine Works Co., Brantford.
FEED WATER PURIFIERS
Stewart Heater Co., Buffalo, N.Y.
FEED WATER REGULATORS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Chaplin, Fulton Mfg. Co., Pittsburg, Pa.
Elliott Co., Pittsburgh, Pa.
Laurie & Lamb, Montreal.
FILTERS
Bowser & Co., Inc., S. F., Toronto, Ont.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
FILTERS, WATER
Canadian Griscom-Russell Co., Ltd., Montreal.
Darling Bros., Ltd., Montreal, Que.
Frick Co., Waynesboro, Franklin Co., Pa.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Scaife & Sons, Wm. B., Pittsburgh, Pa.
York Manufacturing Co., York, Pa.
FIRE BRICK, PLASTIC
Beveridge Paper Co., Montreal.
Gates, John W., St. James St., Montreal.
FIREPROOF COLD STORAGE DOORS AND WINDOWS
Jamison Cold Storage Door Co., Hagerstown, Md.
FITTINGS, AIR, AUTOMOBILE, GAS, HYDRAULIC, PIPE, PIPE FLANGED, SCREWED PIPE, STEAM
Jefferson Union Co., Lexington, Mass.
Dart Union Co., Ltd., Toronto, Ont.
H. Mueller Mfg. Co., Sarnia, Ont.
FLANGED STEAM FITTINGS
Direct Separator Co., Syracuse, N.Y.
McAvity, T., & Sons, Ltd., St. John, N.B.
FLANGES
Dart Union Co., Ltd., Toronto, Ont.
Jefferson Union Co., Lexington, Mass.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
FLOORING COMPOSITION
Armstrong Cork & Insulation Co., Montreal, Que.
FLUE CLEANERS
Babcock & Wilcox, Montreal.
Liberty Mfg. Co., Pittsburg, Pa.
Pilley Packing and Flue Brush Mfg. Co., St. Louis, Mo.
William B. Pierce Co., Buffalo, N.Y.
Wm. C. Wilson & Co., Toronto.
FLUE GAS ANALYSIS INSTRUMENTS
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Uehling Instrument Co., New York.
Precision Instrument Co., Detroit, Mich.
Penberthy Injector Co., Windsor, Ont.
FLUMES, STEEL
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
FREEZER DOORS
Jamison Cold Storage Door Co., Hagerstown, Md.
FRICTION LEATHERS
Graton & Knight Mfg. Co., Montreal.
FURNACES, BOILER
Gates, J. W., Montreal, P.Q.
FURNACES, SMOKELESS
Babcock & Wilcox, Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Detroit, Mich.
FUSES
Can. H. W. Johns-Manville Co., Toronto, Ont.
Economy Fuse & Mfg. Co. of Canada, Montreal.
Johns-Pratt Co., The, Hartford, Conn.
GAS ANALYSIS INSTRUMENTS, ETC.
Penberthy Injector Co., Windsor, Ont.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Uehling Instrument Co., New York, N.Y.
GASKETS, RUBBER, ASBESTOS
Can. H. W. Johns-Manville Co., Toronto, Ont.
Durabla Mfg. Co., New York, N.Y.
Frick Co., Waynesboro, Franklin Co., Pa.
Garlock Packing Co., Hamilton, Ont.
Johns-Pratt Co., The, Hartford, Conn.
Peerless Rubber Mfg. Co., New York, N.Y.
Thomson-Gordon, Ltd., Hamilton, Ont.
GASKETS, LEAD, COPPER AND LEATHER
Graton & Knight Mfg. Co., Montreal, Que.
Shell Bar Boico Supply Co., Toronto, Ont.
Wm. C. Wilson & Co., Toronto, Ont.
GAS COLLECTORS
Precision Instrument Co., Detroit, Mich.
GAS PRODUCER PLANTS
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Laurie & Lamb, Montreal.
GAUGE COCKS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Garlock Packing Co., Hamilton, Ont.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.
W. J. Wall, Montreal.
GAUGE GLASSES
Wm. C. Wilson & Co., Toronto.
GAUGES, AMMONIA, OIL, GAS, AIR
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y
GAUGES, PRESSURE, VACUUM, DRAFT AND RECORDING, AND MICROMETER
Babcock & Wilcox, Montreal.
Foxboro Company, Foxboro, Mass.
Lunkenheimer Co., Cincinnati, O.
Precision Instrument Co., Detroit, Mich.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.
GAUGES, WATER
Babcock & Wilcox, Montreal.
Jenkins Bros., Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
Penberthy Injector Co., Windsor, Ont.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
GEARS, FIBRE CUT
Beveridge Paper Co., Ltd., Montreal, Que.
GEARS, CUT, WORM, MORTISE
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
GENERATORS, STEAM TURBO
Can. General Electric Co., Toronto, Ont.
Laurie & Lamb, Montreal.
GENERATORS AND CONVERTORS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. General Electric Co., Toronto, Ont.
GOVERNORS, ENGINE
Escher Wyss & Co., Montreal, Que.
McAvity, T., & Sons, Ltd., St. John, N.B.
Waterous Engine Works Co., Brantford.
GRAPHITE, BOILER
Jos. Dixon Crucible Co., Jersey City.
Wm. C. Wilson & Co., Toronto.



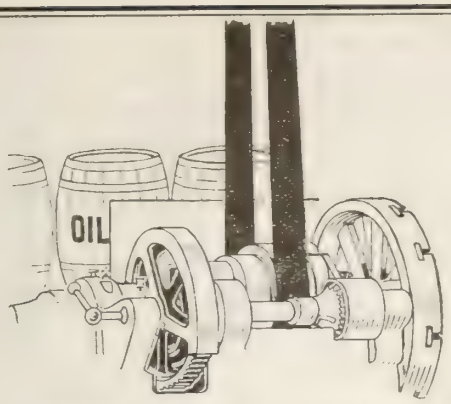
Plan of "Bennis" Coal Bunker with Elevator feeding a "Bennis" Stoker

Plants similar to the above have been installed in many of the new National Factories to ensure maximum output and rapid and efficient handling with the minimum of labour. "Bennis" Conveyors and Elevators are indispensable for the cheap and efficient transport of material in bulk. Schemes prepared to any requirements.

Write to-day for descriptive literature.

ED. BENNIS & CO., LTD.

Little Hulton, Bolton; 28 Victoria Street, S.W. London, Eng.



Scandinavia Belting

Is a Good Belt For Oily Places

Please do not understand from this that this belt or any other will give good service if it is constantly reeking with oil. Any oily or greasy belt will slip, and a slipping belt will burn and crack.

What we mean is that the action of the oil does not have a bad influence on the fabric itself to any extent. To get good service, if the belt is continually being subjected to oil, keep the oil cleaned from the pulley side of the belt and apply "Agrippa," a belt adhesive, to overcome the tendency of an oily belt to slip.

"Scandinavia" is one of the belts on which an adhesive may successfully be used, and this is not true of all belts, as the adhesive often opens up the joints or plies. "Scandinavia" has neither joints nor plies.

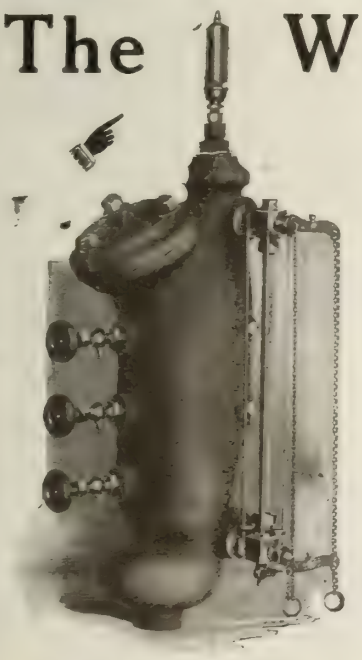
If you have any belt drives such as described above try this belting and if you follow the above suggestions you will be surprised.

Federal Engineering Co., Limited

172 John Street - - - Toronto, Ont.

Note:-Do not use "bar" or "stick" dressings on textile belts

The Whistle Instantly Blows!



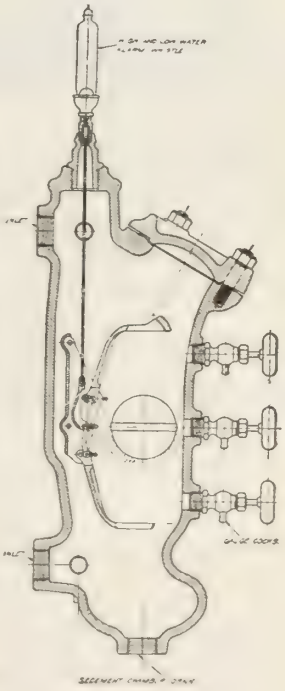
Exterior

When the water in your boilers rises above or falls below its proper level you should know it instantly.
If you are depending upon a gauge glass you are taking risks. Rid yourself of all worry and care of boiler explosion in your steam plant by installing

THE ANDERSON Safety Water Column

The "Anderson" sounds the high and low water alarm plainly, unfailingly, and unceasingly. With it you know whether the water is RIGHT or not.

Extremely simple in design, as will be seen by accompanying engravings. The operating mechanism is assembled as a single unit in a removable hanger frame suspended from bronze pivots. The rise or fall of an unattached seamless Lake Superior copper high pressure float strikes against this mechanism, which in turn holds the small steam whistle valve open as long as the water level remains above or below normal.



Cross Section

The **Anderson Safety Water Column** is equally adapted for any old or new boiler—any make, size or description. Our illustrated catalog is worth sending for. Write now.

The V. D. Anderson Company

1935 West 96th St., - Cleveland, Ohio

GRATES, DUMPING, ROCKING, STATIONARY
Babcock & Wilcox, Montreal.
Boiler Repair & Grate Bar Co., Toronto, Ont.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
C. T. Coe Co., 10 Johnson St., Newark, N.J.
[illegible] Galt, Ont.
Mont. Engineering & Engineering Co., Montreal.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Waterous Engine Works Co., Brantford.

GREASE CUPS
Albany Lubricating Co., New York City.
Detroit Lubricator Co., Walkerville.
[illegible] Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto
Penberthy Injector Co., Windsor, Ont.

GREASE AND OIL EXTRACTORS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Canadian Griscom-Russell Co., Ltd., Montreal
Elliott Co., Pittsburgh, Pa.
[illegible] & Lamb, Montreal.

GREASES
Albany Lubricating Co., New York City.
Can. Economic Lubricant Co., Montreal, Que.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Jos. Dixon Crucible Co., Jersey City.
Wm. C. Wilson & Co., Toronto.

HAND LEATHERS OR PADS
Graton & Knight Mfg. Co., Montreal.

HANGERS
Can. General Electric Co., Toronto, Ont.
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Can. S K F Co., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Goldie & McCulloch Co., Galt.
Waterous Engine Works Co., Brantford.

HEATERS
Alberger Heater Co., Buffalo, N.Y.
Babcock & Wilcox, Ltd., Montreal.
Can. Sirocco Co., Windsor, Ont.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
Laurie & Lamb, Montreal.
McAvity & Sons, T., St. John, N.B.
Scaife & Sons, Wm. B., Pittsburgh, Pa.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Waterous Engine Works Co., Brantford.

HEATERS, EXHAUST STEAM
Can. Allis-Chalmers, Ltd., Toronto, Ont.

HEATERS, METERING
Can. Allis-Chalmers, Ltd., Toronto, Ont.

HEATING SYSTEMS, FANS
Can. Sirocco Co., Windsor, Ont.

HOISTS, GRIP
Jordan Bros., Inc., New York, N.Y.

HOISTING AND CONVEYING MACHINERY
Babcock & Wilcox, Ltd., Montreal.
Waterous Engine Works Co., Brantford.

HOSE, METALLIC
Pennsylvania Flexible Metallic Tubing Co., Boston, Mass.

HOSE, STEAM, SUCTION AND WATER
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Asbestos Co., Montreal.
Garlock Packing Co., Hamilton, Ont.
Goodyear Tire & Rubber Co., Toronto.
Peerless Rubber Mfg. Co., New York, N.Y.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

HYDRAULIC ACCUMULATORS
Smart-Turner Machine Co., Ltd., Hamilton.

HYDRAULIC MACHINERY
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
John Mc[illegible] Caledonian Iron Wks., Montreal.

HYDRAULIC PRESSES
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

ICE MAKING MACHINERY
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Griscom-Russell Co., Ltd., Montreal.
Frick Co., Waynesboro, Franklin Co.
[illegible] Refrigeration Co., Montreal.
York Mfg. Co., York, Pa.

INDICATORS, ELECTRIC—ALL TYPES
[illegible] Mfg. Co., Brooklyn, N.Y.
Lehlbach Instrument Co., New York, N.Y.

INDICATORS, STEAM AND GAS ENGINE
[illegible] & Valve Mfg. Co., Boston, Mass.
Canadian Fairbanks-Morse Co., Montreal.
[illegible] Co., Toronto, Ont.
[illegible] Co., New York, N.Y.

INDICATORS—AMMONIA, HYDRAULIC
[illegible] Co., Walkerville, Ont.

INDICATORS, SPEED
[illegible] Mass.

INJECTORS
Babcock & Wilcox, Ltd., Montreal.
[illegible] Toronto, Ont.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
[illegible] Windsor, Ont.

INSULATING BRICK
Armstrong Cork & Insulation Co., Montreal, Que.
Beveridge Paper Co., Ltd., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.

INSULATING COMPOUNDS
[illegible] Toronto, Ont.

INSULATORS
Ed. Bennis & Co., Little Fulton, Bolton, Eng.
Beveridge Paper Co., Ltd., Montreal, Que.
Johns-Pratt Co., The, Hartford, Conn.

IRON FILLER
Can. H. W. Johns-Manville Co., Toronto, Ont.

LACE LEATHERS
Graton & Knight Mfg. Co., Montreal
Wm. C. Wilson & Co., Toronto.

LAMPS, ARC
Canadian Fairbanks-Morse Co., Montreal.
Can. General Electric Co., Toronto, Ont.
Can. H. W. Johns-Manville Co., Toronto, Ont.

LAMPS, ELECTRIC
Wm. C. Wilson & Co., Toronto.

LAMPS, INCANDESCENT
Canadian Fairbanks-Morse Co., Montreal.
Can. General Electric Co., Toronto, Ont.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Can. Laco-Philips Co., Ltd., Toronto, Ont.

LAMPS, NITRO
Can. Laco-Philips Co., Ltd., Toronto, Ont.

LAMPS, TUNGSTEN AND NITRO
Can. General Electric Co., Toronto, Ont.
Can. Laco-Philips Co., Ltd., Toronto, Ont.

LEATHER STRAPPING
Graton & Knight Mfg. Co., Montreal.

LUBRICANTS
Albany Lubricating Co., New York City.
Canadian Economic Lubricant Co., Montreal.
Jos. Dixon Crucible Co., Jersey City.

LUBRICATORS, CYLINDER
Albany Lubricating Co., New York City.
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

LUBRICATORS, FORCE FEED
Can. Detroit Lubricator Co., Walkerville, Ont.
Darling Bros., Montreal.
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

LUBRICATORS, PLAIN
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

MACHINERY INSULATION
Armstrong Cork & Insulation Co., Montreal, Que.
Beveridge Paper Co., Ltd., Montreal, Que.

MANGENESITE PASTE
Wm. C. Wilson & Co., Toronto.

MECHANICAL STOKERS
Babcock & Wilcox, Ltd., Montreal.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Dertoit, Mich.

METERS, ELECTRIC
Can. H. W. Johns-Manville Co., Toronto, Ont.

METERS, STEAM
Can. Allis-Chalmers, Ltd., Toronto, Ont.

METERS, WATER
Allen General Supplies, Toronto, Ont.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Foxboro Company, Foxboro, Mass.
McAvity & Sons, T., St. John, N.B.
The John McDongall Caledonian Iron Works Co., Ltd., Montreal.
Precision Instrument Co., Detroit, Mich.

MIXING VALVES
Mueller Mfg. Co., H., Sarnia, Ont.

MILL AND MINING MACHINERY
Canadian Fairbanks-Morse Co., Montreal.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Goldie & McCulloch Co., Galt.
Waterous Engine Works Co., Brantford.

METER TESTERS
Mueller Mfg. Co., H., Sarnia, Ont.

MOTORS
Canadian Fairbanks-Morse Co., Montreal.
Can. General Electric Co., Toronto, Ont.

OAKUM
Wm. C. Wilson & Co., Toronto.

OFFICE RAILINGS
Jas. Morrison Brass Mfg. Co., Toronto.

OIL CUPS
Albany Lubricating Co., New York City.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

OILER, COMPOUND FEEDERS
Lunkenheimer Co., Cincinnati, O.

OILERS, GAUGE
Lunkenheimer Co., Cincinnati, O.

OILERS, MULTIPLE
Can. Detroit Lubricator Co., Walkerville, Ont.
Lunkenheimer Co., Cincinnati, O.

OIL FILTERS AND CIRCULATING SYSTEMS
Bowser & Co., Inc., S. F., Toronto, Ont.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
Jas. Morrison Brass Mfg. Co., Toronto.

OIL SEPARATORS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
Dunn Separator Co., Syracuse, N.Y.
Elliott Co., Pittsburgh, Pa.
Leitch Co., Arthur S., Toronto, Ont.
Liberty Mfg. Co., Pittsburgh.
Jas. Morrison Brass Mfg. Co., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.

OILING SYSTEMS
Albany Lubricating Co., New York City.
Bowser & Co., Inc., S. F., Toronto, Ont.
Lunkenheimer Co., Cincinnati, O.

OILS, LUBRICATING
Albany Lubricating Co., New York City.
Can. Economic Lubricant Co., Montreal, Que.
Kellogg & Co., E. H., New York, N.Y.
Wm. C. Wilson & Co., Toronto.

PACKING, ASBESTOS
Johns-Pratt Co., The, Hartford, Conn.

PACKING ENGINE
Can. Asbestos Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Can. B. K. Morton Co., Toronto, Montreal.
Canuck Supply Co., Ltd., Montreal, Que.
Crane Packing Co., Chicago, Ill.
Garlock Packing Co., Hamilton, Ont.
Johns-Pratt Co., The, Hartford, Conn.
Peerless Rubber Mfg. Co., New York, N.Y.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING FIBRE
Beveridge Paper Co., Ltd., Montreal, Que.
Can. B. K. Morton Co., Montreal, Que.
Johns-Pratt Co., The, Hartford, Conn.
Wm. C. Wilson & Co., Toronto.

PACKING, HYDRAULIC
Can. Asbestos Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Can. B. K. Morton Co., Toronto, Montreal.
Crane Packing Co., Chicago, Ill.
Durabla Manufacturing Co., New York.
Garlock Packing Co., Hamilton, Ont.
Goodyear Tire & Rubber Co., Toronto.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, METALLIC
Can. B. K. Morton Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Crane Packing Co., Chicago, Ill.
Greene, Tweed & Co., New York.
Holmes Metallic Packing Co., Wilkesbarre, Pa.
Steel Mill Packing Co., Windsor, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, ROD
Can. Asbestos Co., Montreal, Que.
Can. B. K. Morton Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Crane Packing Co., Chicago, Ill.
Garlock Packing Co., Hamilton, Ont.
Canuck Supply Co., Ltd., Montreal, Que.
Steel Mill Packing Co., Windsor, Ont.
Peerless Rubber Mfg. Co., New York, N.Y.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, SHEET
Can. Asbestos Co., Montreal, Que.
Can. B. K. Morton Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Canuck Supply Co., Ltd., Montreal, Que.
Durabla Manufacturing Co., New York.
Garlock Packing Co., Hamilton, Ont.
Jenkins Bros., Ltd., Montreal.
Johns-Pratt Co., The, Hartford, Conn.
Peerless Rubber Mfg. Co., New York, N.Y.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, AMMONIA, STEAM AND WATER
Can. Asbestos Co., Montreal, Que.
Can. B. K. Morton Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Canuck Supply Co., Ltd., Montreal, Que.
Crane Packing Co., Chicago, Ill.
Garlock Packing Co., Hamilton, Ont.
Greene, Tweed & Co., New York.
Goodyear Tire & Rubber Co., Toronto.
Johns-Pratt Co., The, Hartford, Conn.
Steel Mill Packing Co., Windsor, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, LEATHER
Can. B. K. Morton Co., Toronto, Montreal.
Canuck Supply Co., Ltd., Montreal, Que.
Garlock Packing Co., Hamilton, Ont.
Graton & Knight Mfg. Co., Montreal.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING PISTON
Crane Packing Co., Chicago, Ill.

PACKING, VALVE STEM
Crane Packing Co., Chicago, Ill.
Johns-Pratt Co., The, Hartford, Conn.

PAINTS
Wm. C. Wilson & Co., Toronto.

PAINT, DAMP RESISTING
Toch Bros., Toronto, Ont.

PENSTOCKS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.

PILLOW BLOCKS
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Waterous Engine Works Co., Brantford.

PIPE COILS
York Mfg. Co., York, Pa.

PIPE COVERINGS, STEAM, BRINE, AMMONIA AND ICE WATER
Armstrong Cork & Insulation Co., Montreal, Que.

PIPE STEEL
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

PIPE VISES AND CUTTERS
Armstrong Mfg. Co., Bridgeport, Conn.

PIPE, GAS
Can. Allis-Chalmers, Ltd., Toronto, Ont.

PIPES, WATER
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

PIPING AND FITTINGS
Frick Co., Waynesboro, Franklin Co., Pa.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
York Mfg. Co., York, Pa.

PIPING, STEAM
Babcock & Wilcox, Ltd., Montreal.

PLATE WORK
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

PLUG COCKS
Homestead Valve Mfg. Co., Pittsburgh, Pa.

PLUMBING SUPPLIES
Mueller Mfg. Co., H., Sarnia, Ont.
Wm. C. Wilson & Co., Toronto.

SOCIATED PRESS WIRE.

DAILY N

AY, DECEMBER 14, 1917

IA

CRUSHER WILL BE PLACED AT LIGHT PLANT

Order is Sent to Columbus Company To Rush Machine.

FACTORIES ARE PROMISED RELIEF

To facilitate the handling of coal into the conveyor at the plant of The Springfield Light, Heat and Power company a coal crusher with a capacity of fifty tons an hour will be installed at once. An order was placed by the light company with The Jeffrey Manufacturing company of Columbus Friday morning for the shipment of the crusher.

The crusher has a capacity of fifty tons of coal an hour which is more than sufficient to meet the needs of the light company in providing power, light and heat for the manufacturers and citizens generally.

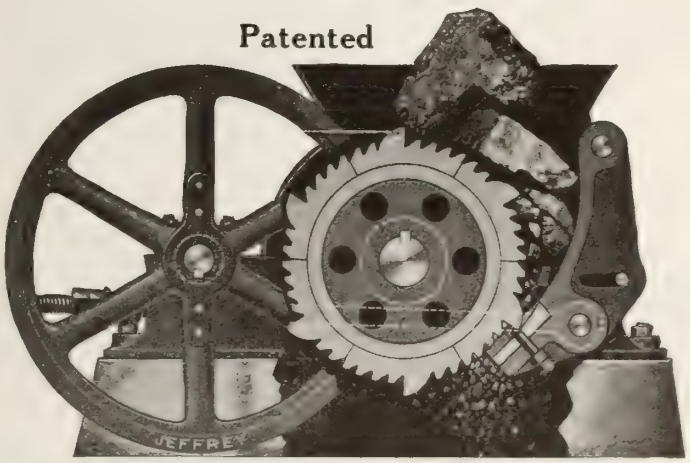
Arrangements were made with the railway officials by which the promised to place a car at the disposal of the Jeffrey company at Columbus at 4 p m., Friday, for the loading of the machine. It is expected that the crusher will arrive here some time Friday night. Steps have been taken to rush the installing of the crusher. Then the factories will be able to start up again.

Mr. Ashburner stated that the main trouble at the light plant was the inability of the company's employes to break up the coal fast enough to feed the boilers. Slack and nut can be used without crushing but such coal can not be obtained in sufficient quantities to keep the plant going at needed capacity.

EAST OHIO CITY
FEARS FUEL RIOT

Factories Were Closed Down Until a Jeffrey Single Roll Coal Crusher Was Installed

Patented



Power companies, traction companies and factories all over the country are having trouble, due to lack of **proper sizes** of coal for their stokers.

Meet This Situation as Many Companies are doing

Make Your Own Stoker Coal With Jeffrey Single Roll Crusher

Bulletin No. 141-A gives Complete Information.

The Jeffrey Mfg., Co.

Canadian Branch & Warerooms, Montreal

If any advertisement interests you, tear it out now and place with letters to be answered.

POWER PUMPS
American Steam Pump Co., Battle Creek, Mich
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
Waterous Engine Works Co., Brantford.
Garlock Packing Co., Hamilton, Ont.
Laurie & Lamb, Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.

POWER, TRANSMISSION MACHINERY
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Goldie & McCulloch Co., Galt.
Jeffrey Manufacturing Co., Montreal.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
& New York
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Morse Chain Co., Ithaca, N.Y.
Waterous Engine Works Co., Brantford.

PRESSES
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

PRESSURE, BLOWERS, CENTRIFUGAL
Can. Sirocco Co., Windsor, Ont.

PULLEYS
American Pulley Co., Philadelphia, Pa.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Wm. Hamilton Co., Ltd., Peterboro.
Jeffrey Manufacturing Co., Montreal.
Waterous Engine Works Co., Brantford.

PULP MILL MACHINERY
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Jeffrey Manufacturing Co., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

PUMPING MACHINERY
American Steam Pump Co., Battle Creek, Mich.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Bawden Machine Co., Toronto.
Laurie & Lamb, Montreal.
McAvity & Sons, T., St. John, N.B.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.
Waterous Engine Works Co., Brantford.

PUMPING MACHINERY, ELECTRICAL
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Jeffrey Manufacturing Co., Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.

PUMPS, AIR
American Steam Pump Co., Battle Creek, Mich
Bawden Machine Co., Ltd., Toronto.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Montreal.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co. Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, CONTRACTORS'
Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
McAvity & Sons, T., St. John, N.B.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, ELECTRICAL
American Steam Pump Co., Battle Creek, Mich.

PUMPS, FEED WATER
Can. Allis-Chalmers, Ltd., Toronto, Ont.

PUMP GOVERNORS AND REGULATORS
Bawden Machine Co., Ltd., Toronto.
Darling Bros., Montreal.
G. M. Davis Regulator Co., Chicago.
D'Este Co., Julian, Boston, Mass.
Elliott Co., Pittsburgh, Pa.
Mason Regulator Co., Boston, Mass.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.
Watson & McDaniel Co., Philadelphia.

PUMP STRAINERS
Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Darling Bros., Ltd., Montreal.
Liberty Mfg. Co., Pittsburgh, Pa.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, HAND AND POWER
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Darling Bros., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, CENTRIFUGAL
American Steam Pump Co., Battle Creek, Mich.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Darling Bros., Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Waterous Engine Works Co., Brantford.

PUMPS, DUPLEX

PUMPS, GEARED, COMPOUND
American Steam Pump Co., Battle Creek, Mich
Bawden Machine Co., Ltd., Toronto.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Montreal.
Inglis Co., The John, Toronto, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, HYDRAULIC, PRESSURE
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Darling Bros., Montreal.
Inglis Co., The John, Toronto, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.

PUMP LEATHERS
Beveridge Paper Co., Ltd., Montreal, Que.
Can. B. E. Morton Co., Toronto, Montreal.
Graton & Knight Mfg. Co., Montreal.

PUMPS, OIL
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Ltd., Toronto.
Bowser & Co., Inc., S. F., Toronto, Ont.
Can. Detroit Lubricator Co., Walkerville, Ont.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, STEAM TURBO
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Darling Bros., Montreal.
Escher Wyss & Co., Montreal, Que.
Pulsometer Engineering Co., Ltd., London, Eng.

PUMP TANK, RECEIVER
American Steam Pump Co., Battle Creek, Mich.
Smart-Turner Machine Co., Hamilton, Ont.

PUMPS, STEAM
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Ltd., Toronto.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
Inglis Co., The John, Toronto, Ont.
Laurie & Lamb, Montreal.
Leitch Co., Arthur S., Toronto, Ont.
McAvity & Sons, T., St. John, N.B.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, TRIPLEX
Smart-Turner Machine Co., Hamilton, Ont.

PUMPS, VACUUM
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Ltd., Toronto.
Laurie & Lamb, Montreal.
Leitch Co., Arthur S., Toronto, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PYROMETERS
Foxboro Co., The, Foxboro, Mass.
Jas. Morrison Brass Mfg. Co., Toronto.
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.

RADIATOR TRAPS
Sarco Co., Inc., New York, N.Y.

RADIATOR AIR VENTS
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

RAGS
Wm. C. Wilson & Co., Toronto.

REBOILERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

RECEIVERS, AIR
Can. Allis-Chalmers, Ltd., Toronto, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.

RECORDING INSTRUMENTS
Can. H. W. Johns-Manville Co., Toronto, Ont.
Foxboro Co., The, Foxboro, Mass.
Precision Instrument Co., Detroit, Mich.
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.

REFRIGERATOR DOORS, WINDOWS, ETC.
Jamison Cold Storage Door Co., Hagerstown, Md.

REFRIGERATING MACHINERY
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Griscom-Russell Co., Ltd., Montreal.
Frick Co., Waynesboro, Franklin Co., Pa.
Linde Canadian Refrigeration Co., Montreal.
Vilter Mfg. Co., Milwaukee, Wis.
York Mfg. Co., York, Pa.

REFUSE DESTRUCTOR
Canadian Griscom-Russell Co., Ltd., Montreal.
Laurie & Lamb, Montreal.

REGULATORS, PRESSURE
Chaplin-Fulton Mfg. Co., Pittsburgh, Pa.
D'Este Co., Julian, Boston, Mass.
Jas. Morrison Brass Mfg. Co., Toronto.
Taylor Instrument Co., Rochester, N.Y.

REGULATORS, TEMPERATURE
Sarco Co., Inc., New York, N.Y.
Taylor Instrument Co., Rochester, N.Y.

RETORTS
MacKinnon, Holmes & Co., Sherbrooke, Que.

REVOVLING DOORS FOR HARDENING ROOMS
Jamison Cold Storage Door Co., Hagerstown, Md.

ROOFING
Wm. C. Wilson & Co., Toronto.

ROPE
Wm. C. Wilson & Co., Toronto.

ROPE PRESERVATIVE
Cling Surface Co., Buffalo.

ROTARY CONVERTERS
Canadian Fairbanks-Morse Co., Montreal

RUBBER HOSE
Can. H. W. Johns-Manville Co., Toronto, Ont.
Garlock Packing Co., Hamilton, Ont.
Liberty Mfg. Co., Pittsburg, Pa.
Thomson-Gordon, Ltd., Hamilton, Ont.

RUBBER MOLDS
Bawden Machine Co., Ltd., Toronto.

SAFES
Canadian Fairbanks-Morse Co., Montreal.
Goldie & McCulloch Co., Galt.

SCALE REMOVERS
Babcock & Wilcox, Ltd., Montreal.
Beveridge Paper Co., Ltd., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
William B. Pierce Co., Buffalo, N.Y.

SEAM PROTECTORS, GIRTH
National Boiler Protector Co. of Canada, Montreal, Que.

SHAFTING
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Waterous Engine Works Co., Brantford.

SHAKING AND DUMPING GRATES
Babcock & Wilcox, Ltd., Montreal.
Galt Foundry Co., Galt, Ont.
Waterous Engine Works Co., Brantford.

SMOKE BOXES, STACKS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

SMOOTH-ON
Wm. C. Wilson & Co., Toronto.

SPECIAL MACHINERY
Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Waterous Engine Works Co., Brantford.

SPEED INDICATORS
Foxboro Co., The, Foxboro, Mass.
Schaeffer & Budenburg Mfg. Co., Brooklyn, N.Y.
L. S. Starrett Co., Athol, Mass.

SPLICE PROTECTORS
Jordan Bros., Inc., New York, N.Y.

SPROCKET CHAIN ATTACHMENTS
Waterous Engine Works Co., Brantford.

SPROCKET RIMS
Babbitt Steam Specialty Co., New Bedford, Mass.

SPUR WHEELS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Waterous Engine Works Co., Brantford.

STACKS, STEEL
Babcock & Wilcox, Ltd., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.

STAND PIPES, STEEL
MacKinnon, Holmes & Co., Sherbrooke, Que.

STAYBOLTS, FLEXIBLE
Can. Allis-Chalmers, Ltd., Toronto, Ont.

STEAM SEPARATORS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Darling Bros., Montreal.
Direct Separator Co., Syracuse, N.Y.
D'Este Co., Julian, Boston, Mass.
Elliott Co., Pittsburgh, Pa.
Leitch Co., Arthur S., Toronto, Ont.
Penberthy Injector Co., Windsor, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Watson & McDaniel Co., Philadelphia.

STEAM SPECIALTIES
Alberger Heater Co., Buffalo, N.Y.
Canadian Fairbanks-Morse Co., Montreal.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
D'Este Co., Julian, Boston, Mass.
Liberty Mfg. Co., Pittsburg, Pa.
Lunkenheimer Co., Cincinnati, O.
Mason Regulator & Engineering Co., Montreal.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor.
Watson & McDaniel Co., Philadelphia.

STEAM TRAPS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Anderson Co., Y. D., Cleveland, O.
Canadian Fairbanks-Morse Co., Montreal.
Can. Sirocco Co., Windsor, Ont.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
Davis Regulator Co., G. M., Chicago.
D'Este Co., Julian, Boston, Mass.
Dunham Co., Ltd., C. A., Toronto, Ont.
Elliott Co., Pittsburgh, Pa.
J. T. Long, 84 Adam St., Montreal, Que.
Can. Morehead Mfg. Co., Woodstock.
Mason Regulator & Engineering Co., Montreal.
Nashua Mach. Co., Boston, Mass.
Sarco Co., Inc., New York, N.Y.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Watson & McDaniel Co., Philadelphia.

STEEL BARRELS
Smart-Turner Machine Co., Hamilton, Ont.

STEEL DRUMS
Smart-Turner Machine Co., Hamilton, Ont.

STEEL TANKS
Babcock & Wilcox, Ltd., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works, Brantford, Ont.

STOKERS
Babcock & Wilcox, Ltd., Montreal.
Ed. Bennis & Co., Little Fulton, Bolton, Eng.
Detroit Stoker Co., Detroit, Mich.
Galt Foundry Co., Galt, Ont.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Dertoit, Mich.

OIL FILTRATION EFFICIENCY

The efficiency of any Oil Filtering and Circulating System is measured by the saving which it effects in oil and labor, in addition to reducing friction to an absolute minimum. This in turn depends on the capacity of the System to remove from the circulating oil, all foreign matter which causes friction, performing these operations with the least possible attention and little or no "upkeep." The ability of the System to do this depends on the efficiency of the clarifying and filtering devices.

In a

BOWSER
ESTABLISHED 1885

these features have been incorporated in the best possible relation to each other and in a manner which presents the best method for a commercially practical system.

Our engineers have an unequalled service to offer in Oil Filtering Problems, due to their thirty-three years' experience. This service is yours for the asking. Write to-day for complete information.

S. F. Bowser & Co., Inc.
Fort Wayne, Ind. - U. S. A.

The illustration shows the Bowser 6F System, the leader of Oil Filtering and Circulating equipment. Especially suited where large volumes of water return with the dirty oil.

STRAINERS
Babcock & Wilcox, Ltd., Montreal.
Bawden Machine Co., Ltd., Toronto.
Elliott Co., Pittsburgh, Pa.
Self-Cleansing Strainer Co., Chicago.

STRUCTURAL STEEL WORK
Babcock & Wilcox, Ltd., Montreal.
MacKinnon, Holmes & Co., Ltd., Sherbrooke, Que.

SUPERHEATERS, STEAM
Babcock & Wilcox, Ltd., Montreal.

SWITCHBOARDS
Can. General Electric Co., Toronto, Ont.

SWITCHES AND SWITCH BOXES
Can. H. W. Johns-Manville Co., Toronto, Ont.

TACHOMETERS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Foxboro Co., The, Foxboro, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

TANKS, BLOW-OFF
Darling Bros., Montreal.
John McDougall Caledonian Iron Works, Montreal.
Waterous Engine Works Co., Brantford.

TANKS, FREEZING, STORAGE AND WATER COOLING
Frick Co., Waynesboro, Franklin Co., Pa.

TANKS, OIL
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Bowser & Co., Inc., S. F., Toronto, Ont.
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

TANKS, WATER
Inglis Co., The John, Toronto, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

TAPPING MACHINES
Mueller Mfg. Co., H., Sarnia, Ont.

TECHNICAL BOOKS
MacLean Publishing Co., Toronto.

THERMOMETERS
Foxboro Co., The, Foxboro, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.

THERMOSTATS
Sarco Co., Inc., New York, N.Y.

TOOLS
Mueller Mfg. Co., H., Sarnia, Ont.

TRANSFORMERS
Can. General Electric Co., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.

TRANSMISSION MACHINERY
American Pulley Co., Philadelphia, Pa.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Goldie & McCulloch Co., Galt, Ont.
Jeffrey Manufacturing Co., Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Waterous Engine Works Co., Brantford.

TRAPS, STEAM AND WATER-LINE
D'Este Co., Julian, Boston, Mass.

TRUCKS, FACTORY
Beveridge Paper Co., Ltd., Montreal, Que.
Canadian Fairbanks-Morse Co., Montreal.

TUBE CLEANERS
Babcock & Wilcox, Ltd., Montreal.
Elliott Co., Pittsburgh, Pa.
Liberty Mfg. Co., Pittsburg, Pa.
Pilley Packing and Flue Brush Mfg. Co., St. Louis, Mo.

TUBE CUTTERS
Babcock & Wilcox, Ltd., Montreal.
Liberty Mfg. Co., Pittsburg, Pa.

TUBES, BOILER
Babcock & Wilcox, Ltd., Montreal.

TUBE EXPANDERS
Babcock & Wilcox, Ltd., Montreal.
Liberty Mfg. Co., Pittsburg, Pa.

TUBING, FELXIBLE METALLIC
Pennsylvania Flexible Metallic Tubing Co., Cleve-

TUNGSTEN LAMPS
Bawden Machine Co., Toronto.

TURBINE OIL
Kellogg & Co., E. H., New York, N.Y.

TUNGSTEN LAMP (Vacuum and Gas Filled Types)
Can. Laco-Phillips Co. of Toronto, Ont.

TURBINE WATER WHEELS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Boving Co., Hamilton.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.

TURBINES, STEAM
Belliss & Morcom, Birmingham, Eng.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Coe Co., C. T., 10 Johnson St., Newark, N.J.
Coppus Engr. & Equip. Co., Worcester, Mass.
Escher Wyss & Co., Montreal, Que.
Kerr Turbine Co., Wellsville, N.Y.
Laurie & Lamb, Montreal.
John McDougall Caledonian Iron Works, Montreal.
Sturtevant Co. of Canada, B. F., Galt, Ont.

UNIONS
Canadian Fairbanks-Morse Co., Montreal.
Dart Union Company, Toronto.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.

UNIONS, BALL JOINT, COMBINATION, FLANGED PIPE, GROUND JOINT, MALLEABLE IRON, FLANGE, PIPE, SWING
Jefferson Union Co., Lexington, Mass.
Dart Union Company, Ltd., Toronto, Ont.

VACUUM GOVERNORS
Smart-Turner Machine Co., Ltd., Hamilton.
Canadian Steam Boiler Equipment Co., Toronto.
G. M. Davis Regulator Co., Chicago.
Leitch Co., Arthur S., Toronto, Ont.

VACUUM REGULATING VALVES
Can. Steam Boiler Equipment Co., Toronto, Ont.
Darling Bros., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

VACUUM TRAPS
Can. Morehead Mfg. Co., Woodstock, Ont.
Can. Sirocco Co., Windsor, Ont.
Cole, Ltd., Geo. W., Toronto.
Nashua Mach. Co., Boston, Mass.

VALVE DISCS
Wm. C. Wilson & Co., Toronto.

VALVE LEATHER
Beveridge Paper Co., Ltd., Montreal, Que.
Can. B. K. Morton Co., Toronto, Montreal.
Graton & Knight Mfg. Co., Montreal.

VALVE RESEATING MACHINES
Darling Bros., Montreal.

VALVES
Babcock & Wilcox, Ltd., Montreal.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Can. Steam Boiler Equipment Co., Toronto, Ont.
Frick Co., Waynesboro, Franklin Co., Pa.
G. M. Davis Regulator Co., Chicago.
D'Este Co., Julian, Boston, Mass.
Homestead Valve Mfg. Co., Pittsburg.
Jenkins Bros., Montreal.
Kerr Engine Co., Walkerville, Ont.
Liberty Mfg. Co., Pittsburg, Pa.
Lunkenheimer Co., Cincinnati, O.
Mason Regulator & Engineering Co., Montreal.
Mason Regulator Co., Boston, Mass.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor.
Pratt & Cady, Hartford, Conn.
Watson & McDaniel Co., Philadelphia.
Wm. C. Wilson & Co., Toronto.
York Manufacturing Co., Philadelphia.

VALVES, ACID RESISTING
Homestead Valve Mfg. Co., Pittsburg.
McAvity & Sons, T., St. John, N.B.

VALVES, BACK PRESSURE
Can. Allis-Chalmers, Ltd., Toronto, Ont.

VALVES, BLOW-OFF
Babcock & Wilcox, Ltd., Montreal.
Canadian Fairbanks-Morse Co., Montreal.
Elliott Co., Pittsburg, Pa.
Homestead Valve Mfg. Co., Pittsburg.
Jenkins Bros., Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Watson & McDaniel Co., Philadelphia.

VALVE CHAIN WHEEL
Babbitt Steam Specialty Co., New Bedford, Mass.

VALVES, FOOT
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Smart-Turner Machine Co., Ltd., Hamilton.

VALVES, GATE
Babcock & Wilcox, Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

VALVES, MULTIPORT
Can. Allis-Chalmers, Ltd., Toronto, Ont.

VALVES, NON-RETURN STOP
Canadian Fairbanks-Morse Co., Montreal.

VALVES, REDUCING
D'Este Co., Julian, Boston, Mass.
Leitch Co., Arthur S., Toronto, Ont.
Liberty Mfg. Co., Pittsburg, Pa.
Mason Regulator Co., Boston, Mass.
Jas. Morrison Brass Mfg. Co., Toronto.
Mueller Mfg. Co., H., Sarnia, Ont.
Watson & McDaniel Co., Philadelphia.

VALVES, RELIEF
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
McAvity & Sons, T., St. John, N.B.

VALVES, RADIATOR
Jenkins Bros., Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.

VALVES, POP
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.

VALVES, PUMP
Beveridge Paper Co., Ltd., Montreal, Que.
Canadian Fairbanks-Morse Co., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

VALVES, SAFETY THROTTLE
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Detroit Lubricator Co., Walkerville, Ont.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.

VALVES, VACUUM
Sarco Co., Inc., New York, N.Y.

VAULTS AND VAULT DOORS
Canadian Fairbanks-Morse Co., Montreal.
Goldie & McCulloch Co., Galt.

VENTILATING APPARATUS
Sturtevant Co. of Canada, B. F., Galt, Ont.

VOLTMETERS
Can. H. W. Johns-Manville Co., Toronto, Ont.

WASHERS, FIBRE
Beveridge Paper Co., Ltd., Montreal, Que.

WASHERS, LEATHER
Graton & Knight Mfg. Co., Montreal.

WASTE
Wm. C. Wilson & Co., Toronto.
Can. Steam Boiler Equipment Co., Toronto, Ont.

WATER COLUMNS, GAUGES
Babcock & Wilcox, Ltd., Montreal.
Elliott Co., Pittsburg, Pa.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.
W. J. Wall, Montreal.

WATER HOSE
Can. H. W. Johns-Manville Co., Toronto, Ont.
Liberty Mfg. Co., Pittsburg, Pa.
Pennsylvania Flexible Metallic Tubing Co., Cleveland, O.

WATER LIFTERS
Watson & McDaniel Co., Philadelphia.

WATER MOTORS
Elliott Co., Pittsburg, Pa.

WATER PURIFIERS, SOFTENERS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Laurie & Lamb, Montreal.
Scaife & Sons, Wm. B., Pittsburgh, Pa.

WATER SUPPLY SYSTEMS
Mueller Mfg. Co., H., Sarnia, Ont.

WATER WHEELS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Escher Wyss & Co., Montreal, Que.
MacKinnon, Holmes & Co., Sherbrooke, Que.
John McDougall Caledonian Iron Works, Montreal

WATERWORKS SUPPLIES
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
McAvity & Sons, T., St. John, N.B.

WATTMETERS
Can. H. W. Johns-Manville Co., Toronto, Ont.

WHISTLES, PLAIN OR CHIME
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.

WIRE BRUSHES
Pilley Packing and Flue Brush Mfg. Co., St. Louis, Mo.
Penberthy Injector Co., Windsor, Ont.

WRENCHES
Greene, Tweed & Co., New York.
Trimont Mfg. Co., Roxbury, Mass.
Williams & Co., J. W., Brooklyn, N.Y.

WATER SCAIFE AND WE-FU-GO
PURIFICATION SYSTEMS
SOFTENING & FILTRATION
FOR BOILER FEED AND ALL INDUSTRIAL USES
WM. B. SCAIFE & SONS CO. PITTSBURGH, PA.

Don't buy that New Electrical Apparatus Just Yet

WE can supply you with high-grade apparatus that has been slightly used and discarded through no fault of its own, at an **immense saving in cost.** For instance, in many cases we take over entire plants simply because of changed conditions such as increased capacity, change of system, etc.

EVERYTHING IS OVERHAULED AND REFINISHED BY US AND **GUARANTEED** AS GOOD AS NEW, BOTH ELECTRICALLY AND MECHANICALLY.

Our catalogs of offerings should be in the hands of every power plant superintendent each time they are gotten out, and it will be worth while for anyone interested in this class of power plant equipment to be on our mailing list to receive **all** offerings.

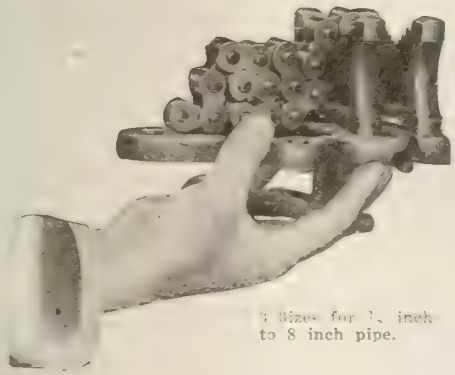
Nearly all of the principal power, lighting and street railway plants in the United States are our customers.

WRITE FOR OUR LATEST CAT ALOG of **Power House Equipment, Street Cars, Motors, Hoists, Compre ssors, etc.**

MACGOVERN & COMPANY, Inc.

114 Liberty St., New York City

Placed in the Hands of Power Engineers



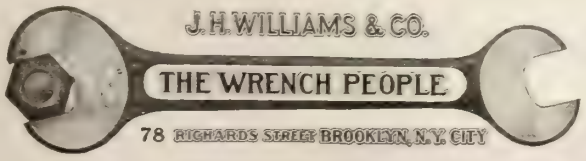
3 Sizes for ¾ inch to 8 inch pipe.

Williams "VULCAN" and "AGRIPPA"

CHAIN PIPE TOOLS

Readjust pipe disturbances in the beginning.

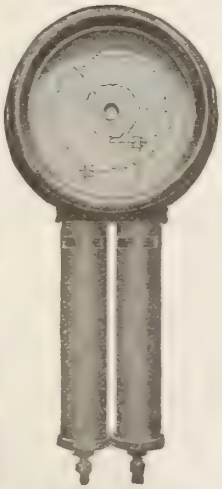
This inexpensive precaution that insures a minimum of interruptions and overtime repairs and frequently prevents heavy losses through leaks or explosions, is too vital a necessity to be ignored.



UEHLING WASTE METER

COMBINED

CO_2 AND TEMPERATURE RECORDER



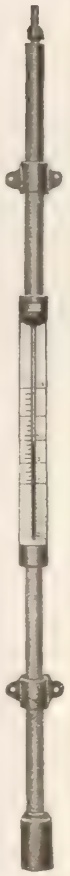
Record of CO_2 and stack temperature on one chart.

Does your fireman know how much fuel he is wasting? Do you know?

The **Uehling CO_2 Recorder** makes a complete 24 hr. record of your combustion efficiency and the **CO_2 indicator at the Boiler Front** holds the fireman responsible.

Get more **Steam** per pound of **Coal** and reduce your annual fuel consumption.

Let us know the number and size of your boilers and coal consumed per year, upon receipt of which information we will be glad to send you full particulars.



CO_2 Indicator for Boiler Front

Let us hear from you. We are pioneers in the manufacture of Indicators and Recorders for Power Plant purposes.

Send for our Bulletin No. 110.

Uehling Instrument Company

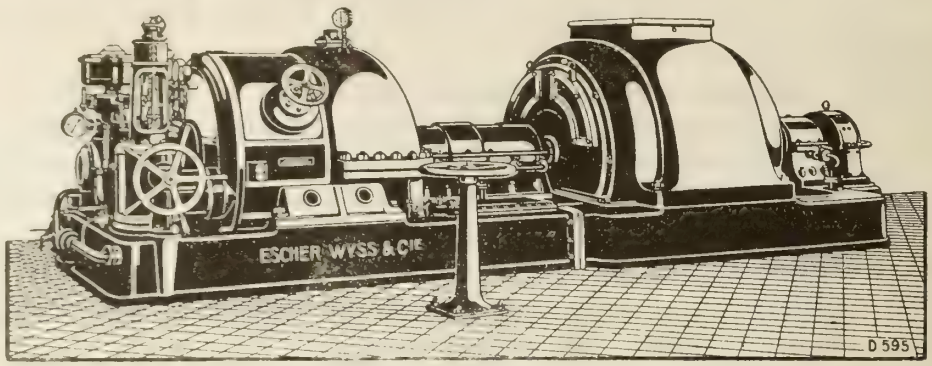
2008 Empire Building **New York City**

If any advertisement interests you, tear it out now and place with letters to be answered.

Escher Wyss & Co., S.A. ZURICH (Switzerland)

Montreal Office: 211 Coristine Building

Zoelly-Steam Turbines



Zoelly-Rotary-Compressors

15/18

INDEX TO ADVERTISERS

PAGE

A

Albany Lubricating Co. 73
Alberger Heater Co. 54
American Steam Gauge & Valve Mfg. Co. 52
American Steam Pump Co. 8
Anderson Co., V. D. 81
Armstrong Cork Insulation Co. 11

B

Babbitt Steam Specialty Co..... 62
Babcock & Wilcox 78
Bennis & Co., Ltd., Ed..... 81
Boiler Inspection Dept. 77
Boving Hydraulic & Eng. Co.. 76
Bowser, S. F., & Co., Inc.... 85

C

Can. Allis-Chalmers Co..... 9
Can. Assoc. Stationary Engrs.. 70
Can. Bond Hanger & Coupling Co. 73
Can. Detroit Lub. Co. 64
Can. Fairbanks-Morse Co. 4
Can. General Electric Co..... 9
Can. H. W. Johns-Manville Co., Ltd. 3
Can. Morehead Mfg. Co..... 6
Can. S K F Co. 5
Can. Steam Boiler Equipment Co. 4
Canuck Supply Co., Ltd. 5
Chaplin-Fulton Mfg. Co. 5
Cling-Surface Co. 7
Cole Ltd., Geo. W. 5
Coppus Eng. & Equip. Co..... 6
Crane Packing Co. 62

D

Darling Bros. 64
Dart Union Co. 6
[illegible] 5
D'Este Co., Julian 6
Direct Separator Co. 50
Dixon Crucible Co., Jos. ... 6

PAGE

Dominion Belting Co. 74
Dominion Coal Co. 76
Dunham & Co., C. A. 57
Durabla Mfg. Co. 52

E

Economy Fuse & Mfg. Co. of Canada 77
Elliott Co. 45
Engineering & Mach. Works of Canada, Ltd. 2
Escher Wyss & Co. 88

F

Federal Engineering Co. 81
Francis, Walter J., & Co..... 58
Frick Co. 11

G

Galt Foundry Co. 5
Garlock Packing Co. 72
Garth Co. 76
Gates, John W. 48
Goldie & McCulloch Co. 16
Graton & Knight Mfg. Co..... 51
Greene, Tweed & Co. 53

H

Holmes Metallic Packing Co... 76
Homestead Valve Mfg. Co..... 68
Hoyt Metal Co. 2

I

Inglis Co., John..Inside back cover

J

Jamison Cold Storage Door Co. 12
Jefferson Union Co. 65
Jeffrey Mfg. Co. 83
Jenckes Bros. 69
John Pratt Co., The 60
Jones Underfeed Stoker Co.... 1

PAGE

Jordan Bros., Inc. 8

K

Kellogg & Co., E. H..... 58
Kerr Engine Co. 68

L

Ladd Co., The Geo. T..... 77
Laurie & Lamb 13
Leitch Co., The Arthur S..... 6
Liberty Mfg. Co. 4
Linde Canadian Refrigeration Works Co. 10
Lunkenheimer Co. 66

M

MacGovern & Co. 87
MacKinnon, Holmes & Co..... 58
MacLean's Magazine 56
Magnolia Metal Co. 5
Mason Regulator Co. 6
Mason Regulator & Eng. Co... 7
McAvity & Sons, T. 66
McDougall Caledonian Iron Wks. Co. 14
McGhie, W. C. 76
McLaren, D. K., Ltd. 71
Metlskin Co., Inc. 50
Morrison Brass Mfg. Co., Jas. Outside back cover
Morse Chain Co. 75
Mueller Mfg. Co., H. 67
Murphy Iron Works 3

N

National Boiler Seam Protector Co. 76

P

Penberthy Injector Co. Front cover
Pennsylvania Flexible Metallic Tubing Co. 52

PAGE

Pilley Packing & Flue Brush Mfg. Co. 77
Power Plant Equipment Co... 58
Pratt & Cady Co., Inc. 50

S

Sarco Co., Inc. 48
Scaife, Wm. B., & Sons Co.... 86
Schaeffer & Budenberg Mfg. Co. 6
Shell-Bar, Boico Supply, Ltd... 3
Smart-Turner Mach. Co. 77
Starrett, L. S., Co..... 78
Steel Mill Packing Co..... 60

T

Taylor Instrument Cos..... 8
Thomson-Gordon, Ltd. 60
Toch Bros. 62
Trimont Manufacturing Co.... 78

U

Uehling Instrument Co. 87
United States Rubber Co..... Inside front cover

V

Vilter Mfg. Co. 10

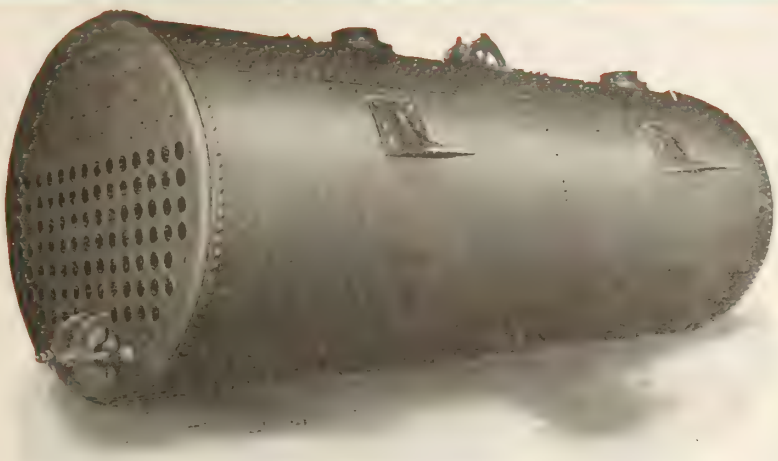
W

Wall, W. J. 48
Waterous Engine Works Co... 1
Watson & McDaniel Co..... 76
Williams & Co., J. H. 87
Wilson, Wm., C., & Co..... 47

Y

York Mfg. Co. 12

INGLIS BOILERS



Boilers for All Services

INGLIS BOILERS have been successfully meeting all Canadian Industrial demands for over half a century. Built to last and give efficient and economical service.

MAKERS of ERIE CITY WATER TUBE BOILERS — VERTICAL and HORIZONTAL.

The Inglis representative is at your service and will be pleased to show you various types of boilers and their uses.

The John Inglis Company

Limited

ENGINEERS AND BOILER MAKERS

14 Strachan Avenue Toronto, Canada

MADE IN CANADA

J.M.T. Steam Goods and Specialties

Twin Marine Safety Valve

Complete Line

Everything for the Engine and Boiler Room in steam goods and specialties.

All J.M.T. Products are modern in design and represent *quality* in workmanship and material

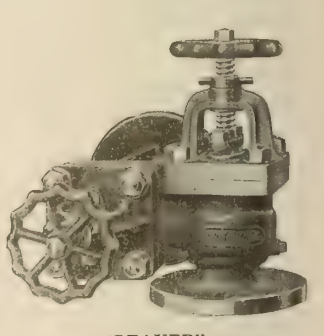
They are factory tested and can be relied upon to give long and satisfactory service. Approved by provincial boiler inspection departments.

J. M. T. Reducing Pressure Valve.

Model "C" Safety Valve

A FEW OF OUR LINES

Stop Valves	Inspirators
Check Valves	Jet Pumps
Gate Valves	Steam Gauges
Safety Valves	Vacuum Gauges
Relief Valves	Ammonia Gauges
Reducing Valves	Gauge Board Outfits
Steam Traps	Lubricators
General Boiler Mountings	Pipe Fittings
Injectors	Steam Whistles
Ejectors	Engine Indicators
	Pipe Tools, etc.



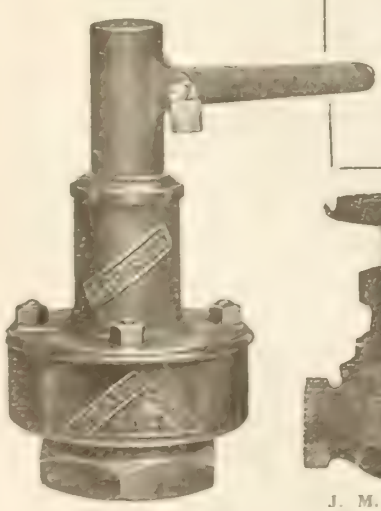
"BEAVER" Combined Stop and Check Valve.

Quick Service

THE JAMES MORRISON BRASS MFG. CO., LIMITED

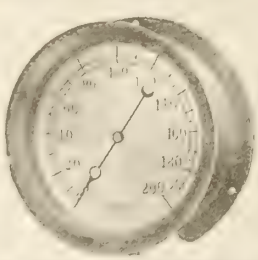
93 to 97 Adelaide St. W.

TORONTO



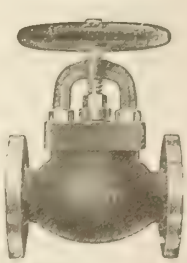
Low Pressure Safety Valve

J. M. T. Globe Valve, Renewable Disc.



GAUGES AND RECORDING INSTRUMENTS

Manufacturers of a full line of high-grade Pressure Gauges, Recording Gauges, etc., for all requirements.



Beaver Valve.

J. M. T. Improved Injector.

POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power; and to the operation of Refrigerating Machinery.

Published by The MacLean Publishing Company, Limited, 143-153 University Ave., Toronto

MONTREAL: Southam Bldg. LONDON, ENG.: 88 Fleet St., E.C. WINNIPEG: 1207 Union Trust Bldg

Vol. XI—No. 5 Publication Office, Toronto—May, 1918 Published Monthly $1.00 per Year.

"The Smile of Satisfaction"

Made in both Double and Single Connection Style

Write for our Catalog

Penberthy Injector Co., Limited
WINDSOR, ONT.

TRADE PENBERTHY MARK

Peerless

SIGHT FEED
Lubricators
are Specially Designed

For Stationary and the better class of steam engines and embody the newest and best features in Lubricator Construction. For reliable and satisfactory service they have no equal.

Look for Our Trade Mark

No Feedless Days with a

Peerless

Nationalizing the Distribution of Mechanical Rubber Goods

For the last thirty years users of Mechanical Rubber Goods have found their various needs most perfectly filled by such famous brands as:

Peerless Rainbow Belting, Rainbow Packing, Sawyer Canvas Belting, Eureka Fire Hose, Giant Steam Hose, Rinex Soles, Supremo Conveyor Belting, Holdtite Friction Tape, Peerless Honest John Packing, Relio Belting, Usco Radiator Hose, Rainbesto Packing, Buckeye Splicing Tape, Four Ace Seamless Belting, Paragon Fire Hose, Anaconda Tender Hose, Peerless Air Hose, Kold-Pak Jar Rubbers, Revero Garden Hose, Spring Step Heels, Giant Seamless Belting, Giant Suction Hose, Usudurian Packing, as well as hundreds of miscellaneous rubber items, such as rubber soles and heels, rubber tiling, matting, mats, plumbers' supplies, rubber thread, rubber toys and golf balls.

Now, to effect that close co-operation between manufacturing and distributing required by the great growth of this nation's industries and its demands for mechanical rubber goods of recognized quality and workmanship, we have established branches in all principal cities.

These, plus the quick facilities of our factories advantageously located in the big centers East and West, constitute a nationalized service that our friends and users will find adequate to meet every occasion.

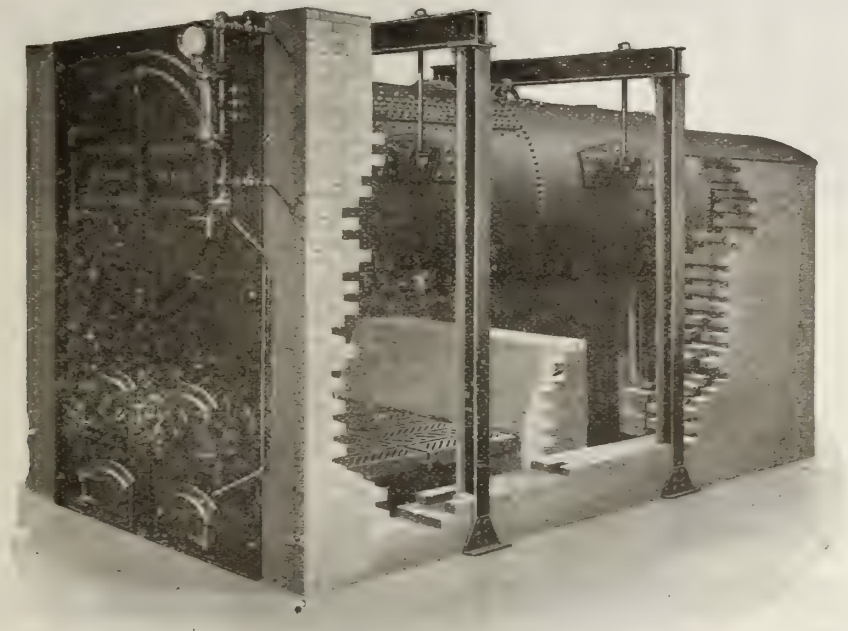
To make identification of these goods doubly easy and absolutely certain, all of these well known brands still carry their old and familiar trade-marks, and in addition the great United States seal, the hall mark of quality of the largest rubber manufacturer in the world.

UNITED STATES RUBBER COMPANY
US
RUBBER SYSTEM
AND ASSOCIATED COMPANIES

United States Rubber Company

Mechanical Goods Division NEW YORK

BOILERS



WATEROUS Return Tubular Boilers are quick steaming, economical of fuel and absolutely reliable.

Power Boilers up to 165 H.P. Heating Boilers in sizes to 72″ x 16′—most standard sizes carried in stock.

We can supply brick or all-steel settings designed and dimensioned to give best results with whatever fuel you are using.

Boilers in stock for immediate shipment.

2—48″ x 14′ H.R.T. Boilers
3—54″ x 14′ H.R.T. "
7—60″ x 14′ H.R.T. "
5—72″ x 18′ H.R.T. "

Catalogue on Request.

Waterous

BRANTFORD, ONTARIO, CANADA

If any advertisement interests you, tear it out now and place with letters to be answered.

In the Hoyt Metal Co.'s plant a body of picked men, headed by the best metal mixer in Canada, work intelligently, enthusiastically, energetically, bent on turning out the best metals man can make. Under a perfect, smooth-working system entirely devoid of "red tape" they are giving manufacturing Canada the benefit of years of experience in the alloying of metals. They are putting a quality into Hoyt Metals that can be found in no other alloys.

HOYT METAL CO., TORONTO

New York, N.Y. London, Eng. St. Louis, Mo.

Grey Iron Castings

Heavy or Light

Estimates promptly furnished. High grade grey iron castings up to 30,000 lbs. Modern foundry, fully equipped. Address enquiries to nearest office

Engineering & Machine Works of Canada, Limited

Formerly
St. Catharines Works of
The Jenckes Machine Co., Ltd.

Head Office and Works
St. Catharines, Ont.

Sales Offices
710 C.P.R. Building, Toronto
344 St. James Street, Montreal
Hall Machinery Co., Sherbrooke, Que.

Murphy AUTOMATIC Furnace

Murphy Stokers

A few longtime constant users, and there are others!

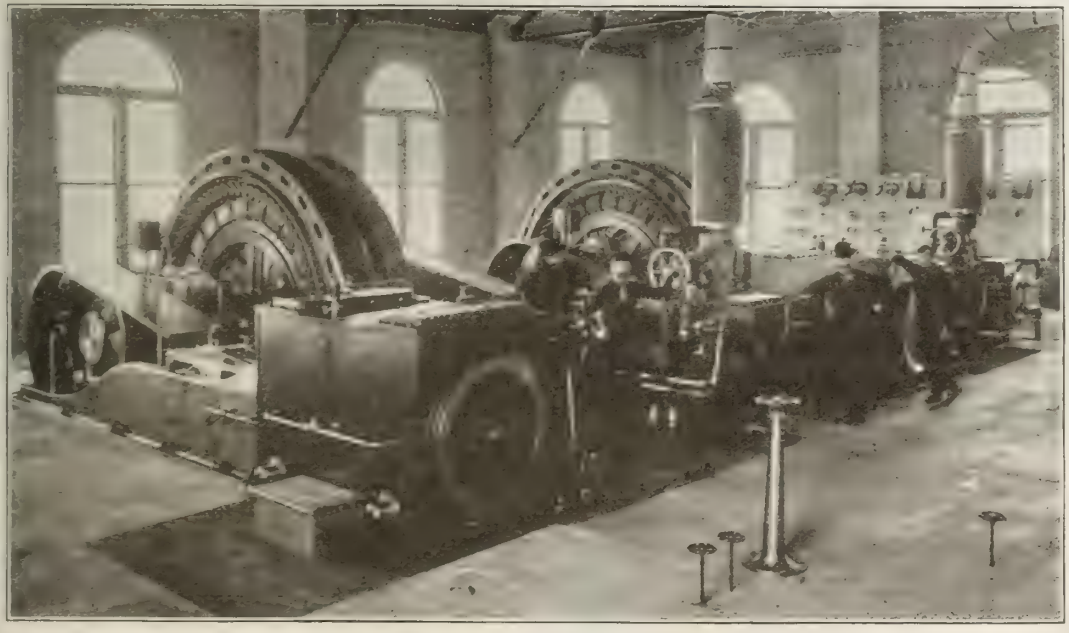
Lockport Paper Co.,	Lockport, N.Y.	33 years constant use
Hartje Paper Co.,	Steubenville, Ohio	24 years constant use
Sherwin Williams Co., 12 contracts 20 Stokers	Montreal, P.Q. Cleveland, Ohio Kensington, Ill.	16 years constant use
Laurentide Co., Ltd.,	Grand Mere, P.Q.	13 years constant use
Ford Motor Co.,	Detroit, Mich.	
" "	Des Moines, Iowa	18 years constant use
" "	New York, N.Y.	
Ohio Traction Co.,	Cincinnati, Ohio	28 years constant use
16 Repeat Orders		74 Murphy Stokers

For printed matter address

MURPHY IRON WORKS,

DETROIT, MICH. BUFFALO, N.Y.

25 Cycle Engine Generator Sets For Sale



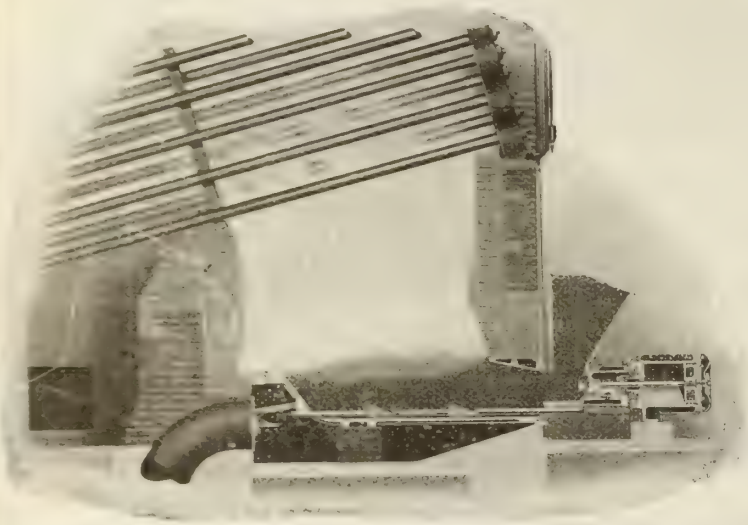
1—250 KW.
1—300 KW.

25 Cycle 3 phase Westinghouse Generators Direct connected to McIntosh & Seymour Cross Compound Gridiron Valve Engines 150 R.P.M.

These units were in use only seven months and are in first class condition. Write for further particulars and quotations.

Power Plant Equipment Co., Dominion Bank Building Toronto, Ont.

JONES UNDERFEED STOKER



keeps down the fuel bills

Burns less coal and cheaper coal.

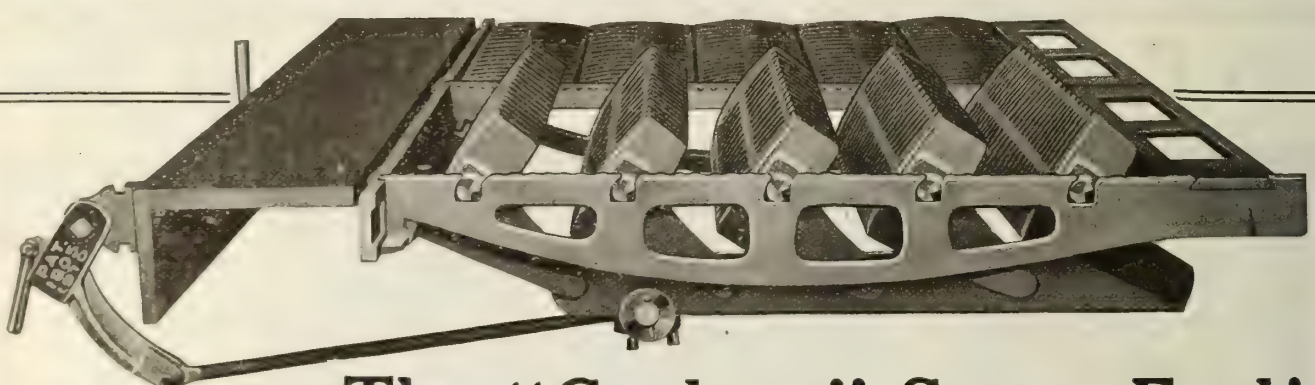
Gives you complete combustion and a smokeless stack —you can get a steady steam pressure regardless of your loads. Hundreds of Jones Stokers are making **fuel savings from 15% to 25%** in plants like your own.

They are the simplest stokers built. No grates to lose fuel through and few working parts, none of which move in contact with fire.

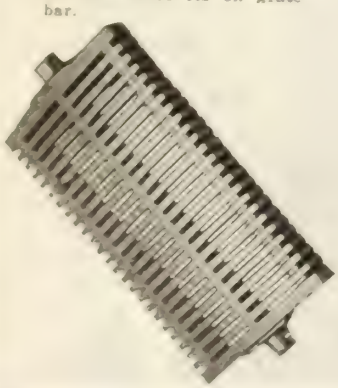
It will pay you to get in touch with us.

Saving money is making money.

Jones Underfeed Stoker Co. Ltd.
37-41 Britain Street, TORONTO



1—Note new jarring, shaking movement whereby ashes are shaken off centre of bar without letting good fuel into ash pit.
2—Note new lock frame.
3—Also new coupling device.
4—And centre rib on grate bar.



The "Cyclone" Saves Fuel!

About the most patriotic move you can make just now is help conserve Canada's coal supply. There may be a crisis next winter! CYCLONE SHAKING AND DUMPING GRATES SAVE FUEL—tons of it in a few weeks. Burns low grade fuel—every bit of it—with maximum results. This is accomplished by 60% air space and 90% underdraught, a feature of CYCLONE construction. No waste.

THIRTY DAYS TRIAL—This is the confidence we have in the Cyclone Grate. Easy to put in, no shut-down necessary. Let us hear from you.

The Canadiau Steam Boiler Equipment Co., Ltd.

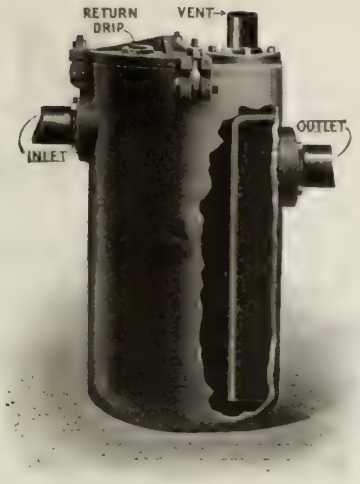
Sole Makers sor Canada

20 McGee Street **Phone G. 2660** **Toronto, Ontario**

Agents:

ST. JOHN, N.B.	F. W. Blizard, 329 Charlotte St.
MONTREAL	Mason Regulator & Engineering Co., Ltd., St. James St.
HAMILTON	Robt. Fitzsimmons, 8 Grove St.
CALGARY	The Western Foundry & Metal Co.
WINNIPEG	Vulcan Iron Works

Webster Oil Separator, Horizontal



Blow Off Tank.

Webster Steam Separator.

A Few of Our Lines in Great Demand

ALL OF OUR PRODUCTS ARE
RECOGNIZED AS STANDARD

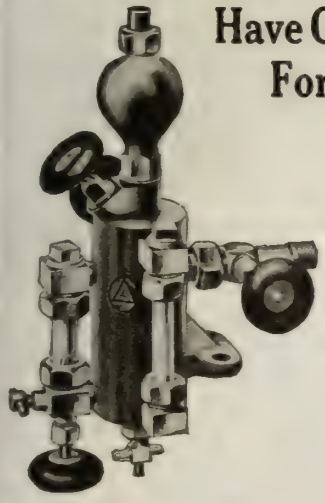
Steam Appliances Elevators Pumps for any Service Webster System of Heating

Darling Brothers Limited

120 Prince St. :-: MONTREAL

Detroit Lubricators

Have Given Satisfaction For Forty Years.



Built in a sufficient variety of styles to lubricate properly every type of steam engine, pump, gas engine, air compressor, etc.

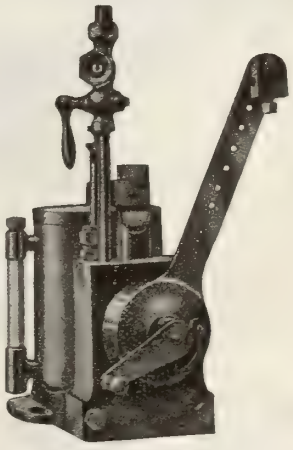
Send to-day for catalog L 1. The information on lubricating devices contained in it will be valuable to you.

THEIR efficiency holds over half the world's trade.

Makers of Stewart Carburetors.

CANADIAN DETROIT LUBRICATOR COMPANY, LTD.
WALKERVILLE, ONT.

The Lubricator that knows its Business



Clutch Drive Pattern

Force feed Lubrication is acknowledged to be the only correct method.

The Rochester Lubricator

Manufactured by
Greene Tweed & Co., New York
Sole Agents for Canada

Darling Brothers, Limited

120 Prince Street, Montreal

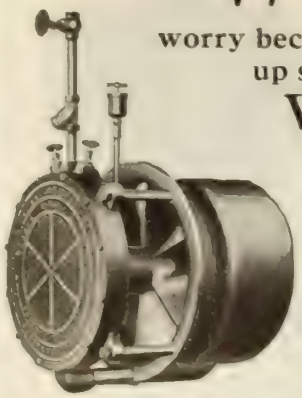
If any advertisement interests you, tear it out now and place with letters to be answered.

WHY

worry because you cannot keep up steam pressure

WHEN

it is so easy and cheap to overcome your difficulties by installing a



COPPUS TURBO BLOWER

It means constant steam pressure, regardless of uneven loads, poor draft and poor coal, and it will pay for itself in a short time on account of better combustion. It also will increase your boiler capacity to 200, and even 300%, of its normal rating without injury to the boiler. Cut out this Ad., put your name and address on the margin and mail to us. Without further trouble you will get all the particulars.

500,000 H.P.

In boilers equipped with Coppus Turbo Blowers in four years. The Coppus has replaced a great many other blowers, but no other blower has ever replaced a Coppus.

Coppus Engineering & Equipment Company
167 Union Street, Worcester, Mass.
Montreal Sales Agents:
Mason Regulator & Engineering Co.
Toronto Sales Agents:
The Power Plant Equipment Co., Toronto

MASON

Reducing Valves

Pump Regulator
Balanced Valves
Damper Regulators

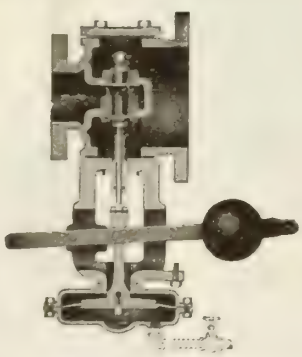
If you order a Mason you will get absolute satisfaction. This we guarantee you. You simply cannot make a mistake.

Dependable regulation under every possible condition.

Our complete catalog tells you WHY. Let us mail you a copy.

Mason Regulator Company
BOSTON, MASS.

TORONTO REPRESENTATIVES:
The Arthur S. Leitch Co.,
506 Kent Bldg., Toronto.



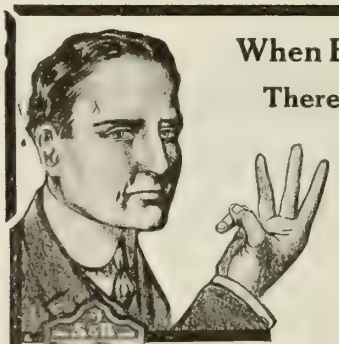
Kieley & Mueller Specialties

Regulating Valves
Back Pressure Valves
Pump Governors
Separators
Traps

FOR EVERY SERVICE

SALES ENGINEERS

THE ARTHUR S. LEITCH CO.
TORONTO



When Buying Thermometers

There's Just Three Things to Remember—

First, you must have accuracy and sensitiveness—

Second, durability is absolutely essential—

Third, the thermometer must be suitably constructed for the intended application.

Accuracy, sensitiveness and durability are absolutely guaranteed in

"Crescent" Thermometers

And with nearly seventy years of experience to our credit, we are qualified to properly interpret your needs.

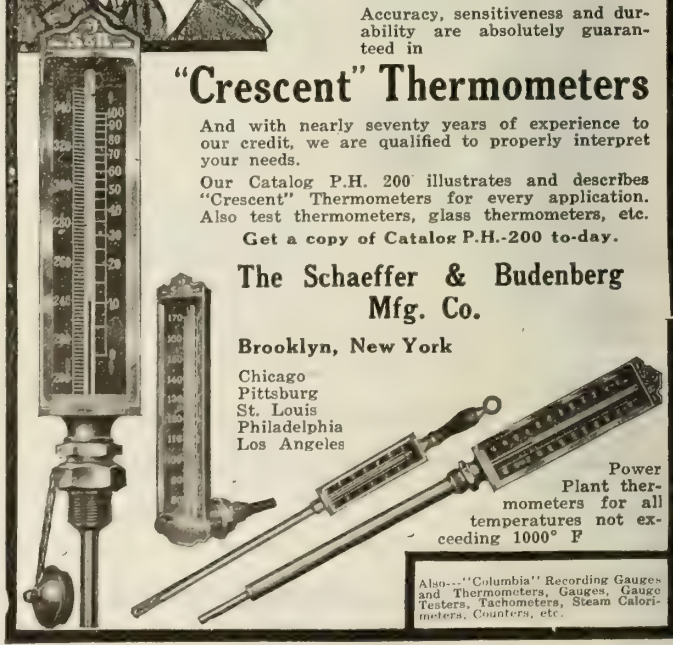
Our Catalog P.H. 200 illustrates and describes "Crescent" Thermometers for every application. Also test thermometers, glass thermometers, etc.

Get a copy of Catalog P.H.-200 to-day.

The Schaeffer & Budenberg Mfg. Co.

Brooklyn, New York

Chicago
Pittsburg
St. Louis
Philadelphia
Los Angeles



Power Plant thermometers for all temperatures not exceeding 1000° F

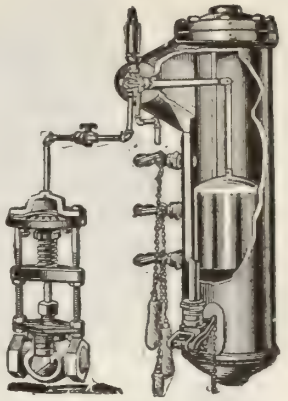
Also—"Columbia" Recording Gauges and Thermometers, Gauges, Gauge Testers, Tachometers, Steam Calorimeters, Counters, etc.

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

MASON'S

QUALITY

MADE-IN-CANADA PRODUCTS



Mason Reducing Valve

In these days of industrial stress and strain you can't afford to equip your power plant with anything but the highest grade equipments. Here is a list of specialties, well known for their quality, which cannot but appeal to engineers and power plant superintendents.

MASON Reducing Valves (Genuine).
MASON Pump-Governors.
MASON Pressure Controllers.
BUNDY Steam Traps for Every Service.
COPPUS Turbine-driven Blowers.
SIMS Hot Water Generators.
SIMS Open Feed Water Heaters.
BUNDY Oil Separators.
ASHTON Gauges and Safety Valves.
FEDERAL Metallic Packing.
EVERLASTING Blow-off Valves.
STRATTON Steam Separators.
REILLY Multicoil Feed Water Heaters.
REILLY Evaporators and Distillers.
REILLY Multiscreen Feed Water Filters.

Every one of these lines is one of the reasons why we make permanent friends of our customers.

SERVICE—Our Salesmen are practical engineers. They know the practical application of our lines to actual conditions and SELL FROM KNOWLEDGE, not from catalog. **This means real service to you.**

BULLETINS UPON REQUEST.

Reilly Multicoil Feed Water Heater

The Mason Regulator & Engineering Co., Limited

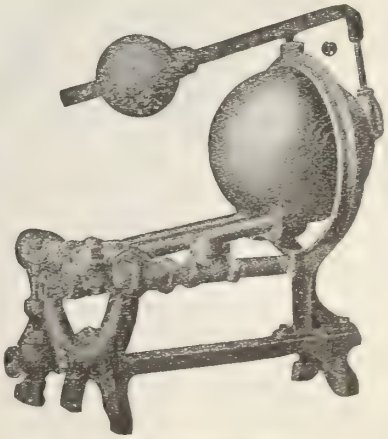
***Successors to* H. L. PEILER & COMPANY**

MONTREAL, Office and Factory, 135 DAGENAIS STREET

TORONTO REPRESENTATIVE, The Arthur S. Leitch Co., 506 Kent Building, TORONTO

The Ashton Improved Lock-up Pop Safety Valve

The Ashton Improved Single Spring Bourdon Steam and Pressure Guages



New Bundy Return Trap

If any advertisement interests you, tear it out now and place with letters to be answered.

This book should be in the hands of every pump user. A postal will bring your copy promptly

MARSH and AMERICAN

Steam and Power Driven Pumps and Air Compressors

Marsh and American Pumps are especially adapted for long, hard service because they are *extra heavy* in design and of *extremely rigid construction.* Every unit is built amply strong to withstand 24-hour-a-day service and to stand up under any unforeseen strain which may be placed upon it. Piston rods on the steam pumps are extra large and made of solid bronze. The water ends are equipped with heavy cast bronze removable bushings.

This superior construction not only insures continuous and satisfactory operation, but practically *eliminates expensive shut-downs.* Marsh and American Pumps are the product of over 25 years' experience in the design and construction of high grade pumping machinery. Over 135,000 in actual service throughout the world.

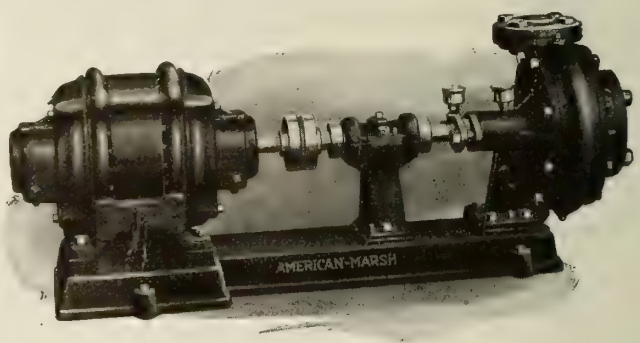
The AMERICAN-MARSH LINE OF CENTRIFUGAL PUMPS is composed of both single and double suction types which are designed for heads up to 125 feet. They are equipped with wide ring oiled bearings and the single suction type has overhanging casing enabling the discharge to be taken at any angle desired.

CANADIAN AGENTS

A. R. Williams Machinery Co., Toronto.
Williams & Wilson, Montreal.
London Engine Supplies Co., London, Ont.
Stuart Machinery Co., Winnipeg.
Mechanics' Supply Co., Quebec, Que.
Gorman, Clancy & Grindley, Limited, Edmonton and Calgary.
Taylor Engineering Co. Ltd., Vancouver, B.C.

American Steam Pump Company

Battle Creek, Mich.



American-Marsh Centrifugal Pump.

BOICO CHASES SCALE

It positively removes boiler scale and prevents further formation.

By its action hundreds of dollars' worth of fuel is saved annually in many plants.

It will not carry over in the steam; it will not cause foaming or priming, and is guaranteed not to injure packing or valves in the slightest. Write for our trial offer.

Anti-Klinker Shell Bar Grates

[illegible] of the total surface is air space—ample [illegible] to command perfect composition, adding as much as 25% more heat to the fuel gases and [illegible] clinker formation.

Anti-Klinker Shell Bar Grates cannot twist or warp. [illegible] evenly cleaned and they ensure more heat from less fuel.

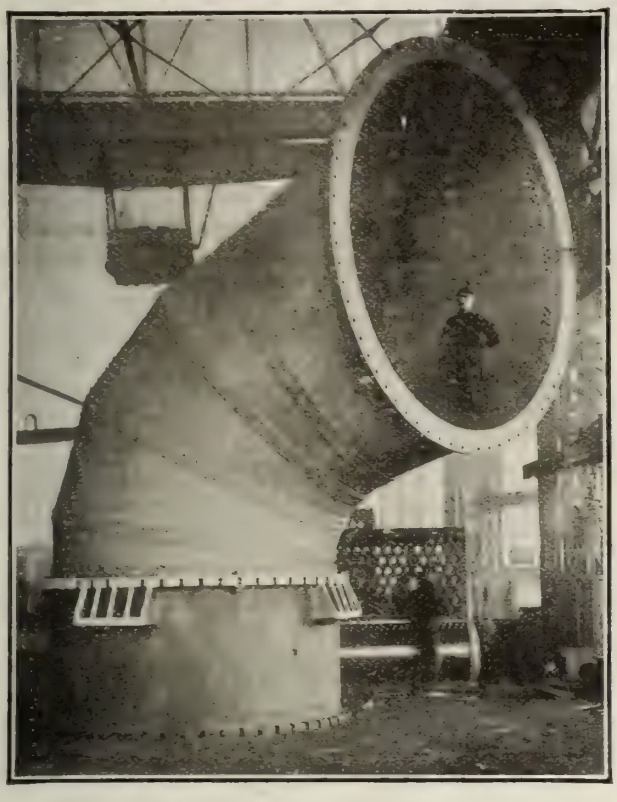
COPPER ASBESTOS BOILER GASKETS

Are made of copper, with pure asbestos cord-filled corrugations. They put a stop to leaks in pipe lines, for they never blow out and never stick.

TIP-IT PATENT WELDING PROCESS.
gives you tools whose shanks are carbon and whose cutting tips are high-speed steel. A money-saver!
Get in touch with us to-day!

SHELL-BAR BOICO SUPPLY, LIMITED, 376 Dufferin Street, TORONTO

Plate and Boiler Work



Steel Plate Penstock Elbow

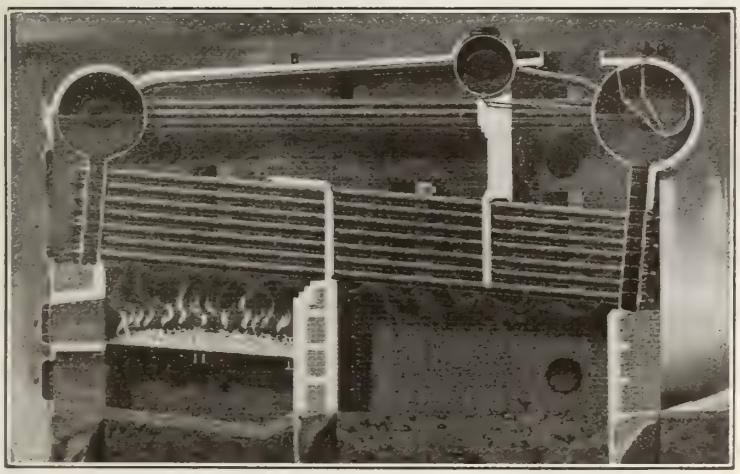
WE have the largest and best equipped plate shop in Canada, and make a specialty of heavy and difficult plate work. A good example of this is shown in accompanying illustration of a large penstock for one of the Niagara Falls power plants, 10 ft. 6 in. in diameter at the bottom and turning to an elipse at the top 12 ft. 10⅝ in. high and 11 ft. 8⅛ in. wide.

The Canada Water Tube Boiler is adapted for power plant service of all descriptions for steam pressures up to 150 lbs. The addition of the superheating drum insures absolutely dry steam under worst conditions, and normally delivers steam superheated from 10 to 30 degrees without external superheater. The circulation is theoretically correct. It is built in sizes from 100 to 500 h.p. per unit.

Return Tubular Boilers are built in all sizes allowed by the different Provincial Inspection laws and are built under Ontario Government Inspection. Either horizontal, vertical or locomotive portable types are furnished.

WE have the exclusive right to manufacture and sell in Canada the Steam Specialties of the Harrison Safety Boiler Works, including their complete lines of Cochrane Open Feed Water Heaters, Independent Meters, Steam and Oil Separators, Multiport Safety Exhaust Outlet Valves and Sorge-Cochrane Hot Process Water Softener.

We have also similar rights for Squires' Steam Traps, Pump Governors and Reducing Valves.



Canada Water Tube Boiler

CANADIAN ALLIS-CHALMERS

LIMITED

Head Office - - TORONTO

Sales Office: Montreal, Halifax, Sydney, Ottawa, Cobalt, South Porcupine, London, Winnipeg, Calgary, Edmonton, Nelson and Vancouver

If any advertisement interests you, tear it out now and place with letters to be answered.

ARE YOUR SUMMER PROFITS NORMAL

Or does the heat rob you of just returns?

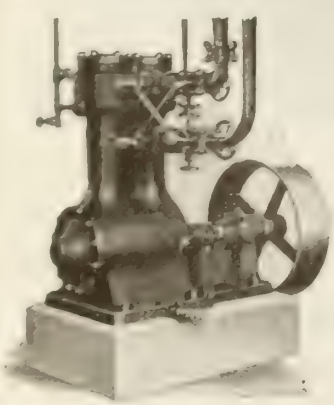
Recent trade developements are forcing manufacturers in all lines to adopt every means to keep their profits normal. You have been investigating, you have studied materials and methods, but--do you GIVE YOUR TEMPERATURES CAREFUL CONSIDERATION

Our Engineers have studied these problems 25 years

THE LINDE CANADIAN REFRIGERATION COMPANY, LIMITED

37 ST. PETER STREET, MONTREAL

Manufacturers of Quality Refrigerating Machinery



Ice-making and Refrigerating Machinery

Built in any capacity that you desire. HORIZONTAL OR VERTICAL

Our SMALL MACHINES have the same "regularity of Operation," "Reliability" and "Efficiency" as our large ones.

AMMONIA FITTINGS, CONDENSERS, BRINE COOLERS, ETC.

Our Machines are in daily operation in Canada

CORLISS and POPPET VALVE ENGINES

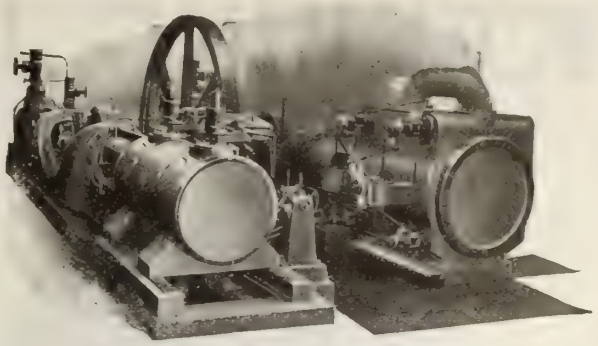
The Vilter Manufacturing Company

242 Beecher St. - - - Milwaukee, Wisconsin

ECONOMY
SIMPLICITY
DURABILITY

The combination that increases the proprietor's profits and makes the engineer happy.

Our designers have been following these guiding points for nearly forty years and they have been found to



REDUCE
—OPERATING EXPENSE
—REPAIR BILLS
—AMMONIA
—ENGINEER'S TROUBLES

Proof of the above is universal. Ask any Frick User.

Write for catalogues and bulletins.

Frick Company
WAYNESBORO, PA. U.S.A.
ICE MACHINERY SUPERIOR SINCE 1882

Canadian Representatives:

FRICK ICE & REFRIGERATING COMPANY, MONTREAL, CANADA

Hooverizing Refrigeration

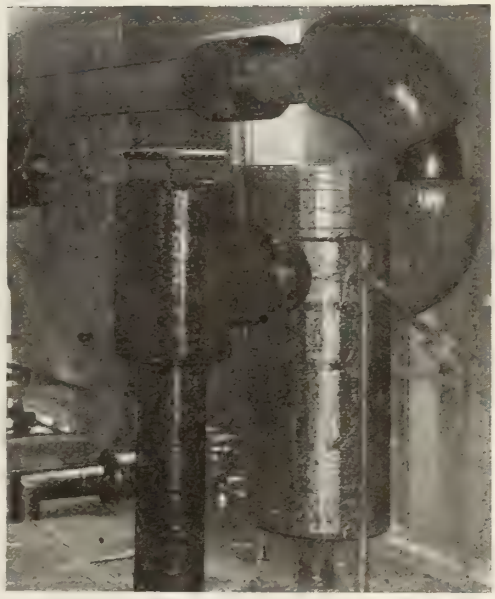
In these days of high operating costs you need no administrator to impress upon you the necessity for stopping all preventable loss in your plant. Your own sound business judgment tells you that that is the logical course. But how can it be accomplished?

One of the leaks which should receive your earliest attention is the loss of refrigeration from bare or improperly covered brine and ammonia lines, coolers, etc. This waste is hard to measure because it cannot be seen or felt; but it exists nevertheless. For instance, do you realize that only 176 feet of 2-inch bare pipe carrying brine at 15° F., with the surrounding air at 75° F., will lose one ton of refrigeration per day? At the low cost of 75 cents per ton, this loss would total $270.00 per year.

By applying Nonpareil Cork Covering of the proper thickness, about 80% of this waste would be eliminated, and approximately $216.00 would be saved the first year —more than enough to pay the cost of the covering. After that, this saving of $216.00 per year would be practically clear profit.

Nonpareil Cork Covering

For All Cold Pipes



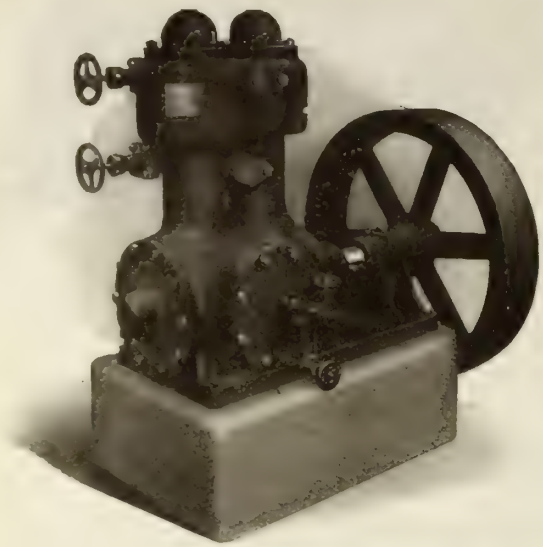
Brine line and tank insulated with Nonpareil Cork Covering. The Artificial Ice & Storage Co., Canton, O.

All the assistance that many years of experience can give is at your disposal, just for the asking. Our 64-page, illustrated book, regarding Nonpareil Cork Covering, would be of especial interest to you, we believe.

Armstrong Cork & Insulation Co., Ltd.
504 McGill Bldg., Montreal, Quebec, Canada
11 Church Street, Toronto, Ontario, Canada

Also manufacturers of Nonpareil Corkboard Insulation for cold storage rooms, Nonpareil High Pressure Covering for steam lines; Nonpareil Insulating Brick for boiler settings, and Circle A Cork Brick for cold storage room floors.

KEEPING UP QUALITY



Circumstances over which we had no control made it necessary to increase our prices, but our 20-year-old policy will not permit us to lower our standard of quality, or in any way abuse the confidence which our many customers have in YORK PRODUCTS.

During the past 20 years we have constantly sought ways and means to improve the quality of our Ice-Making and Refrigerating Machinery. This policy has been pursued up to the present time, and will be continued in the future. This is our guarantee to the trade.

Safeguard your interests by adopting YORK QUALITY.

YORK MANUFACTURING COMPANY

(Ice-Making and Refrigerating Machinery Exclusively)

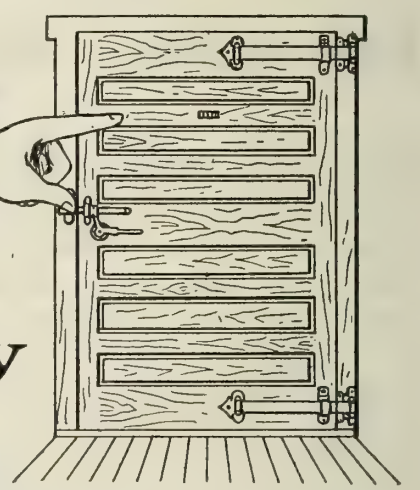
YORK, PA.

For information and prices write to the

CANADIAN ICE MACHINE COMPANY

WINNIPEG, 85 Lombard St. TORONTO, 82 Chestnut St. MONTREAL, 626 Coristine Bldg.

These Doors SERVE Because They SAVE



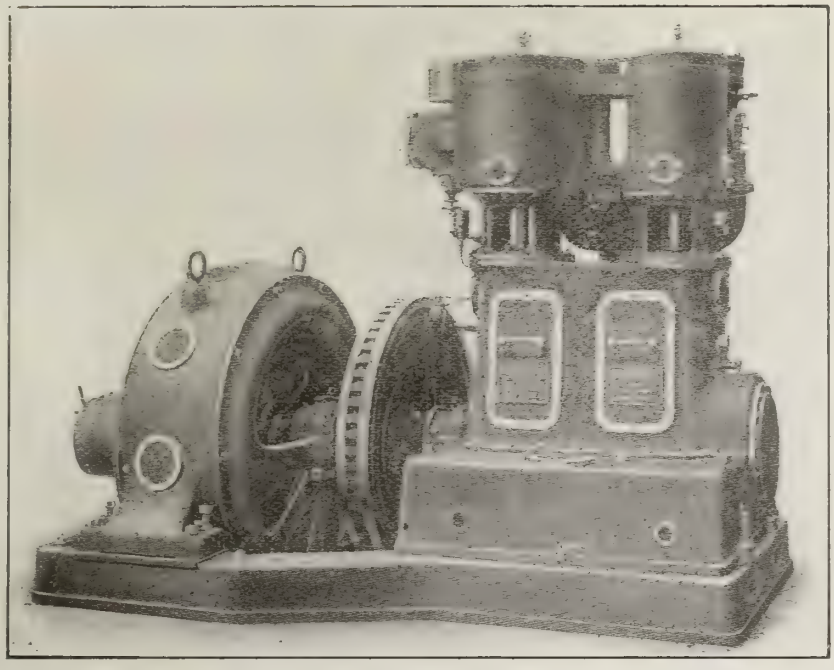
That these DOORS do SERVE and SAVE is evidenced by the fact that OVER 50% of our business is REPEAT ORDERS. No, not for replacements, but FOR ADDITIONS! JAMISON DOORS promote EFFICIENCY and ECONOMY to the extent larger facilities and new plants are necessary. Our motto is: "Build for your customers' success—your own must follow." We long ago substantiated our claims and established our present enviable prestige through competitive tests, and now, are advocates of the most thorough investigation into relative merit of various makes prior to ordering. There is a reason: our latest catalog explains it.

Jamison Cold Storage Door Company

Formerly Jones Cold Storage Door Co. P.O. Box 93 HAGERSTOWN, Md., U.S.A.

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

BELLISS & MORCOM, LTD.
Engines and Air Compressors



Belliss & Morcom Motor-Driven Air Compressor.

Belliss Steam Engines, Steam Turbines, Diesel Engines,
Air Compressors, Condensing Plants

Heenan Refuse Destructors, Air Coolers, Water Coolers,
Oil Coolers, Dynamometers

Paterson Water Softening Plants and Filters

Centrifugal Pumps

We can make good delivery for War Service.

LAURIE & LAMB

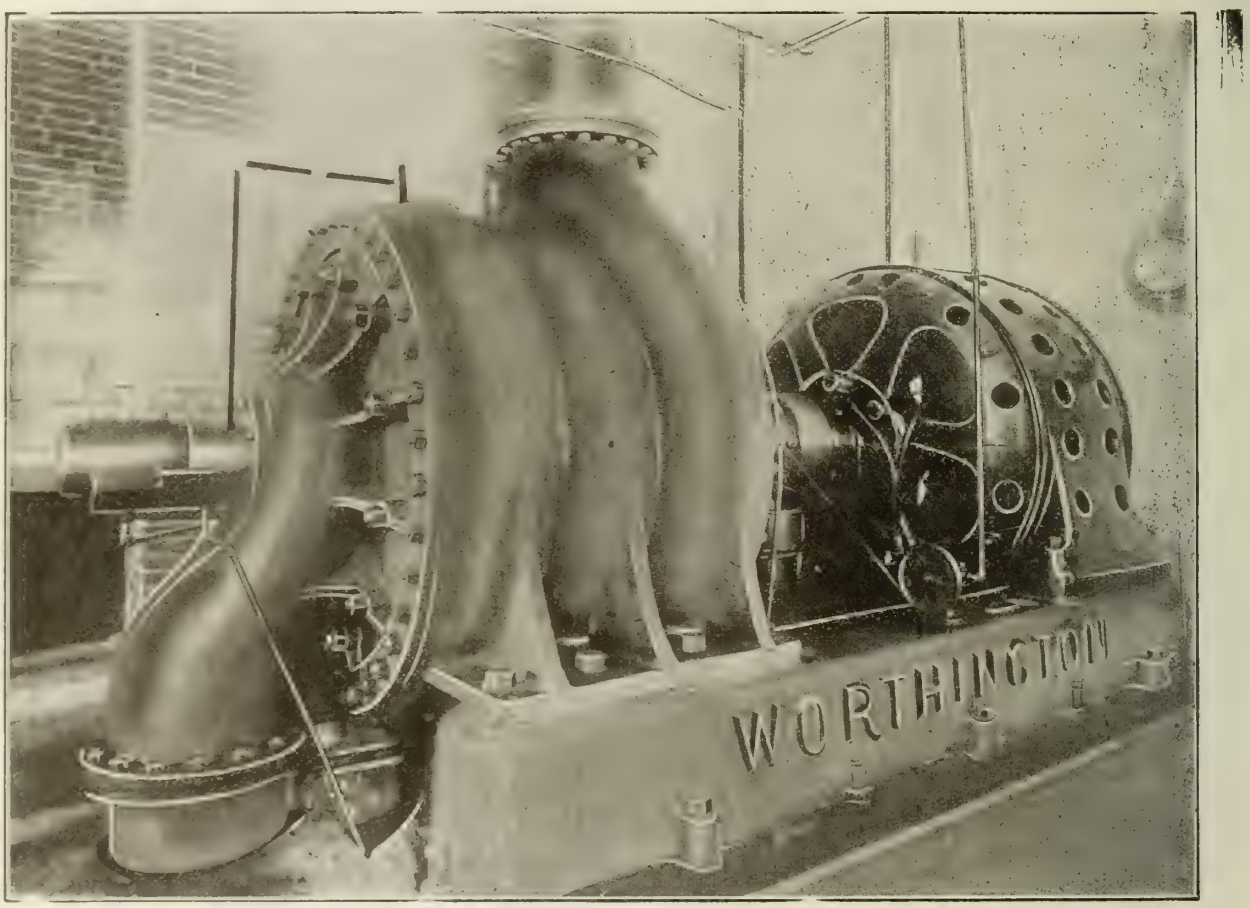
Engineers

211 Board of Trade Bldg. :-: :-: **MONTREAL**

THE JOHN McDOUGALL CALEDONIAN IRON WORKS CO., Limited

Manufacturers of Boilers, Castings, Condensers, Elevators, Engines, Filters, Forgings, Hydraulic Machinery, Pumps — centrifugal and reciprocating, Steam Turbines, Tanks, Water Wheels, Water Works Plants

Works : Seigneurs and William Streets, MONTREAL



5,000,000 gallons daily—Montreal Water Works—Driven by 400 H.P. Induction Motor.

Our Engineers have spent many years developing Centrifugal Pumps and we are now able to offer you perfected designs in any size pump from inch and a half and up for any service you may desire, and to be driven either with motor, engine or belt.

Write us for Engineering information, or prices, any time.

Sole Canadian Agents for H. R. Worthington Co.

Keeping in Stock at Montreal a large assortment of their Boiler, Feed and General Service Pumps

The Publisher's Page

TORONTO MAY, 1918

THERE is a special treat in store for our readers next month. Our June issue this year will be our Annual C.A.S.E. Pre-Convention and Annual Equipment and Supply Directory Number. It will be doubly interesting and doubly valuable since the editorial pages and the advertising sections will vie with each other in quantity and quality of instructive information.

Our editors have arranged a special programme, including several articles on leading power plants in the city of London (Ont.), where the 1918 Convention is to be held. There will, of course, be C.A.S.E. features and the regular departments will be even brighter and more instructive than usual.

Manufacturers of power equipment and supplies recognize the importance of our annual number and many arranged for extra space in which to present for the consideration of the engineers a description of their lines which will not only do them justice but which will enable engineers to become thoroughly familiar with them and their respective merits.

Engineers are more and more learning to appreciate the advantages of intelligent instructive advertising—this is as it should be. An engineer's work deals very largely with engineering equipment and the necessary supplies to keep it running.

Advertising deals with the same thing exactly. Moreover, the advertising appearing in POWER HOUSE is placed there by firms manufacturing good products and marketing them through a good medium by appealing to good engineers. These firms recognize the buying influence of even obscure engineers, and the compliment will not be lost upon the thoughtful observing members of the profession.

Last month we published a letter by John Hale, ex-secretary of the C.A.S.E., two paragraphs of which we would like to reproduce herewith:—

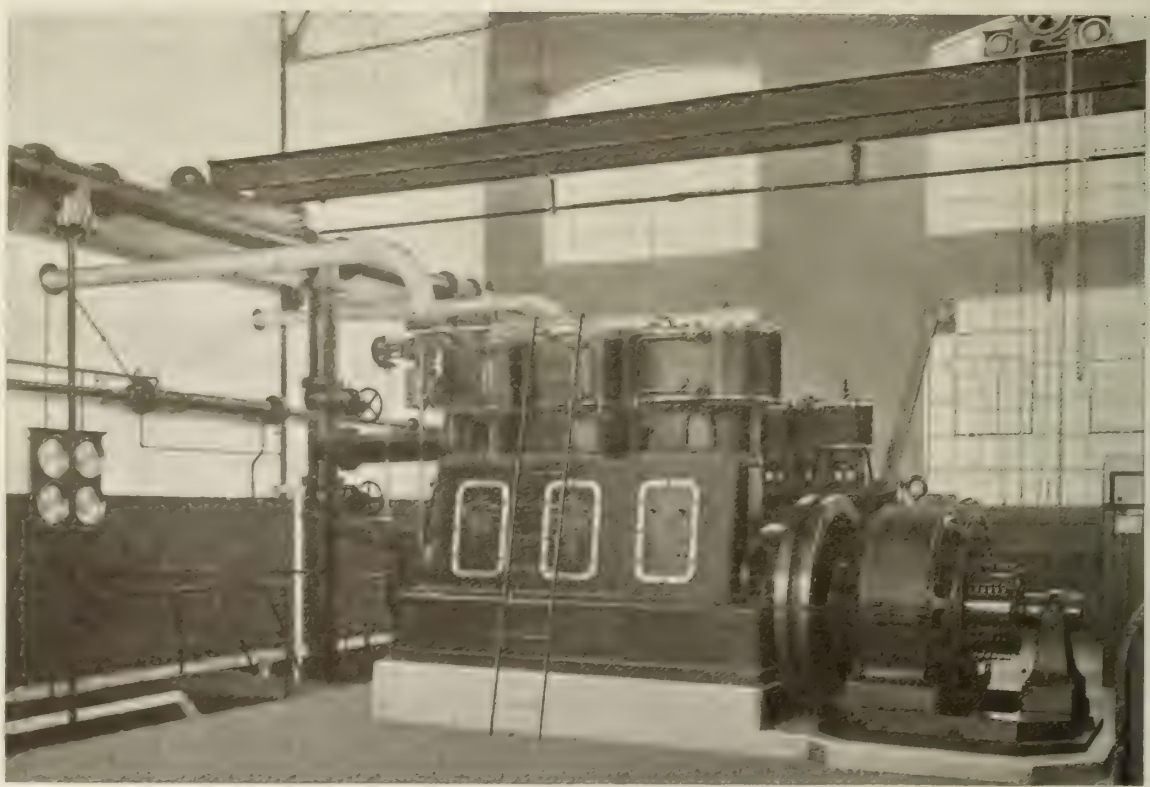
> Speaking for other engineers with whom I have talked, as well as for myself, I can say that POWER HOUSE Buyers' Directory is invariably consulted when supplies are needed. If the average engineer does not mention POWER HOUSE when writing to advertisers it is probably because they do not think it necessary or they may forget to do so. Of one thing I can assure you and that is our members certainly prefer goods advertised in POWER HOUSE to any others.
>
> I would like to mention the exchange of views among the engineers through the medium of POWER HOUSE. If Canadian engineers would use the pages of POWER HOUSE to exchange their ideas more one among the other, they would be not only benefiting themselves but would be helping those less fortunate. We have in Canada engineers who will compare with any engineers in the world and I feel that there should be a greater exchange of ideas and I am taking this up with our members at once.

We urge you to study the advertising pages, not merely to read them. Use them as you would a text-book because that's what they are—a text-book of modern power plant equipment. Not complete, perhaps, but extremely valuable and becoming increasingly so. If manufacturers do not give you the kind of information you would like and need tell us. Or better still, tell the advertisers. They'll appreciate it, and thank you for your suggestions.

And finally, help other engineers, help us and help yourself by contributing your ideas to POWER HOUSE. Every engineer has a pet scheme or idea which should be passed on. Pass it on, friend, and multiply its usefulness, yours and ours.

POWER EQUIPMENT

Built to Meet Your Own Requirements



A corner in the Engine Room of our New Power Plant recently erected at our Main South Works. Equipped with G. & McC. Co. Three-Cylinder Compound and Two-Cylinder Compound Vertical Forced Lubrication Steam Engines.

G. & McC. CO. ENGINES and BOILERS

will provide your plant with

A Continuous and Economical Service

WE BUILD

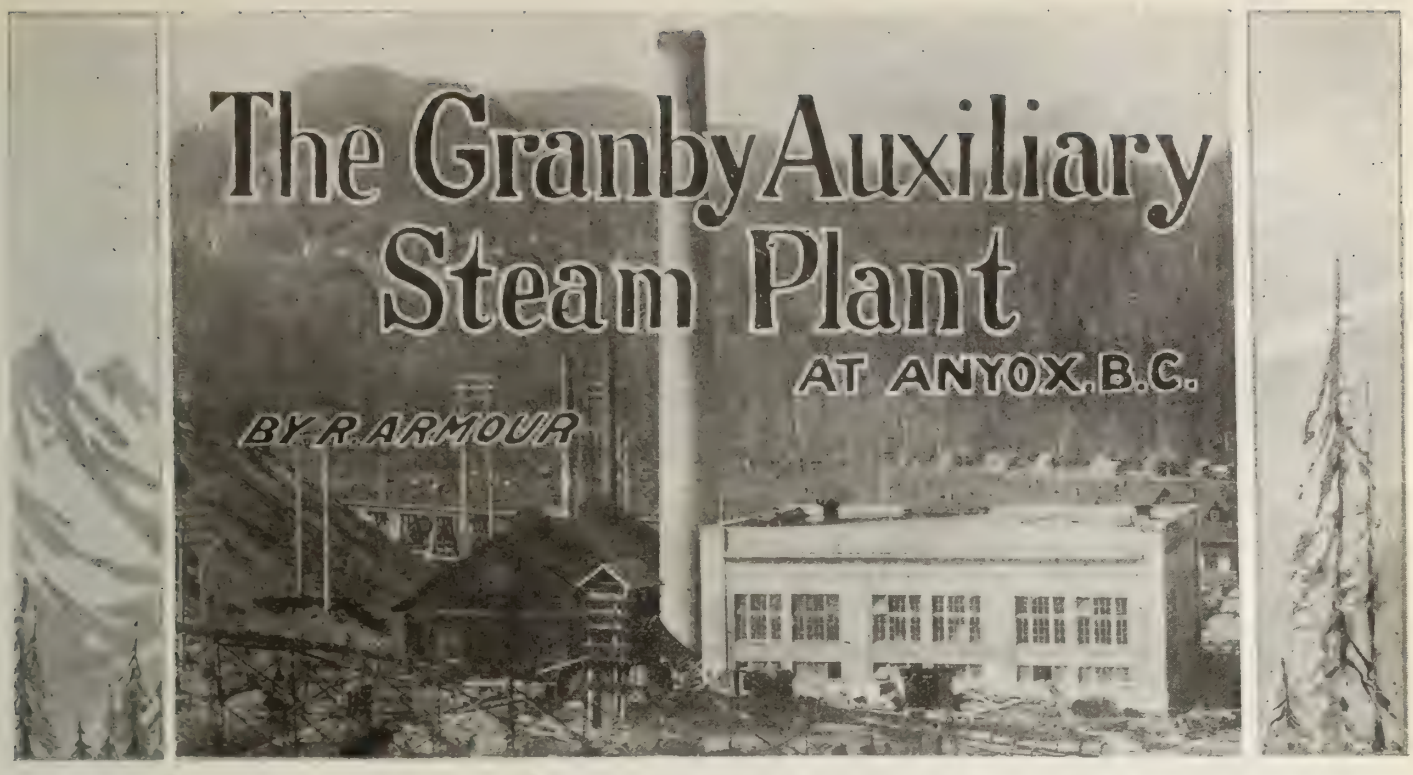
Horizontal and Vertical Steam Engines; Steam Turbines; Return Tubular and Water Tube Boilers; Heaters, Tanks; Pumps and Condensers; Transmission Machinery; Safes, Vaults and Vault Doors.

The advice of our Engineering Experts, our Catalogues, Specifications, Photographs, etc., will be cheerfully supplied to interested parties.

The GOLDIE & McCULLOCH CO., Limited

Head Office and Works: GALT, Ontario, Canada

TORONTO OFFICE:	WESTERN BRANCH:	QUEBEC AGENTS:	BRITISH COLUMBIA AGENTS:
Suite 1101-2,	248 McDermott Ave.,	Ross & Greig, 412 St. James St.	Robt. Hamilton & Co.,
Traders Bank Bldg.	Winnipeg, Man.	Montreal, Que.	Vancouver, B.C.



PART I.

The many uses for power in the various metallurgical operations connected with the refining of metals necessitate more than usual provision for adequate and unfailing supply. The following article deals with the steam plant auxiliary of one of the largest smelters in British Columbia.

THE power plant of the Granby Consolidated Mining, Smelting & Power Company, Ltd., at Anyox, B.C., where their copper mines and smelter are located, consists of a hydro-electric power plant, known as No. 1 power house, which furnishes power for the various operations of the company. During a period of about five months in the winter, however, the water supply is not sufficient, and a 6,000 horse-power auxiliary steam plant has been installed. It is this auxiliary steam plant which is dealt with in this article.

The distributing switchboards are in No. 1 power house, the power generated being used for general lighting, several large electric cranes at smelter, electric locomotives taking ore to the furnaces and waste from the mine, for supplying compressed air for converters, furnaces for drilling operations at the mine, motors running machinery at the machine shop, crushers at the mine, and coke hoists at the wharf. As there is also between 6 and 7 miles of track, with several 42-ton locomotives, this will give a general idea of how the power is expended.

Anyox, which is at seaboard situated on Granby Bay, is in Northern British Columbia, being approximately 1,000 miles north of Vancouver, and 100 miles from Prince Rupert, the latter town being the largest of any importance in northern British Columbia.

The auxiliary steam power plant is rated at 6,000 h.p., and while the No. 1 power house or hydro-electric plant is the larger, the writer believes that a description of this auxiliary plant may be of greater interest to the steam engineer. The way in which the plant is arranged, and instruments installed, along with numerous observations made by the writer on the performance of the plant may be of value for comparison with other plants somewhat similar.

Building

The main building is constructed of reinforced concrete with a dividing wall between boiler and engine rooms. The approximate size is 84 ft. 7½ ins. wide, by 175 ft. in length and about 50 ft. high, the dividing wall running through the centre of the building lengthwise. The floor is finished in slabs of concrete 2 ft. square, finished with iron cement surface, which is essential where heavy machinery is being installed.

The main floor of engine room is raised about 15 ft. above the level of boiler room, the engine room basement being on a level with the boiler room floor.

Addition to No. 2 Power House

The machinery in the addition was formerly in No. 3 power house, was housed in a frame building adjoining No. 2 power house, but this building was pulled down and an extension added to No. 2 power house, this extension being the same height and witdth as No. 2 power house, and about 78 ft. long, with ing into boiler and engine rooms—boiler room being 26 ft. 7 in., and engine room 40 ft. 6 in., the length of these being the same as No. 2 power house, 84 ft. 7½ ins. Along the sides of the main building of the annex are concrete piers running from floor to roof at 14 ft. 1¼ in. centres, these piers being 12 ins. broad and projecting from the wall about 14 ins. The lighting throughout is so arranged that splendid results are obtained by means of powerful nitrogen lamps with inverted shades and reflectors.

Boiler Room

There are five Babcock & Wilcox water-tube boilers, rated by the makers at 550 boiler horse power, or a total of 2,750, and having an approximate heating surface of 5,550 square feet each.

These boilers have double drums, 48 in. dia. by 23 ft. 6 in. long, and are fitted with superheaters, each boiler having 252 4 in. tubes 18 ft. long. The boilers are fitted with Crane 7 in, non-return balanced stop valves, which will not open until the pressure on the outlet side and in the boiler are balanced.

In a battery of boilers, if the attendant stops firing on one boiler that boiler will cut itself off the line as soon as the pressure drops on account of the pressume on top of valve from other boilers being greater than the pressure in the boiler with the fires off, and

STAFF AND EMPLOYEES OF MECHANICAL DEPARTMENT, GRANBY CONSOLIDATED MINING, SMEITING AND POWER CO., ANYOX, B.C.

while this lessens the danger when opening large stop valves under high pressure, the makers furnish a caution plate which should be fitted on every main stop valve. This plate reads, "Drain superheater before opening this valve."

The superheater pipes are flooded from a pipe connection to the water space on the side of the drum and before starting to fire a boiler the superheater should be flooded by opening flooding cock on this pipe. When steam is up another cock coming from superheater drain should be opened to drain superheater, first closing the flooding cock. It takes at least 20 minutes to drain the superheater which is shown by small square glass fitted on superheater drain, so that one can see whether steam or water is passing. The drain cock should now be closed, and when the pressure on the boiler which is being cut in is nearly the same as the others already on the header, the main stop valve can be opened slowly.

The B. and W. boilers are well known, but for those who have not had experience with this type of boiler with superheater, a description of the method of draining superheater is well in order, as those who have had this experience will know.

Safety Valves

Each drum is fitted with two 3 in. McAvity safety valves, and as there are two drums to each boiler this makes four 3 in. safety valves for each. In order to comply with the Boiler Inspection Act of this province the boilers carry 175 lbs., but are allowed 217 lbs. per square inch. Safety valves in this province are not locked with key and padlock by the inspector. The control of safety valves is left to the engineer, but if he carries more pressure than allowed by the boiler inspector's certificate for boiler he is quite liable to have his engineer's certificate cancelled.

There are several features necessary for safety valves to comply with boiler rules here. The seat must be locked in some way, usually a ¼ in. or ⅜ in. set-screw, screwed from outside casing into thread of seat which keeps lower portion of seat from getting out of place. The valve lift is ⅛ in. to each inch of valve diameter, so that for a 3 in. safety valve the lift would be ⅜ in.

GENERAL VIEW OF BOILER ROOM—5 B. AND W. BOILERS OF 500 H.P. EACH.

Steam Header

The steam header is 12 in. diameter and 55 ft. long. Boilers are connected to header by 7 in. pipes forming S bends. Directly behind No. 1 boiler, near the end of header, is a 6 in. valve for pipe running to feed pumps, oil pumps, etc. Next in order are an 8 in. stop valve for No. 1 turbine main unit; 7 in. stop valve for No. 1 boiler; 7 in. stop valve for No. 2 boiler; 4 in. stop valve for exciter unit; 4 in. valve for No. 1 unit auxiliaries; 7 in. stop valve for No. 3 boiler; 6 in. valve for No. 2 turbine main unit; 7 in. valve for No. 4 boiler; 7 in. valve for future unit; 3 in. valve for No. 2 turbine auxiliaries; 7 in. valve for No. 5 boiler; 4 in. valve for No. 3 compressor unit. As before mentioned each boiler has a 7 in. balanced stop valve directly on top of boilers, which makes one valve on boiler and a stop valve on header for each boiler. There are two 2 in. blow-off pipes from mud drums of boiler, with a 2 in. asbestos packed cock on each pipe and a quick-opening 2½ in. valve or disc valve on each boiler. The superheater 1¼ in. drain pipe on each boiler is also connected into blow down pipe.

Boiler Feed Pump

There are two boiler feed pumps which consist of DeLaval steam turbines direct connected to DeLaval 3-stage centrifugal pumps running 3,300 revs. per min.

BLAKE AND KNOWLES OPEN FEED WATER HEATER OF 3,000 H.P. RATING.

Steam pressure into turbine is 175 lbs. per sq. in. and exhaust is at atmospheric pressure. Capacity of each pump is 180 gallons per minute ,and water pressure carried is about 250 lbs. per sq. in.

One very noticeable feature of this installation is the small amount of space occupied. The base of each pump is only 42 in. long by 24 in. wide, sitting on a concrete foundation 12 in. high. The total height of installation from floor, including base, is about 36 in. There is a 3 in. steam pipe to each pump and a 6 in. exhaust, which exhausts into the feed water heaters.

The suction to pumps from heater is a 6 in. header branching into a 3 in. pipe to each pump. Discharge is 2½ in. from each pump branching into a 4 in. pipe, this 4 in. pipe running to and along the top of boilers with a 2 in. pipe branching off to each boiler. Each branch has a 2 in. gate valve near water header, then there is the regulating valve with a long rod attached to valve spindle which the fireman can reach from the boiler-room floor below for regulating the feed water into the boiler.

Near the steam drum on the feed line there is a 2 in. combination stop and check valve, stop being next to boiler. There is a water gauge glass on each drum and chains reaching the floor which are attached to extension rods and levers so that in the event of a glass breaking the water and steam can be shut off from the floor. A fusible safety plug is on the side of the drum about one-third the distance from the bottom of drum.

Pump Governors

The feed pumps are fitted with two governors—the running governor, in which the steam pressure is on one side of a piston and the water pressure from discharge of pump on the other side, and by means of a spring and regulating nut the pump can be set to keep any desired water pressure within the limit of the pump. The other or emergency governor consists of a spring and small weight fitted into the shaft of the turbine, and if pump exceeds its speed the weight flies out and trips a lever which in turn allows a steam valve held by a small spring to drop down and close off the steam to the pump. To start the pump again the throttle valve must be first closed, then drain the steam out of line by means of ¼ in. valve near pump, then push up the valve which has the small spring under it and set lever up to keep valve from falling down, then start pump slowly by opening main throttle valve.

One of these pumps supplies water for the entire battery of boilers and is kept running continuously when plant is operating, the fireman opening and closing regulating valves on boilers according to demands for water, but never having any occasion to touch feed pump except to see that bearings have oil, as the pump will maintain whatever water pressure the governor is set for.

Fuel Oil Pumps

There are two Worthington duplex pumps, 6 in. x 4 in. x 6 in., used for supplying fuel oil to the oil burners. The pumps are fitted with Aston governors consisting of species of T-pieces in the steam pipe. The steam pressure comes on the side of a valve in the pipe, which has a spindle projecting through one opening of the T through a packing gland and nut. This spindle extends right to a diaphragm which receives the pressure of oil from discharge side of pump. On the spindle near diaphragm there is a spring and compression nut, so that by increasing or decreasing the compression on the spring by screwing the compression nut in or out, the pressure of the fuel oil is kept constant, and when the governor is working properly the variation of pressure does not exceed two pounds.

Another point which may be worth mentioning about the oil pumps is that most of them have some form of metal packing for the plungers on the oil end. In this case there are white metal rings about ½ in. thick. The writer once had a boiler feed pump handling the returns from a paper machine, and tried several kinds of packing, all of which lasted hardly twenty-four hours. Finally the plungers were taken out and the space for packing was filled with babbit. The plungers were then turned up in the lathe to fit the barrel and this pump was still working well a year afterward at least, to the knowledge of the writer.

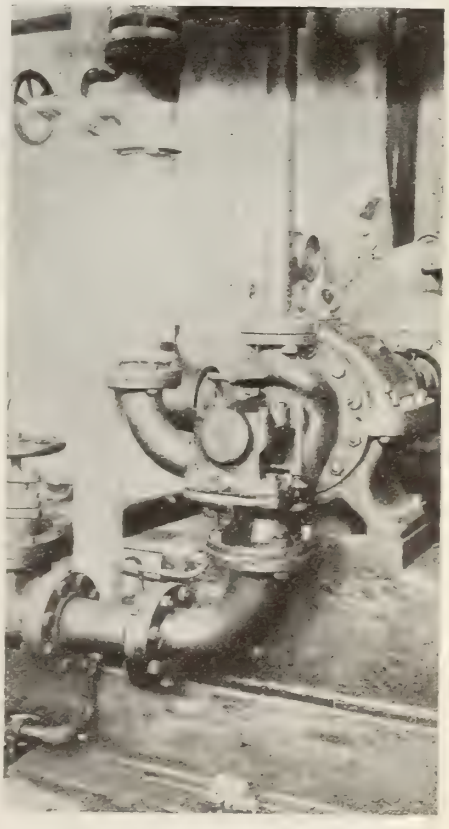
The steam pipe to each pump is 1 in. diameter, the pressure being lowered by a Crane reducing valve from 175 lbs. to 125 lbs. The exhaust pipe is 1¼ in. and exhausts through an oil heater under pumps and out to atmosphere. The suction pipe to pumps is 3 ins. and discharge 2½ ins. The oil tank directly outside power house has a capacity of about 200 barrels, while the main fuel oil tank has a capacity of 34,375 barrels. Diameter of tank is 19 ft. 3 in. by 29 ft. 8½ ins. high.

Fuel Oil Burners

The oil burners used in the furnaces are the Peabody back shot type, that is, the tip of burner is led to back of furnace and flame shoots forward to front of boilers. The furnace is a Peabody furnace, this arrangement of furnaces and burners being furnished by Babcock and Wilcox Company. There are three burners to each furnace; fifteen in the entire battery. Oil pressure to burners averages about 80 lbs. per sq. in., and oil temperature runs about 190 degs. Fahr. to 200 degrees Fahr.

The type of burner is known as the external mixing type. A ¼ in. pipe carries the oil to the tip of the burner and is inside another pipe which is 1 in. dia., this larger pipe carrying steam to the burner tip and at the same time heating the oil. There are two slots in the burner tip, the oil coming out of the top one and the steam coming out of the lower slot. The steam comes out and spreads in the form of a spray and the oil coming out of slot drops on to the steam spray and in this way the oil is broken up or atomized. Fire can be started easily by a piece of lighted waste.

It takes considerable study to burn fuel oil properly so as to get good re-



HOTWELL AND AIR PUMPS OF NO. 1 UNIT; NOTE 2-INCH EQUALIZING PIPE ENTERING TOP OF PUMP.

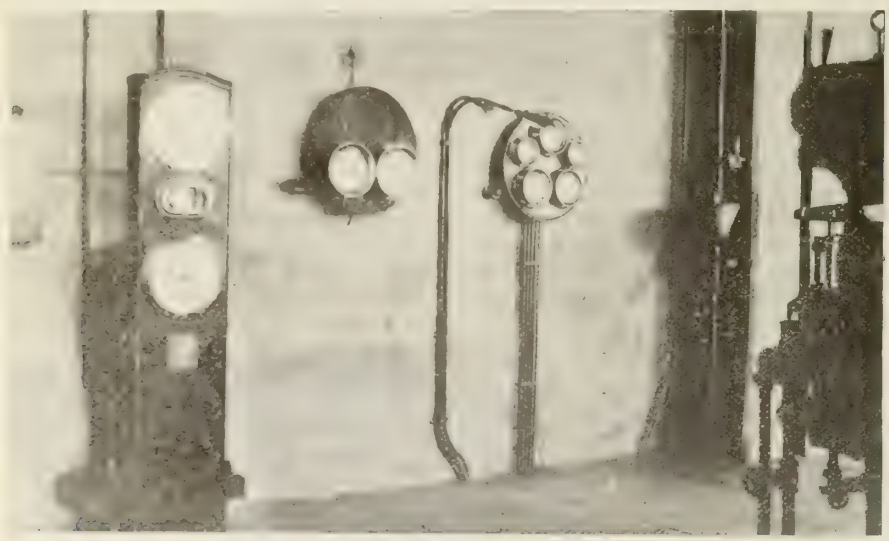
sults, but there are several simple precautions that everyone who attempts to burn oil in a furnace should know or they are likely to do damage or get badly burned. First thing, be sure and open your dampers before starting fire, then turn on steam or air or whatever the atomizing agent may be, blowing through the burner in order to get clear of the water of condensation either in the compressed air or the steam.

Automatic Fuel Oil Control and Damper Regulator

This system of fuel oil and damper regulation is known as the Merit system and was supplied to the plant by the Associated Engineering and Supply Co., San Francisco. It consists of two controllers known as master controllers, with a regulator on each fire and damper, and is much the same in principle as the governor just described on the fuel oil pumps. The fire is operated in three stages: the pilot, or very small fire which is regulated by hand and takes care of the minimum load; then a medium fire, which takes care of the average load of the plant; and the maximum fire which takes care of the largest load the plant will carry. The fires are set by raising steam to highest point. In the plant in question carrying 175 lbs., first raise steam above 175 lbs., then set small fires by hand. When steam drops to 174 lbs. set medium fire, and when steam drops to 173 lbs. set large fire.

The master controllers have the steam pressure acting on top of a diaphragm and oil acting on oil valve at bottom of controller. There is a spring and a compression nut so that the controllers can be set to cut in at whatever pressure is desired, and when steam gets too high controller is put out of action and shuts off control oil to regulators. As soon as steam pressure drops about one pound medium fire will cut in, also medium position of dampers, both front and back dampers, which are operated by regulator and big rods and a weight on a stack damper; then if steam drops about another pound or to 173 lbs. large fire will cut in and dampers will open to suit maximum fire, and when steam rises large fire will cut out, and if it rises further medium fire will cut out, and as the pilot fire is just large enough to keep fires alight the steam will begin to drop; then the medium and later high fires will cut in, and in this way a steady steam pressure is maintained, and even though in this plant the load varies from 200 to 1,600 horse power every few minutes, the regulators maintain a steady steam pressure, with less than five pounds of a variation for the entire day of twenty-four hours.

Before leaving the subject of oil burning, I quote a writer on oil burning named Booth, who says "where you have a properly constructed furnace better results can be obtained firing the oil into furnace with a shovel than can be had with a poorly constructed furnace and the highest type of oil-burning apparatus." The foregoing is a strong statement, but I have found this correct, for where your furnace is poorly laid out good results can not be obtained. The air spacing is most important, that is, allowing air to come up through the space left between the brick on top of grates at the proper place with regard to the flame. Very often an oil-burning fire can be set to burn, but if that boiler had to be set to give proper results, checking same up with a CO_2 recorder, you might find that you were burning double the amount of fuel you ought to burn to give the results you were producing. However, the writer will touch on C. O. recorders in a later portion of the article. The temperature and pressure of the fuel oil are also important, and in numerous tests made by the writer from 190 degs. Fahr. to 200 degs. Fahr. gave the best results.



SHOWING VENTURI WATER METER, STEAM AND PYROMETER GAUGES AND GAUGE BOARD FOR NO. 1 TURBO-GENERATOR UNIT.

Burning Fuel Oil

The following poem relating to oil fuel regulation has reference to British destroyer service, and the writer observed it in the "Victoria Daily Times," October, 1916. It is reprinted here because of its aptness, the rhyme and rhythm making it easy to remember:

"Set the burners open wide,
Do not touch the valves at side.
Keep the pressure on the pump
And up the bally steam will jump.

"If the smoke is black and thick,
Open up the fires a bit.
If the smoke is thick and white,
To slow the fans will be quite right,
For when sufficient air is given
No smoke ascendeth up to Heaven.

"If the jets refuse to squirt,
Assume the cause is due to dirt.
If the flame be short and white,
You have combustion clear and bright,
But should the flame be yellow and long,
Combustion is entirely wrong.

"A wise man to his heater sees
And keeps it at 200 degrees;
To have it more is not quite wise
Because the oil may carbonize.
A little lower has been found
To give as good results all round.

"If the filters are kept clean
No rise of pressure will be seen,
But, should the pump kick up a ruction,
There's likely air within the suction.
The pressure governs the supply
So do not keep it very high.

"If these instructions you will follow
You'll beat the other fellow hollow."

(To be continued.)

GAS FROM STRAW

THREE Prairie Provinces in Canada produce every year 20,000,000 tons of straw. This straw is at present regarded as having no commercial value and is burned. A retort has recently been invented in which the straw is carbonized and thus decomposed into combustible gases, tar, and ammonia. A number of experimental plants have been made, and it is hoped to get them installed on a certain number of farms during the present winter. The gas thus obtained will be utilized by the farmer for purposes of lighting, heating and power, thus producing useful fuels from hitherto waste material.

The retort is made out of highly refined steel and is designed in such a shape that the gases are removable in a very short time; it is also designed for individual use on the farm and is of small dimensions. It consists of three oval cylinders 7½ feet long, with a major axis of 24 inches and a minor axis of 6½ inches, the retort being enclosed in a metal or fire-brick casing with a fire box below. With a scrubber and a gasometer the total cost including installation is expected to be $500.

The straw, compressed into bales the size and shape of the retort, is placed

in it, the doors are shut by a clasp, and straw burnt in the fireplace below. After the operation when straw is used as a fuel, a certain proportion of the gas given off is used for the purpose of the carbonizing process, about 30 per cent. of the total volume of the gas being utilized in this way. The gas begins to come off at a temperature of 200 deg. C. and reaches its maximum between 500 and 600 deg. C. All the gas may be removed from the straw in about 30-45 minutes, rapidity of operation being an important factor from a commercial standpoint.

Each ton of straw produced between 11,000 and 12,000 cubic feet of gas, the quantity and the quality of gas varying slightly from different kinds of straw. The gas after generation in a retort passes into a scrubber (this being a metal cylinder 4 ft. long. by 18 or 20 ins. diameter), and thence into the gas container or flexible bag. If the gas is washed and purified so that the volume is reduced to 10,000 cubic feet, and, as stated above, 30 per cent. be utilized in carbonizing a ton of straw, there would be a surplus of 7,000 cubic feet for every ton of straw carbonized. The calorific value of straw gas is approximately 400 B. T. U.'s per cubic foot, so that one ton of straw would contain 4.000.000 B. T. U's. In this country we reckon that about 250 feet of coal gas is equal to one gallon of petrol, and the thermal value in B. T. U's of a gallon of petrol is calculated in the States at approximately 114,000. In this country we give it a higher value. Taking 7,000 cubic feet as the net output from a ton of straw, the heating value of the gas from that quantity of straw would be 2,800,000 B. T. U's, which can be taken as equivalent to 25 gallons of petrol.

From every ton of straw there is obtained between six to eight gallons of tar and ammoniacal liquors. This tar in its crude state would pay for the cost of baling the straw, which may be approximately put down as 4s. 6d. a ton, so that the farmer would have his fuel prepared ready for use at the cost of hauling it from the field to his retort. The carbon residue, of which there is about 600 pounds to a ton of straw, would find a ready sale as lamp-black.

As indicative of the importance of the scheme in the U. S. A. or Canada it may be mentioned that on the 20,000,000 acres which are cropped annually in the three Prairie Provinces of Western Canada only, and giving a yield of one ton of straw per acre, there is a total yield of straw of 20,000,000 tons. Allowing for washing and purifying and for the use of about 30 per cent. of the gas for the purpose of carbonizing the straw, there would be procurable 140,000,000,000 (one hundred and forty thousand million) cubic feet of gas, which may be taken to be equal to 22,000,000,000,000 (twenty-two million million) h.p. hours.

NAPHTHALENE AS MOTOR FUEL

By L. E.

THE effect of the compulsory search for a substitute for petrol has been highly beneficial, as it has stimulated experiment and test in directions which would otherwise have been neglected under normal conditions, and research has revealed that coal provides an excellent hydrocarbon which can be utilized as fuel for the internal combustion engine: benzol. But this product is indispensable for war purposes, so it was promptly ruled out of court. Yet benzol is but one of the many hydro-carbons derived from coal, although it is admittedly the most acceptable substitute for petrol, as a fuel for the explosion motor. But coal possesses other constituents of a similar character, although somewhat heavier, and amongst these must be mentioned naphthalene, a substance which, while not popularly known under its technical name, is familiar enough.

Naphthalene is a crystal. In its crude condition it might also be compared to dirty, finely-powdered snow, being relatively light and fine in its consistency. In this condition it contains a certain proportion of creosote oil, which imparts an oleaginous character to the substance, but which can be driven out by subjecting the powder to a violent centrifugal or whizzing action, and can be further cleaned or rectified by washing with an acid. But naphthalene is the bugbear of the gas engineer, and of the householder, who depends upon coal gas for illumination. With a slight drop in temperature it condenses in the form of snow and becomes an obstruction in the pipe. A very small quantity suffices to impede the natural passage of the gas, and recourse to the force pump or a liquid solvent are the sole effective palliatives. Apart from its conversion into dyes and carbon blocks and moth balls, naphthalene is of little use except possibly for the preparation of firelighters, to which latter purpose about 50% of the total yield is devoted.

In pre-war days crude naphthalene commanded about $20 per ton, and although the current price is from $25 to $35, its reclamation cannot be described as profitable. The annual yield in the aggregate from the gas and tar works of the British Isles is equivalent to about 10,000,000 gallons. Yet naphthalene is closely allied to the more appreciated hydro-carbon, benzol, and it belongs to the same series. The chemical symbol for benzol is $C_6 H_6$, that for napthalene is $C_{10} H_8$, and this close relationship was responsible for the doping practice which had a certain vogue during the early days of benzol as a motor spirit. This fact was also responsible for another line of action amongst certain French and German investigators. They advocated the possibilities of the compound as a fuel for internal-combustion engines, and carried out experiments to support their assertions, but they never achieved distinct success. The general practice was the dissolving of the naphthalene in a lighter hydrocarbon such as petrol or benzol. These two liquid fuels will readily absorb a certain portion of napthalene, the quantity varying from 20 to 40 per cent. But the experiment did not prove successful in practice.

Success in Sight

Other inventors, confident of their ability to use napthalene as a straight fuel, confined their efforts to achieving success in this direction, but other difficulties arose, and success was not forthcoming. But to-day it seems as though success is within a measurable distance of turning this elusive by-product of coal into a commercial motor fuel, and that without recourse to doping or other expedients.

Some five years ago two English experimenters, Mr. J. H. Willis, and Lieut. G. G. Wilson, attacked the problem. Their investigations elicited one important fact and they resolved to continue their researches from point where text books left off. These had settled that the melting point of the hydro-carbon was 79.8 degrees C., and the laboratory experiments were conducted on methodical lines from this point, and these proved conclusively that it was necessary to raise the temperature to about 133 deg. C., in order so highly to change a small volume of air into naphthalene vapour that sufficient would be present in a form suitable for an explosive mixture with a large proportion of air subsequently introduced. It was also found that the explosive mixture was formed when composed of 12 parts of air to 1 of naphthalene vapour.

A special form of vaporizer had to be devised and subsequently the vaporizer, carburetter and fuel tank were combined. With the experimental installation, starting up is conducted on petrol. After running for about ten minutes by which time the naphthalene has been melted and raised to 275 deg. F., the petrol is shut off and the napthalene vapour switched on.

LUBRICATION OF SHAFTING

TO obtain efficient lubrication a film of oil only is necessary, and to get this without waste the old dodge of using twisted worsted or cotton yarn is hard to beat when properly used. The methods of application differ, although the principle is the same in all cases. A receptacle partly filled with oil forms the reserve supply, and in this there is one end of a loosely spun thread of cotton or woollen yarn, the other end being in contact with the shafting or other part to be lubricated, the oil being drawn over by capillary attraction.

The rate at which the oil passes depends partly on its viscosity and partly on the tightness with which the yarn is spun, while for some purposes a flat woven lamp wick very well supplies what is needed. No large amount of oil is needed for well-balanced machinery which is not overloaded, provided the right quality of oil is used, but it is necessary that the supply be continuous or lubrication will be inefficient. A flood of oil for half the day and dry bearings for the other half is almost as bad as no oil at all, and is avoided in good practice. It is wasteful of lubricant and harmful to the plant.

Electricity and Hydraulics

PRINCIPLES AND OPERATION OF MODERN ELECTRICAL EQUIPMENT—III

By A. M. Pere

THE electrical units dealt with in the previous section, namely, the volt, measuring the potential difference; the ampere, measuring the rate of flow of the current and the ohm, measuring the resistance with which a circuit opposes the flow of electricity, are connected by a simple relation which is easily understood when the definitions of these units are considered.

The volt is the unit of electrical pressure or potential difference which causes a current of one ampere to flow through a circuit having a resistance of one ohm.

When a current flows through a circuit having a resistance of one ohm and under a force or voltage of one volt, the value of the current is said to be one ampere.

When an e.m.f. or voltage of one volt causes a current of one ampere to flow through a resistance, the resistance is said to have a value of one ohm.

Ohm's Law

It is seen that all three of the above definitions are mutually dependent and all three are only different ways of expressing a simple relation known as Ohm's law, which may be stated thus:

The amount of current, in amperes, flowing in an electric circuit can be determined by dividing the e.m.f. in volts by the resistance in ohms of the circuit.

This relation may also be expressed in the form of an equation:

$$\text{Current} = \frac{\text{e.m.f.}}{\text{resistance}}; \quad \text{amperes} = \frac{\text{volts}}{\text{ohms}};$$

$$\text{or } I = \frac{E}{R}$$

In the last of these three forms the letters commonly used as abbreviations are put down. E stands for e.m.f. or voltage; R for resistance in oms and I is used for current, since C has been reserved for another unit little known in commercial usage.

Ohm's law is a most important one and is useful in almost any electrical problem. It is used for direct current and applies when a steady flow of current has been established. In alternating current work other factors enter into consideration which modify the above law under certain conditions. Ohm's law may be used, however, and is correct in the above form when working with single phase alternating current circuits at unity power factor.

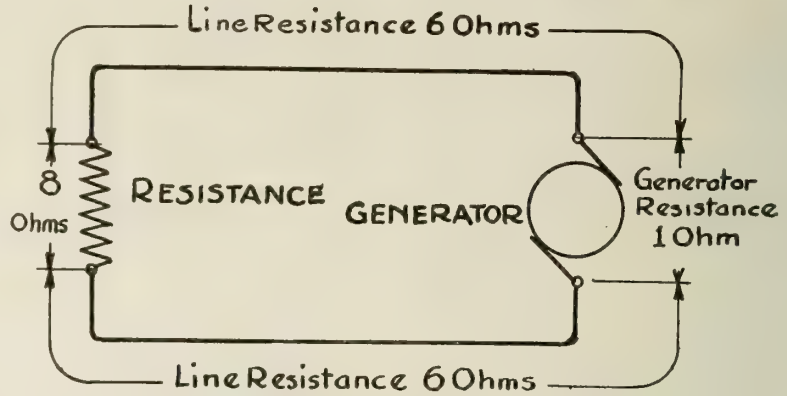


FIGURE 1.

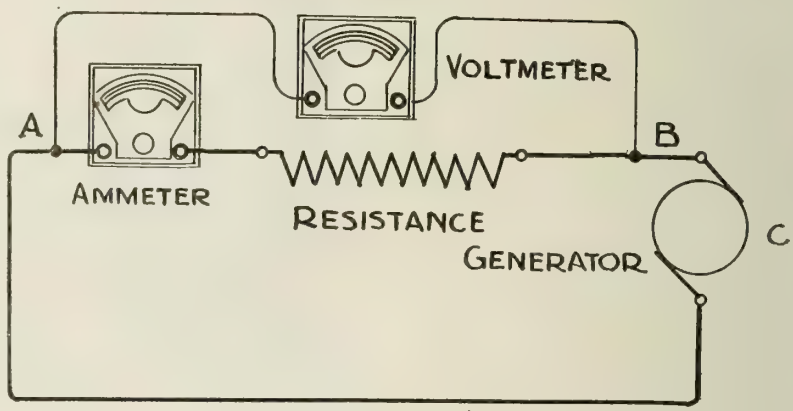


FIG. 2—METHOD OF MEASURING RESISTANCE.

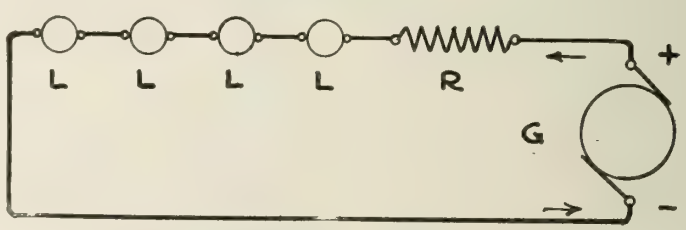


FIG. 3—EXAMPLE OF A SERIES CIRCUIT.

Various Forms of Ohm's Law

As will be gathered from the form of the equation and from the definitions of the quantities involved, Ohm's law enables any one of the three quantities to be found when the other two are known for:

$$R = \frac{E}{I} \text{ and } E = IR.$$

An example or two will serve to show how this law is used:

1—A dynamo having resistance of one ohm and an e.m.f of 150 volts has a lamp whose resistance is 24 ohms connected across its terminals. How much current flows through the circuit?

$$I = \frac{150}{I+24} = 6 \text{ amperes.}$$

In Fig. 1 is shown a circuit having a generator of a resistance of one ohm; a line each side of which is of 6 ohms resistance, and a resistance or other device having a resistance of 8 ohms.

If the generator has an e. m. f. of 147 volts the current flowing will be:

$$I = \frac{147}{21} = 7 \text{ amperes.}$$

If instead of the e. m. f. in Fig. I

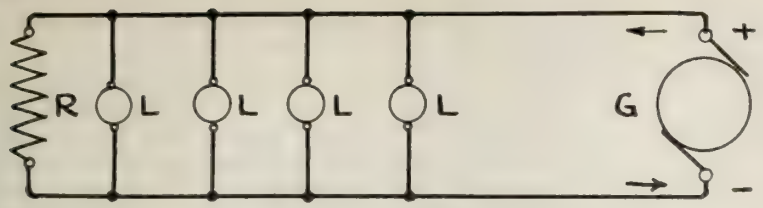


FIG. 4—EXAMPLE OF A MULTIPLE CIRCUIT.

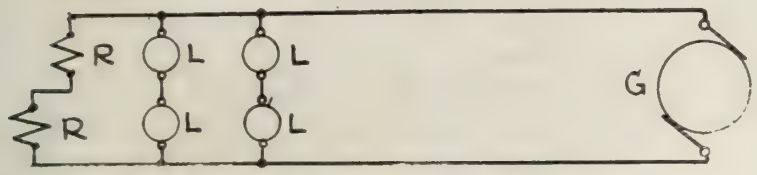


FIG. 5—EXAMPLE OF A SERIES MULTIPLE CIRCUIT.

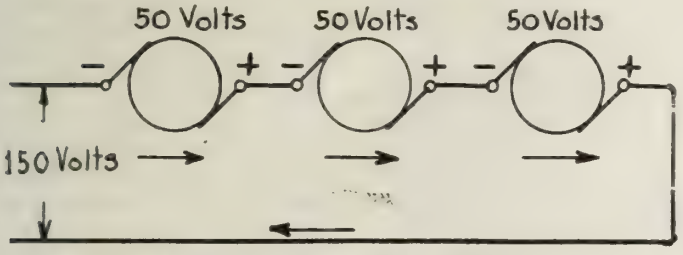


FIG. 6—3 GENERATORS IN SERIES.

being known, a current of 14 amperes is flowing and it is desired to find the voltage or e. m. f., one of the other forms of the equation may be used;

$E = IR$ or $E = 14 \times 21 = 294$ volts.

Ohm's Law Applied to Part of a Circuit

As has been explained it is the electromotive-force or e. m. f. that causes current to flow, and each part of the circuit depending upon its resistance requires a definite portion of the total e. m. f. to drive the current through it. This causes a difference of potential across the ends of the portion of the circuit considered.

In Fig. 2 is shown a circuit composed of a dynamo and a resistance with a voltmeter connected across the ends of the resistance. When the generator is running and delivering power the voltmeter will show a reading and the ammeter also shown in the circuit, will indicate the number of amperes flowing.

To the reading of the voltmeter is given the name potential difference, abbreviated p. d. This term has a slightly different meaning from e. m. f., which latter is usually used in the sense of measuring the voltage across the terminals of a generator or other apparatus when the circuit is open and no current flowing, while the term p. d. is usually applied to a portion only of the circuit.

Ohm's law holds equally good for any part of a circuit and it is not necessary to consider the whole circuit when applying it. The circuit shown in Fig. 2 is an example of this use of Ohm's law and is frequently used in the determining of resistance.

If a current of 10 amperes is flowing through the resistance and the voltmeter indicates a difference of potential of, for example, 15 volts, the resistance may readily be calculated;

$$R = \frac{E}{I} \text{ or } R = \frac{15}{10} = 1.5 \text{ ohms.}$$

Ohm's law for part of a circuit may be stated thus:

The amount of current in amperes flowing through any device in an electric circuit is equal to the fall of potential in volts through the device, divided by the resistance in ohms or $I = E \div R$, which is the same equation as before.

Circuits

A circuit is a path composed of a conductor or of several conductors joined together, through which an electric current flows and a circuit is said to be broken or opened when its conducting elements are disconnected in such a manner as to prevent the current from flowing. It is said to be completed or closed when its conducting elements are so connected as to allow a current to pass.

A circuit is said to be grounded when one of the conductors has been placed in contact with the ground either accidentally or by design. It is possible to use the earth as a conductor and thus dispense with one wire as is done in telegraphy and to a certain extent in street railway work.

The rails are used in street railway work as the return conductor and stray currents traversing the ground give considerable trouble in cities by causing electrolytic action, destroying water pipes, etc.

Series and Parallel Circuits

Conductors are said to be connected in series when they are joined so that the entire current must pass through each conductor or piece of apparatus successively.

Fig. 3 represents a simple series circuit in which all the current must pass through the resistance R and the lamps L before returning to the generator.

Fig. 4 represents a parallel or multiple circuit in wich the current flows through each of the lamps and the resistance, each one taking only a portion

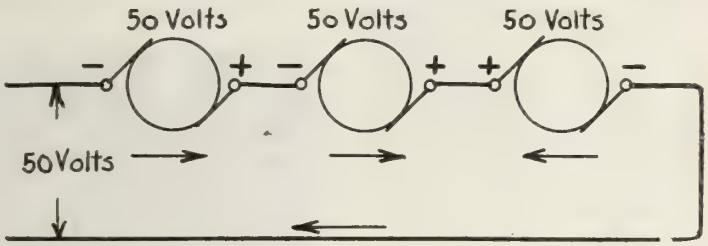


FIG. 7—THREE GENERATORS IN SERIES ONE OF WHICH IS OPPOSING THE OTHER TWO.

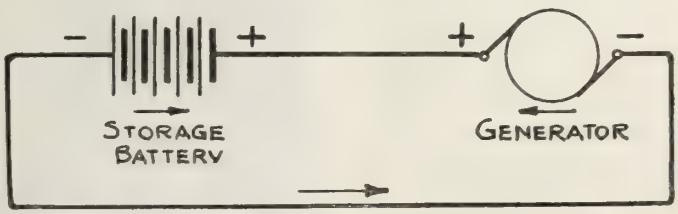


FIG. 8—ELEMENTARY BATTERY CHARGING DIAGRAM.

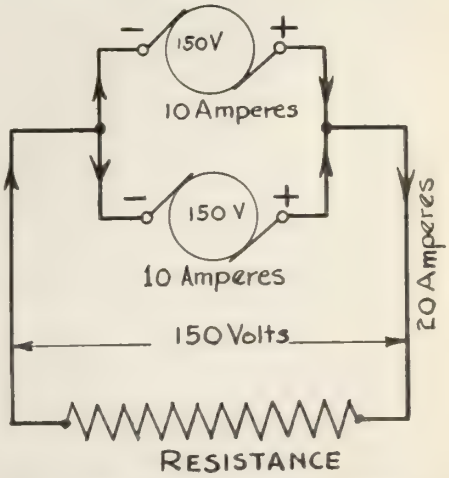


FIG. 9—TWO GENERATORS IN PARALLEL OR MULTIPLE.

of te total current. The term multiple is more frequently used than parallel.

Fig. 5 represents a series multiple circuit in which the current while having two or more paths open to it must still flow in series through the lamps or other apparatus forming one branch.

E. M. F.'s in Series and Parallel

More than one e. m. f. or source of current may act to send current through a circuit and like lamps or other apparatus they may be connected in either series or parallel. If connected in series they may all act to send the current the same way or one or more may tend to cause the current to flow in a direction opposed to the others. Thus in Fig. 6 the generators are all connected in such a manner that they all tend to cause the current to flow the same way and the total voltage or e. m. f. will be the sum of all three or 150 volts if each generator has an e. m. f. of 50 volts. In Fig. 7 one of the generators opposes the others and the resultant voltage is 50 + 50—50=50 volts. A common case of this latter connection is seen when a storage battery is charged as shown in elementary form in Fig. 8. In this case the positive terminal of the battery is connected to the positive terminal of the generator and it is due to the higher voltage of the generator that current flows into the battery when it is being charged.

That part of the e. m. f. which tends to send the current the other way in the circuit or which opposes the stronger e. m. f. is called the counter e. m. f. and the circuit acts as if there were no more voltage present than that due to the difference between the stronger and the weaker electro-motive forces.

If sources of current are connected in parallel they must have the same value or e. m. f. and be connected in the same way or otherwise considerable complexity will result. Fig. 9 shows two dynamos connected together each delivering 150 volts. The voltage in this circuit is simply that due to one machine, but the additional machine has provided a means such that the current in the main circuit comes from two sources instead of one.

Generators are connected in either series or parallel groupings, depending upon the characteristics of the lines and apparatus to which they deliver power. If the line is long and of consilerable resistance it is preferable to employ a series connection. This is very seldom done in direct current work, the more usual case being that of parallel grouping which while leaving the voltage unaltered delivers a greatly increased current depending upon the number of machines.

Answers to Last Month's Problems

A.—Electrical pressure or potential can exist without the flow of current, i.e., when a generator is running and the line switches are open.

B.—The names voltage, potential and electro-motive force are given to that property of an electric circuit which causes or tends to cause a current to flow.

C.—The unit of potential is the volt.

D.—The ampere is the name given to the electrical unit denoting rate of flow.

E.—The coulomb is the unit of quantity measurement of electricity.

F.—A motor running for 2 hours and taking a current of 50 amperes will absorb $50 \times 2 \times 60 \times 60 = 360{,}000$ coulombs or 100 ampere hours.

G.—The unit in which resistance is measured is termed the ohm.

This Month's Problems

1. What current is produced through a resistance of 5 ohms by an electro-motive force of 10 volts?

2. Through what resistance will an electro-motive force of 15 volts produce a current of 3 amperes?

3. What electro motive-force will produce a current of 4 amperes through a resistance of 4 ohms?

4. A dynamo generates 500 volts; the resistance of the circuit including the dynamo is 20 ohms. What is the current?

5. What electro motive force must a dynamo generate to supply an electro-plating current of 20 amperes through a circuit whose total resistance is .2 ohm?

6. An electric bell has a resistance of 400 ohms and will not ring with a current of less than .03 ampere. Neglecting the resistance of the battery and line, what is the smallest electro-motive force that will ring the bell?

7. If a car heater is supplied with an electro-motive force of 500 volts from the trolley, how great must be its resistance if the current is not to exceed 5 amperes?

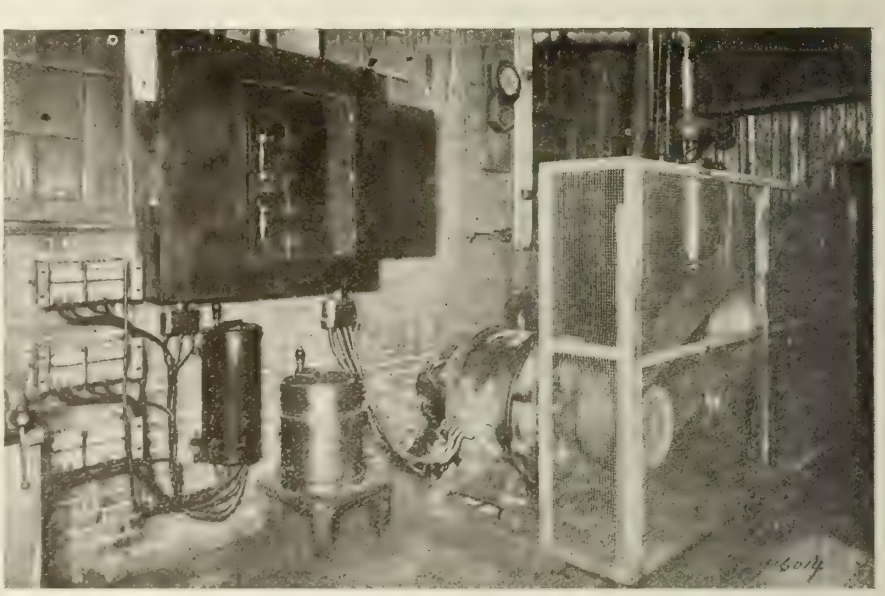
8. Calculate the resistance of the resistance R shown in Fig. 9, assuming as in the diagram that the electro-motive force is 150 volts, the current flowing is 25 amperes and the internal resistance of the dynamo is one ohm. Note: Neglect the resistance of the line in this problem; find the total resistance, and then deduct the generator resistance.

ELECTRIC DRIVE SAVES THIRTY PER CENT.

THE electric motor shown in the accompanying engraving is one of several aggregating 150 horsepower which replaced a steam engine for power purposes in an iron foundry effecting a saving of thirty per cent. in power cost.

The motor shown in the illustration is a 50 h.p. machine and drives a 12-in. by 12-in. Curtis air compressor. This motor is of the wound-rotor type, desirable for compressor service because its field is adjustable. At the left of the compressor motor is seen its controller, that for another motor, and above, Krantz safety-type switches for each motor. These are so arranged that it is impossible to get at any part of the circuit while it is alive. The fuse compartment cannot be unlocked until the switch is open.

In addition to the saving in power-cost, the management finds the power supply of central station lines to be more steady and satisfactory than that of their own power plant. This leaves all their energies free for the main job, turning out sound castings on schedule time and at a minimum cost.



ARRANGEMENT OF 50 HORSE-POWER MOTOR WITH CONTROLLER AND SAFETY SWITCHES.

IT is customary to determine roughly the excess air in boiler furnaces by the per cent. of CO_2 in the flue gases. As a matter of fact, the CO_2 is not an immediate measure except in rare cases, but the practice has grown because it is easy to determine the CO_2, and comparatively difficult to determine the real excess air. Assuming complete combustion, the per cent. of CO_2 is an indirect measure of the excess air used; but in even that case it varies for each different kind of fuel. For example, in the case of fuel oil, 8 per cent. CO_2 would mean about 96 per cent. excess air, while in the case of soft coal it would mean about 125 per cent. excess air.

Switch Gear Standardization: Necessity and Advantages

By C. C. Garrard

The problem of the standardization of equipment is receiving world-wide attention and it is a well-recognized fact that if a country wishes to maintain its position in the engineering markets of the future standardization of equipment will become necessary.

OF all departments of electrical engineering, switch-gear is perhaps the one whose development is in the greatest state of flux and in which more changes and improvements are continually taking place, and will continue to take place, than in any other. Under these circumstances, at first sight, it may be thought that it is a very unfit subject for standardization. Such a conclusion, however, betrays a want of appreciation of the true and best meaning of standardization. Standardization properly understood is essentially a co-operative action on the part of the designers and manufacturers concerned in order that the best product may be produced in the shortest time and with the least expenditure. To attain this end each party throws into the common stock his knowledge and experience; the old-fashioned secretive policy is abandoned, it being recognized that in this, as in so many other departments of national life, the purely individualistic policy must give way to the more enlightened and, in the long run, better paying one of mutual help and combined action.

In a paper read before the Institution of Electrical Engineers, the author summarizes the work which has been done in the past and gives a resumé of the lines along which the standardization of switch gear may be expected to proceed in the future.

The authority for engineering standardization in Great Britain is the Engineering Standards Committee. According to the 1917 report of the committee no single standard specification dealing with any form of switchgear has been issued. Specifications dealing with wall plugs and ceiling roses have, it is true, been prepared, but these come under the domain of accessories and not that of switchgear properly understood. In fact there does not seem to be any suitable organization within the standards committee to deal with such work. There is a sub-committee, with a number of panels for dealing with electrical accessories. But heavy modern switchgear is not properly classed under this designation. It would appear that there is urgent need for the formation of a special sub-committee to deal specifically with switch and controlling gear. This sub-committee could arrange for its special panels for the various subjects and there need be very little, if any, overlapping of the existing electrical accessories sub-committee and panels.

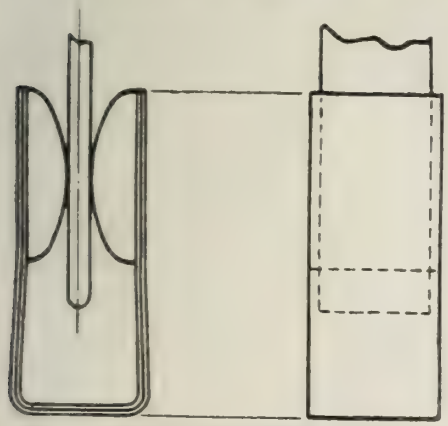


FIG. 1—CONTROLLER-FINGER TYPE OF SWITCH CONTACT.

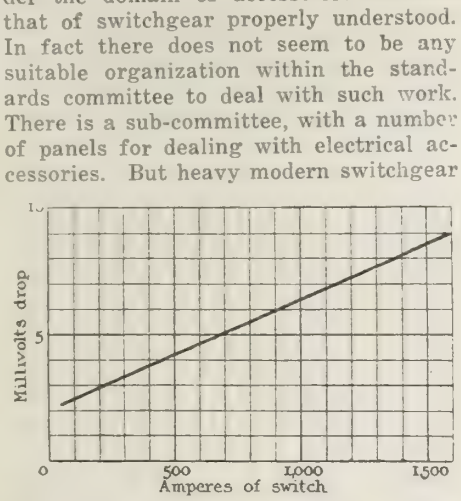


FIG. 2—MILLI-VOLT DROP AT THE JAWS OF KNIFE SWITCHES.

In the following remarks it is desired to explore to some extent the ground indicated, and to discuss a number of matters in connection therewith.

Standard Test Voltage for Switchgear

In the various specifications being issued by the engineering standards committee test voltage are enumerated for the articles dealt with. It would, however, be better if a standard test voltage could be agreed upon applicable to all switch and controlling gear. This should be higher than the corresponding test for machinery. The American standardization rule No. 500 specifies for machinery a test pressure equal to 1,000 volts plus twice the normal; for switches and control apparatus above 600 volts, however, rule No. 509 calls for 2,000 volts plus 2¼ times the rated voltage. This latter test is very good and reasonable, and moreover is a sufficiently high one for any form of switchgear. We cannot do better than adopt it.

Conductivity of Current-Carrying Alloys

The standardization of copper has already received considerable attention from the engineering standards committee, and a similar standardization of the other current-carrying materials used in switchgear should be made. These include brass, gunmetal and phosphor bronze. In passing, it may be mentioned that the whole subject of copper alloys stands in urgent need of standardization. The percentage composition of a "brass" casting is, for example, a very nebulous quantity. Even the standard specification (No. 35), which gives the standard dimensions for brass rods is but little used by the trade. There is no doubt but that electrical engineers, in common with all other users of brass, would heartily welcome standardization along the lines indicated. The following specification for brass castings which has been used in want of a better one may be of interest:—

Specification for Brass and Gunmetal for Castings

Brass.—Castings must be clean and free from sand and without fins, gits, or blow-holes. No trace of iron or nickel must be present. The composition should be within the following limits:—

Copper, 66 to 75 per cent.
Remainder zinc, impurities not to exceed 2 per cent. of total weight.

Gunmetal.—Must be of similar general quality to the brass above specified. Particular care must be given to freedom from blow-holes in order to secure good electrical conductivity. Composition:—

Copper	88 to 90	per cent.
Tin	10 to 11	"
Zinc	1 to 2	"

Knife Switches

A standardization of the length of break, distance between the centre lines of the poles, sizes of terminals, current density in the material and general style of construction is very necessary. At the present time various authorities have fixed their own standards, necessitating special manufacture. In addition, numbers of obsolete requirements are still insisted upon in certain quarters. For example, the condition that the hinge of

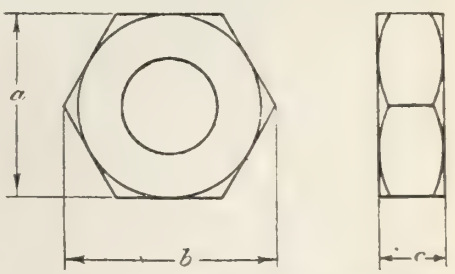


FIG. 3—SWITCHBOARD CONNECTION NUTS. Faces are to be dead true and smooth as they are for surface contacts.

a knife switch should not carry current still survives. This should be obviated in future. As regards the current density of surface contacts, it is not desirable to fix limits as to this, as apparently very high surface densities sometimes

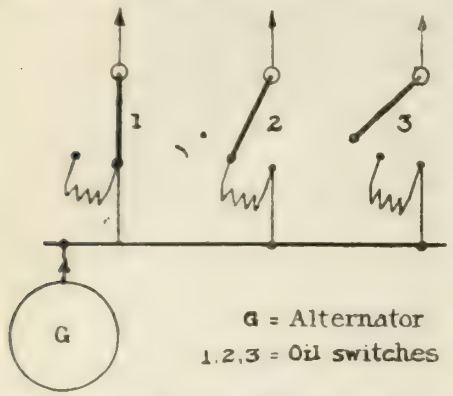


FIG. 4—DIAGRAM ILLUSTRATING THE USE OF TWO STEP OIL SWITCHES HAVING RESISTANCES, OR CHOKING COILS, CONNECTED BETWEEN THE STEPS.

yield very good results. There is much to be said in favor of the type of switch contact illustrated in Fig. 1.

The explanation would appear to be that with the ordinary form of flat contact the current really only passes at a single or a few points. With the controller-finger type, however, a definite line contact is obtained. A standardization of the millivolt drop, at contacts however, would be a very good thing, and, as this is a direct measurement of the capability of the device to make contact, has much to recommend it. The values given in Fig. 2 are founded on actual practice in good class work.

Current-Carrying Back Connection Studs for Switches, Etc.

Considerable variations exist at present in the practice of different manufacturers in regard to back connection studs, more especially as regards the screw threads adopted. The type of thread used must be determined more from considerations of electrical conductivity than from mechanical ones. The Whitworth screw threads, for example, on the larger sizes have too coarse a pitch which cuts unduly into the cross-section of the rod. A standardization of these screw threads, as also of the corresponding nuts, is very necessary. The particulars given in Table 1 have been found suitable by the author and are put forward as a basis of discussion. It will be seen that with the exception of the smallest size the Whitworth form of thread has been adhered to. In all sizes, however, above ⅝ inch diameter the pitch is smaller than that of the corresponding diameter Whitworth standard screw. It would not be desirable to standardize studs above 3,000 amperes. For these very large sizes the laminated construction is to be preferred. Strip connections are riveted and soldered into the switch block. These constitute a better electrical connection and, moreover, are cheaper to construct in these sizes than studs would be.

TABLE I.

Suggested Standards for Back Connection Studs for Switches, etc.

Current in Amperes	Rod Diameter of Studs in inches	Screwing of Stud
3,000	2	11 threads per inch, Whitworth-shaped thread
2,500	1¾	" " "
2,000	1⅝	" " "
1,800	1½	" " "
1,500	1⅜	" " "
1,200	1¼	" " "
1,000	1⅛	" " "
800	1	" " "
600	⅞	" " "
400	¾	" " "
300	⅝	⅝ in. Whitworth standard 11 threads per inch
200	½	½ in. " 12 "
150	7-16	7-16 in. " 14 "
100	⅜	⅜ in. " 16 "
75	5-16	5-16 in. " 18 "
50	¼	¼ in. " 20 "
25	0.184 to 0.186	No. 2 B.A.

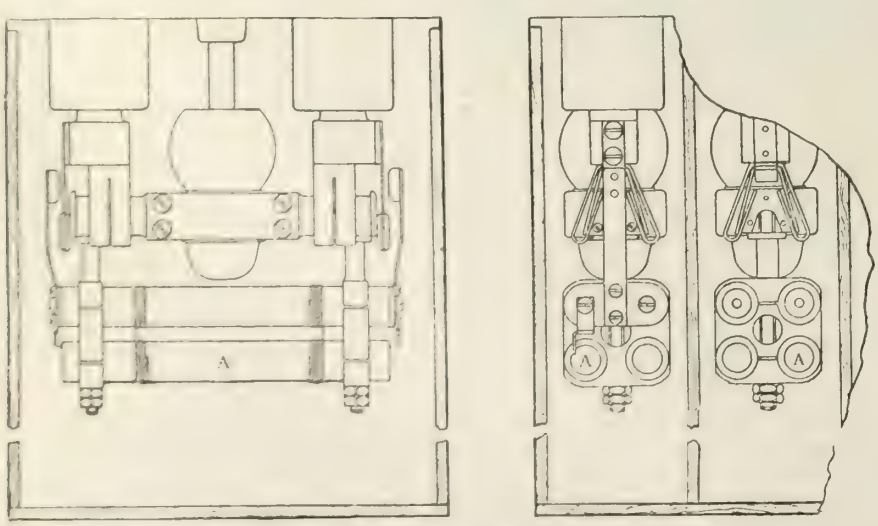


FIG. 5—OIL-SWITCH WITH SELF CONTAINED CHARGING RESISTANCE.
A = charging resistance.

Connection Nuts

The nuts for making the connection between the studs and the connection strips must be thinner than standard Whitworth nuts. This is necessary in the first place from considerations of space, which is naturally limited at the back of switchboards. The chief point, however, is that it must be possible to make a neat job of the multiple strip connections attached to the studs so arranged that they occupy the minimum of space consistent with efficient ventilation. The best arrangement is to make the spacing nuts double the thickness of the standard connection strip.

The nuts should be practically flat sided, the corners only being slightly chamfered to prevent their cutting into the material of the strips.

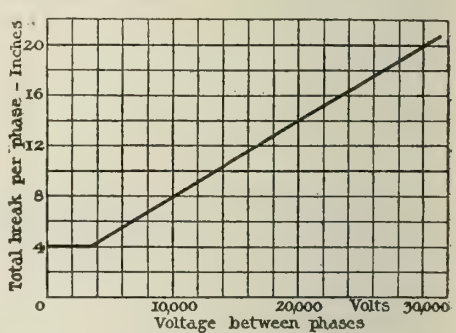


FIG. 6—CURVE CONNECTING TOTAL LENGTH OF BREAK AND VOLTAGE OF OIL SWITCHES.

Oil Switches

The standardization of oil switches is at the moment receiving attention and will therefore not be discussed at great length here. It will, however, not be out of place to call attention to the considerable amount of work which has taken place in other countries. This has had the result, before the war, of greatly assisting our foreign competitors' export trade in switchgear.

The action of heavy-duty oil switches is still really very little understood. The buyer, therefore, in choosing which switch to purchase is greatly influenced by the opinion he holds of the technical knowledge of the manufacturer offering the goods. The German manufacturer, for example, fortified with a set of carefully worked-out standards, was at a great advantage as compared with the British manufacturer who had nothing similar to put forward. Happily we are within measureable distance of an alteration of this state of affairs.

The German rules referred to not only include a set of standards as regards the construction of the switches themselves, but also a number of suggestions to guide the operating engineer in his

selection of a suitable switch having regard to the possible value of the short-circuit current at the situation where the switch is to be used. Such a set of rules is of the utmost service.

Referring again to the switches themselves, the most important point in their standardization is that of their rating in terms of breaking capacity. It is obvious that such a rating can only be reliable if based upon actual experience. It must be confessed that many of the ratings of oil switches which are guaranteed by various manufacturers are merely intelligent guesses, as means for making such tests are as a rule not available. In the appendix will be found references to a number of such tests which have been published. The opportunities for making such tests in this country are, however, very few. The engineers in charge of our large supply undertakings are naturally chary of undertaking the not negligible risks entailed in such tests. Yet such systematic tests are necessary if progress is to be made in a reasonable time. In this connection it is noteworthy

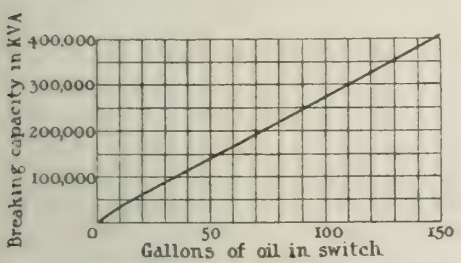


FIG. 7—CURVE CONNECTING QUANTITY OF OIL AND BREAKING CAPACITY OF OIL CIRCUIT BREAKERS.

that recently, and since the war, the Allgemeine Electricitats Gesellschaft of Berlin has built a special laboratory for the specific purpose of testing oil switches. This has been described recently in the technical press; it is worthy of the attention of the institution that, while last year the British Government, through he Department for Scientific and Industrial Research, encouraged an investigation in the subject of switching and arcing to the extent of a few hundred pounds, at precisely the same time this Berlin firm was building a special laboratory for exactly the same research at a cost probably one hundred times as great.

The question will be asked: Can this handicap under which we are suffering be removed? If left to the individual firms it is improbable that any single concern will go to the great expense of establishing and running a research laboratory on the necessary large scale. Moreover, to the author it appears that this would be much better dealt with by co-operative action between the industry as a whole and the government. This action could take the form of the establishment of a national high-tension research and standardizing laboratory which could deal with such problems as this and those mentioned under the heading of lighting arresters. The equipment, staffing, and running of an efficient laboratory on the necessary scale mean something altogether different from anything yet attempted in this country. The very best engineering talent should be secured for its direction and considerable financial resources would have to be available for the large scale experiments necessary.

Breaking Capacity of an Oil Switch

The leading consideration to be borne in mind when installing an oil switch on a large system is the maximum power in kilovolt-amperes which it will have to rupture. On large modern plants this power becomes very large and there can be little doubt that to some extent the value of short-circuit has increased more quickly than the corresponding improvements in the oil-switch construction. The use of reactances to limit the short-circuit current has now become recognized as essential for continuity of supply and it is of interest to discuss the conditions imposed upon such sectionalizing of large systems by the present state of development of the oil switch. While it is no doubt possible to construct oil switches for any duty whatsoever yet if too great a demand be made upon them they become so large and unwieldy that it is better to adopt other means of limiting the short-circuit current and thus enabling the relatively smaller switches to be used. It is suggested, therefore, that a maximum breaking capacity of 500,000 k.v.a. should be regarded, at any rate with the present state of the art, as the largest short-circuit load with which any oil switch should be called upon to deal.

The standard rules when formulated should embrace sizes up to this value.

Resistance and Reactance Type Oil Circuit-Breakers

The use of the two-step oil switch (Fig. 4), having a resistance or choking coil connected between the two steps has been advocated in some quarters. The Swiss Elektrotechnischer Verein in its report recommends this. With such a switch, on switching in, the resistance is momentarily connected in series with the circuit and then short-circuited. On switching off the order of procedure is reversed; Fig. 5 is a drawing of such a switch. As such arrangements considerably increase the complexity of the oil switches it is very desirable to elicit expression of opinion as to the advantages of the system and as to whether any standard specification should contain any provision for such an arrangement. Such switches may be regarded from two points of view, that is to say, switching-on and switching off.

Switching-on of Two-Step Oil Switches

The use of the charging resistance is of value in the case of switching-in of large transformers, for preventing the abnormal rush of current which sometimes occurs. Such a current, however, lasts only for a very short time, and the only real trouble is due to the tripping of the overload release gear. This can be guarded against by a time lag on the transformer switch. For switching-in cables such double-contact switches are totally unnecessary.

Such charging resistances are also sometimes called for for switching in large motors, the object being to prevent the concentration of voltage across the end turns of the windings and consequent danger of internal short-circuit. For this purpose a non-inductive resistance is not much good but a charging choke coil should be used. It must be admitted, however, that a method such as this is simply a condonation of inferior insulation of the machine concerned. If this latter were properly constructed, such special switching appliances should not be necessary. If, however, some such safeguard is deemed to be unavoidable, then a small adequately insulated, choke coil permanently in circuit with the machine may be used.

Switching-off of Two-Step Oil Switches

The Swiss Electrotechnical Society base their recommendation of the use of such double-contact switches on their alleged capability of dealing with heavier short-circuits than single-contact switches. It is very much to be doubted whether this contention is right, and in the absence of reliable test results, made under the heaviest conditions, it should not be accepted.

To the present author the great objection to such switches is their complexity. An oil switch in a large system is subjected to such severe usage that it should be constructed in the strongest and simplest manner with as few parts to get out of order as possible. From this point of view the use of double contact switches should be discouraged.

It is possible, by means of special constructions, to shorten considerably the length of break necessary in an oil switch. As, however, these devices come under the destructive effect of the arc every time the switch operates, it would seem a dangerous policy wholly to rely upon them.

It is better to have such a length of break that a reasonable degree of safety is secured, even if the special devices mentioned are put out of action. By length of break is meant the total length; thus if there are two breaks per phase it is the sum of the two breaks. Fig. 6 represents the average of a number of first-class modern manufacturers and may be taken as typical of present-day designs. For switches of exceptionally large breaking capacity, however, the breaks are sometimes larger than those indicated in the curve.

Single and Multiple Tanks on Oil Switches

There is an impression in some quarters that the mere division of an oil-switch tank into three separate tanks, one for each phase, is an advantage from

the point of view of operation under short-circuit. Seeing, however, that the effect of this sub-division is to bring earthed metal betwen the phases and in closer proximity to the contacts, the effect is likely to be the other way about. Of course in all cases for switches of any considerable size, insulating barriers should be arranged between the phases. The question as to whether a separate oil tank should be used per phase is simply, in the first instance, one of size and weight. On the larger switches a single tank becomes too unwieldy to handle. For great breaking capacities, therefore, three tanks are used, and with such switches it is better to arrange for actual concrete or brick barriers to separate the phases entirely.

Amount of Oil Required for Oil Switches

Very considerable variations have existed in the practice of the various manufacturers as regards the quantity of oil deemed necessary for a switch of given breaking capacity. As, however, the oil is the medium for taking up the energy liberated within the switch at the instant of rupture, it is to be assumed, from first principles, that the more oil there is the greater the breaking capacity, provided, of course, that the whole of the oil is brought into effective use. This view is gradually becoming general and much larger oil tanks than were previously used are now common. The curve in Fig. 7 connects the total quantity of oil and maximum k.v.a. breaking capacity, and may be taken as representing good modern practice.

Speed of Operation of Oil Circuit-breakers

A high speed of operation is now recognized as an important factor in increasing the breaking capacity. There are two points to be considered; first, the total time required for the travel of the switch from the instant that the contacts finally part company to the completion of the travel; secondly, the initial speed at which the break contacts separate. The second is the more important, as it is of the utmost importance that the current be finally ruptured during as small a proportion of the total travel as possible. Information regarding these two points should be sufficient to define the action of the breaker in this respect. If by speed of operation is meant the actual velocity of the moving portion of the switch, it must be borne in mind that if there are two breaks per phase the circuit is being actually opened at twice the speed of the mechanism. This could be taken into account by multiplying the actual mechanical speed by the number of breaks per phase.

(To be continued.)

THE DISTILLATION OF COAL UNDER PRESSURE

IT is well recognized that, at the best, the burning of coal under ordinary conditions and manufacture of coke in the beehive oven are very wasteful. The valuable by-products derived from the coal under proper conditions are an exceedingly important factor in many industries.

In the ordinary destructive distillation of coal most of the volatile matter is driven out at 650 deg. C. and lower temperatures. To reach that temperature within the mass of coal, the retort is subjected to a temperature of nearly 1,000 deg. C. As a consequence, a considerable portion of the vapours generated is spontaneously cracked in the retort by remaining in contact with the hot retort walls and the hot coke. Satisfactory means of avoiding that cracking have not yet been developed; in other words, low-temperature carbonization is much written about, but hardly practised so far. It will require a great deal more experimenting before the problem will technically be solved. Distillation under reduced pressure has repeatedly been tried. Messrs. J. H. Capps and G. A. Hulett, of Princeton University, New Jersey, have recently been experimenting on the effects of higher pressures of 20 atmospheres. They find that the increased pressure favors the production of light oils at the expense of the heavier oils, but experiments on a small scale, such as they conducted, offer great analytical difficulties, and in any case a few such experiments hardly admit of any conclusions as to the economic balance of a process. The experiments, described in the "Journal of Industrial and Engineering Chemistry," of October 1, 1917, pages 927 to 935, were made with a steel retort of 1.9 litres capacity. The apparatus resembled a mercury thermometer with a long vertical bulb, into the stem of which a vertical cooling tube had been axially inserted. The heavy vapors rising from the coal were condensed on this internal tube and dripped back into the retort. If the stem had been cooled from the outside the vapors would have run down the inside of the retort wall, where they would have been overheated and have deposited a crust of coke, insulating the coal from the hot walls. The steel retort was wound with asbestos and nichrome tape for electric heating, and the temperature was raised to 600 deg. C. in the start at the rate of about 5 deg. per minute, and then at the rate of 1 deg. per minute. A tube branching off from the stem took the vapors first to a trap condenser and then through a horizontal tube, cooled from outside, to a second condenser and to the apparatus for analyzing and measuring the gases and vapors. The first trap was a vertical cylinder, the vertical axis of which was taken up by a cooling tube; in cross-section this trap was U-shaped; the trap and part of the retort stem were surrounded by a case which was electrically heated so as to prevent the condensation of the low-boiling oils in this first condenser. Thus a rough distinction between heavy and light vapors was rendered possible. The retort, stem and the first trap were made sufficiently strong to bear an internal pressure of 20 atmospheres, which was measured by a gauge. The temperature inside the retort was indicated by a thermocouple. Four kinds of coal were examined, a steam coal from Virginia, a bituminous coal from Pittsburgh, an Illinois soft coal, and a sub-bituminous coal from Wyoming; if we remember rightly these coals have served for several researches conducted by the Bureau of Mines, in conjunction with which Capps and Hulett were working. The general results are that as the pressure was increased, more of the heavy hydrocarbons were decomposed, while up to 5 per cent. more light oils or products of lower boiling-points appeared in the second condenser ;the phenols and acids likewise decreased for reasons which are not clear. At higher pressure more coke was produced, but the calorific value of this coke was increased, the coke being more free from nitrogen, oxygen, sulphur and volatile matter than under ordinary conditions. The volume of non-condensable gas was also increased by the rise of pressure: up to 500 deg. C. more hydrogen was evolved, at 550 deg. and 600 deg. the hydrogen percentage diminished again, probably because the hydrogen then reacted with the nitrogen, oxygen and sulphur and some of the compounds.

ARMATURE BURNED OUT

By M. L.

The cores of generators and motor armatures are built up of soft steel sheet called laminations. This construction is used to reduce the local currents which would be considerable and cause excessive heating were the core solid. Breaking the continuity of the core with joints increases the resistance to eddy currents, but the resistance is further increased either by oxidising the laminations or by giving them a coat of Japan or insulating varnish.

That the object of the laminated construction sometimes may not be appreciated is illustrated by the following experience:—The armature of a large continuous-current generator burned out on account of a ground due to lightning. On removing the damaged coils, it was discovered that a large hole had been burned into the core. The operator, who evidently considered that local repairs might safely be made without regard to laminated construction, went to considerable expense to machine the whole affected part of the core and carefully to dovetail into a block of solid iron into which had been milled slots for the armature coils. The armature was then rewound and replaced in commission, only to be burned out again in the same place after a brief operation.

The operator drew the correct conclusion as to the cause of the second failure; his second repair job was even more original than the first one and more effective. He removed the block of iron and inserted a wooden one. The coils then were repaired and replaced, and this makeshift construction proved to be satisfactory for the time being. Later, the only permanent method of making such a repair was adopted, that is, to remove the defective laminations and reassemble that part of the core with new ones.

Steam and Its Generation

CONSERVATION OF FUEL

By H. James

THE fuel controller has ordered that the Canadian factories economize. This means that all intelligent people are wondering where it will all end and at the same time these people are doing everything they can in their own homes to try and save coal. It is not a question of how many tons can be saved but of how many shovelfuls each individual householder can conserve. A few small details such as keeping the building at a temperature just warm enough and no warmer, say 65 degrees Fah., which will be suffcient, and will result in better health. Double windows, etc., can be fitted better and the furnace fittings can be made tighter and the pipes insulated, while the flues and chimneys should be kept clean.

Are the manufacturers paying as much attention to details as they might?

It seems that there are many ways of effecting economies such as selecting the firemen with a view of obtaining conscientious, intelligent men who will follow instructions and not fire irregularly —light and heavy—and who will distribute the coal evenly. Railway officials, who have spent considerable time on the general fuel situation have found that firing a boiler is a job which requires intelligence if the maximum efficiency is to be maintained because, at best, burning coal is wasteful. The boiler settings should be checked, the draft and grate area considered and the flues should be thoroughly cleaned and made free from scale without waiting for the boiler inspector to come around as these details are just as important as shovelling in the coal. How many of the manufacturers have been asked by the fuel controller to have these details attended to? Not very many. It is not the average householder who is wasteful but it is the factories and hotels.

Plant Economies

It is a good idea to have a recording thermometer showing the room temperatures at all times and it will be noticed how soon the firemen will become interested and the fuel consumption will drop. Conditions have existed where a recording thermometer reduced the fuel consumption over 30 per cent., and this plant was an average factory. It should be borne in mind that sudden changes in the firing should not be made if the maximum results are to be obtained but any changes should be foreseen and gradually made.

Formerly it was possible to specify the brand of coal and to see that the quality was kept up by checking the various ingredients but now the consumer is obliged to take anything he can get, with the result that there is little economy obtained from selecting the different grades.

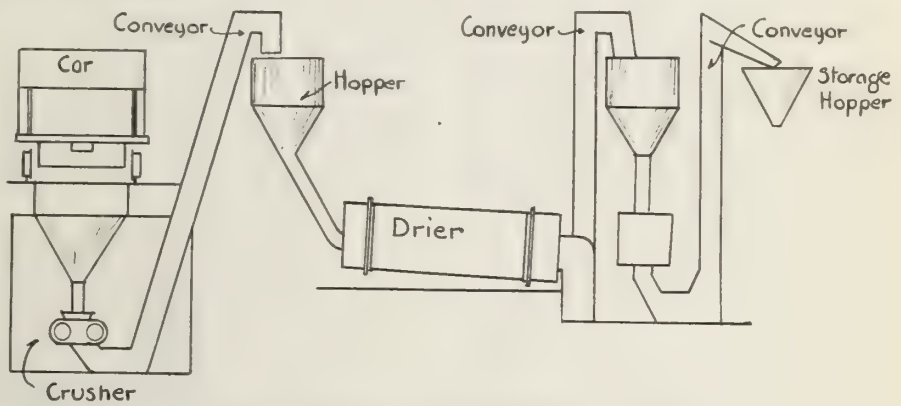
For the small plant, fuel oil is probably cheaper as it possible to control the heat with such ease that slight variations in atmospheric temperature can be allowed for and advantage taken of the mild spells by shutting down periodically or altogether. This flexibility or operation has made it possible to effect considerable saving and on account of the possibility of regulating the fuel and air with precision more perfect combustion is obtained.

The first cost of the oil compares favorably with the increased price of coal, and actual results have shown it is preferable for the small plant. No very radical changes are necessary to alter the equipment except in the drafts and brick work. The only change to the grates is the reducing of the volume of air coming down through by making a checker work of brick. A little experimenting with the different types of furnaces will very easily establish the correct area of combustion chamber, etc. The extra cost for piping tanks, etc., is quite within reason.

Powdered Coal

The use of powdered coal has many advantages over the ordinary method of burning coal and is far more economical as every particle of coal is surrounded with the necessary amount of air to insure complete combustion.

Formerly the specifications for the quality of the coal to be used in pulverizing coal plants were rather exacting but up-to-date practice shows that if due care is given to the operation of a powdered coal plant quite a lot of latitude may be given and the results will not be impaired. Coal containing 28 per cent. volatile combustible matter is being used successfully and even poorer grades may be used. Except in the case of open hearth, puddling of bushelling furnaces, where the composition of the material being worked would be affected



COAL HANDLING AND PULVERIZING PLANT.

sulphur is of little importance, and even in these cases it is a debatable point as to whether the composition would be affected enough to matter. Moisture is absorbed very rapidly by powdered coal; it may amount to 0.01 per cent. per minute for a definite period, after which the absorption rate will diminish. Like fuel oil, if the air is preheated to say 500 degrees Fah., a saving of 20 per cent. may be effected. A simple way of accomplishing this is to pass a few lengths of blast pipe through a chamber heated by waste gases. The feed control and burner sizes are important factors in burning powdered coal. A few typical analyses of coal used in the powdered form are given:

	%	%	%
Volatile combustible matter	33.2	23.55	35.50
Fixed carbon	56.07	67.3	55.15
Water	1.12	0.35	0.40
Ash	9.61	8.08	8.95
Sulphur	1.00	2.04	1.51

An idea of what a pulverized coal plant is like may be gained from the accompanying illustration which shows a permanent installation.

The total equipment necessary for pulverizing, handling, drying and milling 2½ tons per hour, which is sufficient

for five forge furnaces, would cost around $60,000.

Equipment Necessary

The coal is dumped from the car into a steel car hopper located at the end of the milling building and in a concrete pit under the track. The hopper is made of ⅜-inch steel plates, and is 8x8x6 ft. deep, with sides sloping to a square opening where the feeding conveyor is located. A slide gate can be used to control the feed. The conveyor is a 6-inch standard horizontal, U shape, and conveys the coal from the hopper to the milling room. A crusher 20 x 24 in., with two cast iron toothed rolls is capable of crushing lumps from 8 inches to a suitable size for the pulverizer, which is about ¾ inch. The rolls are provided with a spring release in case some foreign substance should get into the crusher. From the crusher there is a boot-legged conveyor to the crushed coal bin. This conveyor is of the bucket type with 35 ft. centers and is covered to make it dust proof.

An arrangement is provided to distribute the coal uniformly in the coal bin which has a capacity of 60 tons and is reinforced 5-16 in. steel plates. The bottom is hoppered and arranged to connect to a conveyor which feeds the drier. The drier should be in a separate building on account of the liability of explosions. The drier reduces the moisture from 7½ per cent. to 1 per cent. It is composed of two shells made of heavy steel plate and having butt joints with inside lapping strips. The outer shell rotates at a speed of 6 r.p.m. and the inner shell connects with the furnace, the hot gases passing through it and at the end are carried away by a fan. The discharge goes to a dust collector which catches the finely divided particles of coal taken up during the passage through the drier. The shell of the drier is 48 in. x 20 ft. long, supported by rollers operated by spur gearing. The whole is placed at an angle and the outer shell contains helical vanes which convey the coal from one end to the other. At the firing end grate bars and ash pit doors for hand firing are arranged. The combustion chamber is lined with fire brick as is also the steel flue which connects with the drier shell.

The exhauster is belt-driven and of the centrifugal type. Provision can be made to deflect the hot gases from the drier when it is not in use by providing an auxiliary pipe connected to the fire box. The dust collector can be of the cyclone type. From the drier the coal is taken to a bin which is connected to the pulverizing mill by a conveyor. A 33-inch belt-driven vertical type with automatic feed and with a screen separator will take care of 2½ tons per hour. The pulverized coal is conveyed to a storage. Coal is taken as required to the furnaces by screw conveyors which lubricate themselves with the coal.

It is important that the pulverizing be fine enough so that the product will have at least 90 to 95 per cent. passing through a 100 mesh sieve. A relatively small air pressure is used by most people, this varies from 1 to 6 ounces, but some use as high as 10 to 15 ounces and have the mixture rotated in a mixing drum which tends to make a more thorough mixture instead of throwing the suspended coal across the furnace, and in some cases having it unburned. Some concerns use slack coal, and by first passing over a trommel the large material is segregated and the small coal sent to the pulverizer. The large coal is sent to the power house and consumed.

MODERN COOLING TOWERS

By Frank C. Perkins

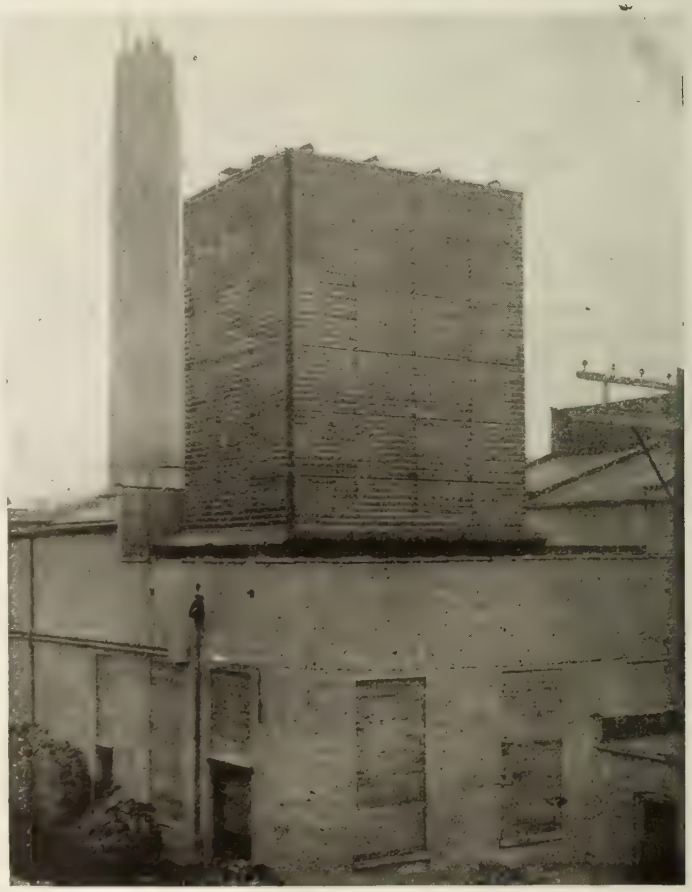
THE accompanying illustration shows a modern cooling tower in use, as developed by Engineer Edwin Burhorn.

In the construction of these cooling towers, a distributing device is placed at the top of the tower. A main trough is provided in the centre of the tower, and running nearly the full length of the tower on its longest dimension. At right angles to the main trough and extending at both sides of the trough are a series of distributing troughs into which the water from the main trough discharges.

It may be stated that the main trough consists of a steel box divided into two parts by means of a longitudinal partition. The water enters at either end through a tapped flange. One of these ends is to be plugged and will serve in cleaning out the lower compartment. A series of vertical pipes is furnished in the partition, and the water issues from these pipes, which are adjustable, so that the amount can be regulated to distribute uniformly throughout the length of the trough. The two sides of the trough are notched at intervals. through these notches the water overflows into the distributing troughs.

It is of interest to note that the main trough is made of heavy steel plate and thoroughly painted at the shop before shipment. A steel walk-way is provided running the full length of the tower alongside of the main trough, giving access to the regulating pipes in the main trough, and to all portions of the tower at the top. A steel ladder is provided to give access to the walk-way from the base of the tower.. The distributing troughs are notched on the sides the full length, at intervals, and the water overflows through these notches to the trough deck below.

A trough deck system of cooling surface is made up of units of proper size and placed side by side so as to give the proper area to suit the capacity of the tower. Each unit consists of a series of parallel troughs notched on the two sides. These parallel troughs rest on a similar series of parallel angle pieces running at right angles and bolted together with ⅜-inch bolts and double washers. The angle pieces stiffen the troughs so that they will maintain their level when full of water, and will also bear the weight of a man without deflection. The various units are bolted to channel iron beams by means of cast iron clips and through bolts, thus requiring no punching of the steel framework. The trough deck system erected level will cause the water to seek its level in the



A MODERN COOLING TOWER CONSTRUCTED OF STEEL PLATE.

troughs regardless of how it enters the troughs from above, and the water being level, will naturally leave the troughs through the notches throughout its entire length uniformly. The water from each notch will strike the top of the supporting angle at the centre and will tend to flow down both sides of the angle pieces in equal proportion. The arrangement of troughs and angle pieces at right angles will prevent water from passing directly through, but will enable a free passage of air up and around all parts of the angles and the troughs, thus exposing the water to the air under favorable conditions.

Arrangement of Troughs

It will be seen that the trough decks are arranged in series one directly below the other. The troughs in one deck are arranged to run at right angles to those in the deck above and below. This method will rectify the distribution of the water from deck to deck, as the tendency of the wind is to blow the water to the leeward side of the tower. Without such rectification, the water concentrates at the leeward side of the tower and, at the bottom of the tower, will splash in considerable volume. This will result in poor cooling effect and considerable loss of water by splashing out of the tower. With the trough deck system the distribution is equalized at each deck so that no matter in which direction the wind may blow, the water is always broken up into fine particles, and exposes the maximum water surface to the surrounding air.

It is pointed out that in the operation of a cooling tower the same water is used over and over again. Through the process of cooling there is a certain loss which must be made up from some outside source. This loss is known as the "Make-up Water," and consists of water lost by evaporation plus water that might be splashed or blown out of the cooling tower. Assuming that there is no less except that due to evaporation, the amount of heat (in British Thermal units) taken away from the water in circulation will equal the number of pounds of water lost, multiplied by approximately 1,000. In other words, every pound of water evaporated will carry away one thousand heat units, and cool one thousand pounds of water one degree, or one hundred pounds of water ten degrees. Therefore, to cool one hundred pounds of water ten degrees requires the evaporation of one pound of water, or 1 per cent. of the amount cooled. Thus, theoretically, the make-up water will be 1 per cent. of the water circulated, to cool the water 10 degrees.

It is said that actual tests on several towers under different conditions have shown the actual loss to be less than 1½ per cent. of the total amount circulated, or practically that due to evaporation. The design of the trough deck system, combined with the louvres, prevents water blowing out of the tower, even in heavy winds, and thus only are we able to accomplish the above mentioned remarkable result.

It is maintained that the distributing and trough deck system described hereinbefore is entirely free from perforations, and has no parts liable to clog up, so that the tower is suitable for any kind of water, and will require practically no attention after once properly adjusted. Experience has demonstrated the desirability and durability of all steel construction. On account of the presence of acid in the water at various locations, due to the character of the water itself in some cases, and in others to the accumulation of acid from smoke in the atmosphere, which latter often contains sulphuric acid, we protect the trough deck system by a thorough dipping in protective compound. The individual parts are made of galvanized material, and after completion are thoroughly dipped in a protective compound, which latter is a special mixture suitable for the purpose.

It is said that where local conditions call for any special material or treatment, a careful study should be made and the proper method adopted. The louvres are ordinarily made of galvanized metal. In certain cases the louvres and trough decks are made of commercially pure copper at some extra cost, and in other cases are made of black steel galvanized by the hot dipping process, which gives a very heavy coating and adds considerably to the durability under bad local conditions. This hot dipping also adds to the cost of the tower.

READER'S QUERY

MY practice lies chiefly in the line of agricultural engines and steam plants of the smaller capacity, these engines, or rather the boilers, are not under government supervision, and a large majority of them are old and nearly all, especially those in localities where the water is charged with minerals, are more or less attacked by scale and corrosion which nearly always leads to pitting and the formation of pin head.

I have read a good deal of technical matter regarding the prevention of scale in boilers, and the principal causes of its formation; some builders advocate the use of kerosene when laying up a boiler, others say that oil of any kind should never enter a boiler. Of course kerosene is supposed to be free from the more dangerous acids, and for that reason some engineers in this branch of the profession use it when laying up a boiler to prevent deterioration and corrosion.

I would like to have the following questions answered:

(1) Do you consider the hydraulic boiler test reliable? It is probably so for the boiler as a whole, and if there is any danger of failure due to fracture of the sheets it will show up under the hydrostatic pressure, but probably the boiler is full of pit holes, not close enough to be dangerous, yet so thin as to be liable to burst at any time. I have placed a boiler under the test myself and found that everything seemed to be all right, yet a short time after a burst occurred. I would like to know if a boiler more or less afflicted with pit holes is actually dangerous.

(2) When laying up a boiler for a few months how should one proceed? I do not refer to large stationery boilers, that is a comparatively easy matter, as a man can enter these boilers, but with the small internally-fired boilers a man must proceed without any knowledge of the boiler's condition.

(3) I suppose no oil except the kerosene should be used unless it is known to be free from acid, and the boiler should be thoroughly boiled out with soda before being put into service again. Is this correct?

(4) Could kerosene be used in connection with the purger on an injector to feed through to the boiler with the feed water?

(5) Is it possible for one to test a small boiler with a light hammer and be able to locate weak places and pit holes, or can this test be considered reliable in the hand of one not accustomed to the different sounds?

(6) What sound should a boiler give out when in good condition, also what would be the indications of weak or worn and corroded places?

(7) What effect has age on the boiler plates provided they have escaped the effects of scale and corrosion; is it possible that the alternate contraction and expansion has the effect of producing structural changes

Forest, Ont. Roy J. Brodie.

Answer

(1) In the writer's opinion the hydrostatic test alone is not reliable, but after the boiler has been thoroughly inspected, internally and externally and the plates hammered with a test hammer to locate thinning, slack stays, broken screw stays, etc., the hydrostatic test with slightly warm water is very useful in summing up as it enables the inspector to locate and have leaks stopped up in the seams, tubes, etc. By careful inspection it can be determined if the straps are properly spaced to support the flat surfaces of thin plates and by this method plates which have been thinned through corrosion or which have had screw stays broken may deflect on test.

(2) When laying up a portable boiler for the winter the handholes should be opened up and all scale scraped out, using a hose with nozzle pressure to wash out the loose scale. After the scale has been disposed of and the hand hole covers replaced the boiler should be filled up and two gallons of kerosene oil poured in. The exact amount of oil depends to a large extent upon the size of the boiler. The blow-off should next be opened and the boiler allowed to empty slowly; this will distribute the oil in a thin film on the inside surfaces and preserve them from the action of the lying up period. If the boiler lies for six months the oil will have evaporated by the time the boiler is put into service and any slight residue will not

matter. Externally the plates should be scraped clean and painted with graphite paint to preserve them.

(3) Yes, and refer to question 2.

(4) Keep all oil out of boilers under operation, oil is dangerous.

(5) Yes, in the hands of an experienced man the test hammer is invaluable for testing boilers.

(6) The sound given out by a hammer in testing plates that are of full thickness is well known to competent inspectors, and an experienced man testing boilers can immediately tell when he comes to thin spots as these give out a different sound of a tinny nature. Weak, worn and corroded places are observed by this means.

(7) The plates in a boiler which has been in constant use for a large number of years undergo a gradual change, becoming less ductile and being "crystallized in service." This is due to the expansion and contraction of the plates in service.

CAUSES OF CHIMNEY TROUBLES

By C. T.

QUITE recently a contractor having trouble with a steam plant invited an examination of the conditions existing by twelve individuals who seemed to have the necessary experience to find out the cause of the trouble, and whilst no two of them agreed each claimed to be confident of the solution of the problem. Among the opinions expressed were that the coal was poor, that the smoke flue was too long, that the chimney flue was not large enough, that it was too large, that it was due to the smoke flue not running upgrade, that it was due to two fires running into one flue, and finally the manufacturers of the steam boiler sent a representative who declared that he would stake his twenty years' experience that the trouble was due to the chimney not being high enough, although it was one foot higher than the peak of the roof. After all this the builder himself discovered that the trouble was caused by an eddy of cold air at the base of the chimney flue. The various wrong opinions were expressed by plumbers, steam fitters, masons and others who should have been able to explain such troubles promptly.

Few people seem to have any definite idea of what the actual troubles in a chimney may be, for there are at least fourteen definite kinds which all manufacturers and steam users should be familiar with and able to detect on sight.

1. The flue may be too small for the work put upon it.

2. The flue may be too large, and therefore the heat not sufficient to cause proper draught. These two troubles can be easily detected by consulting a table of flue sizes in most furnace catalogues.

3. Leaks where outside chimneys join the foundation walls. This condition may be easily traced by watching a lighted candle near the junction point. An inward current will indicate such a leak.

4. Leaks between flue linings and the brick walls of the chimney.

5. Flue joints not set flush. These conditions should be prevented by the inspection of the work as it progresses, and in the case of a straight chimney they can be detected by holding a pocket mirror in the base of the chimney at an angle that will reveal the sky above the chimney top, the entire interior of the chimney being easily visible.

6. The top opening of the chimney may be too small. It is too small if smaller than the balance of the chimney. It is best to finish with a flue lining larger than those below.

7. The top of the chimney may be too low. It must be one foot higher than the roof, at least, unless 20 feet away.

8. The flue lining should be a little higher than the brick wall, and if lower it may cause trouble.

9. Aviators complain of "air pockets." These will spoil the draft of chimneys located next to higher buildings.

10. High trees adjoining will cause similar difficulty.

11. Sharp bends in a chimney can cause trouble by creating eddies and by reducing the capacity of the chimney.

12. A depression or well beneath the flue opening can cause an eddy that will be almost fatal to chimney draught.

13. When a rather small flue pipe enters the base of a chimney a little larger than the capacity required a cold air eddy may exist, due to the cold air settling down one side of the flue, while the hot gases pass up the other side. This can be cured by reducing the size of the flue as it approaches the base.

14. If the smoke flue does not fit airtight all the way into the inner flue lining there will always be trouble. There is especially a chance of leakage between the lining and the brick in this case.

A UNIQUE ELECTRIC COAL CONVEYOR

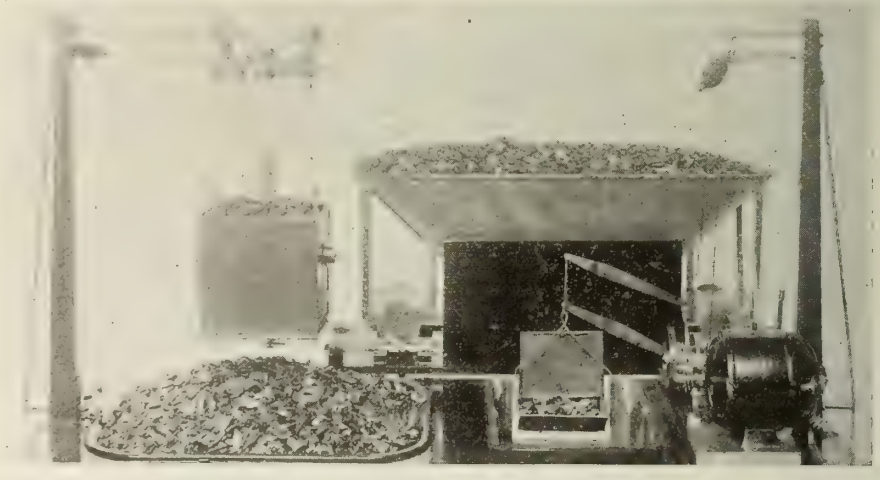
By E. R. K.

THE accompanying illustration shows a model of a new coal conveyor system which is said to be a great improvement in coal unloading and storage methods as developed at Elkhart, Indiana.

This method was devised to handle the unloading and storage of coal for the retail coal dealer, just as mines are employing modern methods in putting coal into the cars.

The conveyor is entirely mechanical and reduces labor by eliminating hand shoveling. One man operator only is necessary and it reduces breakage and degradation by not dropping, dragging, scraping or squeezing the coal, successfully handling all sizes. It increases the storage capacity by filling the bins to the roof with no limit as to height and uses gasoline or electric power for its operation.

This reversible overhead conveyor is provided with a self-dumping and self-closing bucket of thirty-six cubic feet capacity. The railroad track hopper is equipped with a single action, double gate with apron attachment. One operator at the hoist can control the entire operation, lower the bucket any distance from the operator, raise it again and return it to its starting point. A large spring inside the bucket is so placed as to let the coal out by gravity and close again when bucket is empty. The bucket is lowered from overhead car down to the pile and automatically dumped, allowing the coal to pass out without dropping as soon as the bucket is raised. As soon as the tripper comes in contact with the coal the safety device is unhooked, and as the bucket shifts on the suspending ropes this allows the tripper to slide off the bottom and the weight of the contents of the bucket forces the door open.



WORKING MODEL OF UNIQUE COAL HANDLING OUTFIT ADAPTED FOR THE SMALL DEALER.

At the Elkhart installation the bucket used is of 1-ton capacity. The coal is dropped into a pit at the side of the railroad track and filled from a chute which receives the coal from the hopper bottom of the coal car. The bucket is hauled up an incline track, being supplied with trunnion rollers at each side which operate upon the track, and is lowered upon the top of the pile or bin. A trigger releases the bottom of the bucket and the weight of the coal causes the bucket to empty, when the spring bottom immediately closes and is ready

for another load. In order to get the bucket back to the starting point a double drum arrangement and a double pulley on the carrier are used. This device has a capacity of unloading about three cars in eight hours, or ample capacity for the average coal dealer. One of the advantages of this plan is that the coal is not broken up and a second advantage is that nothing like the initial investment cost of a typical coal elevator is required.

HOW TO USE A PSYCHROMETRIC CHART

By J. I. Lyle

IN all branches of engineering requiring more than the ordinary amount of calculation, it has been the tendency to simplify the various computations, as far as possible, by the use of tables or charts, or both. In the field of thermodynamics no one subject has been in greater need of such simplification than air conditioning. Here we have a variety of problems in which a slight alteration of the conditions often makes an astonishing difference in the total results.

Since the development of air conditioning on its present extensive scale it has become a matter of the first importance for heating engineers to familiarize themselves with the principles involved. Up to the present time it is a matter of common knowledge that the average heating engineer has not brushed up on this subject to the extent he should in order to take advantage of his growing opportunities in this field.

Among the various noteworthy psychrometric charts that have been published is one designed by Willis H. Carrier and presented in a paper read before the American Society of Mechanical Engineers. This chart was acclaimed at the time as a classic of its kind and it immediately took rank as an authoritative exposition of the subject. Recently a new form of this chart has appeared, which is reproduced herewith.

It is generally recognized that much time and labor may be saved by the use of this and similar charts, but the fact remains that such saving depends to a very large extent on how familiar one becomes with the chart itself. In short, it is often true that while the advantages of a given chart are freely admitted, the time required to master its use often acts as a deterrent to its widespread adoption.

In an effort to remove this possibility, as far as this particular chart is concerned, the following instructions have been prepared, in which almost every feature of an air conditioning problem has been presented and its solution shown on the chart.

Instructions For Use of Chart

All references to temperature are in degrees Fahrenheit.

Dry-bulb temperatures are represented by vertical lines, with values indicated on lower edge of chart.

Wet-bulb temperatures are represented by oblique straight lines, with values indicated on curved line marked "wet bulb temperature."

Dew-point temperatures are represented by horizontal lines and their values indicated on curved lines marked "wet-bulb temperature."

Percentages of relative humidity are represented by converging curved lines, with values indicated between the oblique straight lines for 63° and 64° wet-bulb temperature.

Any two of the above properties may be found if the other two are known. First, find the point of intersection of the lines representing the given properties, and then follow through this point, the lines representing the unknown properties, and the values of the latter can be read from their respective scales.

Example 1.—Given: Dry-bulb temperature, 70°; wet-bulb temperature 60°. Find the percentage of relative humidity and the dew point. Locate point of intersection of vertical line representing 70° dry-bulb temperature and the oblique line representing 60° wet-bulb temperature.

Reading from this point the percentage of relative humidity is 56 and the dew-point 53.4°.

Example 2.—Given: Dry-bulb temperature, 80°; relative humidity, 59%. Find the dew-point and wet-bulb temperature. Locate the point of intersection of the vertical line representing 80° dry-bulb temperature and the curved line representing 59% humidity.

Reading from this point, the dew-point is 64.8° and the wet-bulb temperature 69.5°.

Example 3. Given: Dry-bulb temperature, 75°; dew-point temperature, 55°. Find percentage of relative humidity and wet-bulb temperature. Locate the point of intersection of the vertical line representing 75° dry-bulb temperature and the horizontal line representing 55° (wet-bulb scale).

Reading from this point the relative humidity is 49.8% and the wet-bulb temperature 62.3°.

Example 4. Given: relative humidity. 50%; wet-bulb temperature, 60°. Find dry-bulb temperature and dew-point. Locate the point of intersection of the curved line representing 50% humidity and the oblique line representing 60° wet-bulb temperature.

Reading from this point. the dry-bulb temperature is 71.7° and the dew point 52°.

Example 5. Given: wet-bulb temperature, 55°; dew-point, 50°. Find dry-bulb temperature and relative humidity. Locate the point of intersection of the oblique line representing 50° wet-bulb temperature and the horizontal line representing dew-point of 50°.

Reading from this point the dry-bulb temperature is 61.5° and the relative humidity 68%.

Example 6. Given: Relative humidity, 40%; dew-point, 40°. Find dry-bulb temperature and wet-bulb temperature. Locate the point of intersection of the curved line representing 40% relative humidity and the horizontal line representing 40° dew point.

Reading from this point, the dry-bulb temperature is 65.02° and the wet-bulb temperature 52°.

Total Heat of Air

The total heat of air is a function of its wet-bulb temperature, as described and proven by Willis H. Carrier in his rational psychrometric formulae. In the chart, it is taken for the sake of convenience as above zero, degrees Fahrenheit.

The total heat in B. T. U. is represented by horizontal lines with values indicated at the left by the scale D, "Total Heat Above Zero Degrees contained in One Pound of Dry Air Saturated with Moisture."

To find the total heat, the wet-bulb temperature must first be determined. Then follow the vertical line through the wet-bulb temperature reading at 100% humidity, to the "Total Heat" curve D. The horizontal line through this point represents the total heat above zero, and the value is indicated on the scale D at the left.

Example 7. Given: Dry-bulb temperature, 70°; relative humidity 60%. Find the total heat. The wet-bulb temperature determined by the method used in Example 2, is 61°. Following the vertical line through the point representing 61° wet-bulb temperature and 100% relative humidity, to its intersection with curve D and then reading horizontally to scale D on the left, the total heat above zero degrees in one pound of given air is 26.7 B. T. U. The total heat to be removed in cooling air between two temperatures is found by substracting the total heat at the lower temperature from that at the upper as follows:

33.5 B.T.U.,	Total heat above zero degrees (dry bulb 70°)
26.7 B.T.U.,	Total heat above zero degrees (wet bulb 61°)
6.8 B.T.U.	Heat to be removed by cooling.

Absolute Humidity (Grains of Moisture Per Cubic Foot)

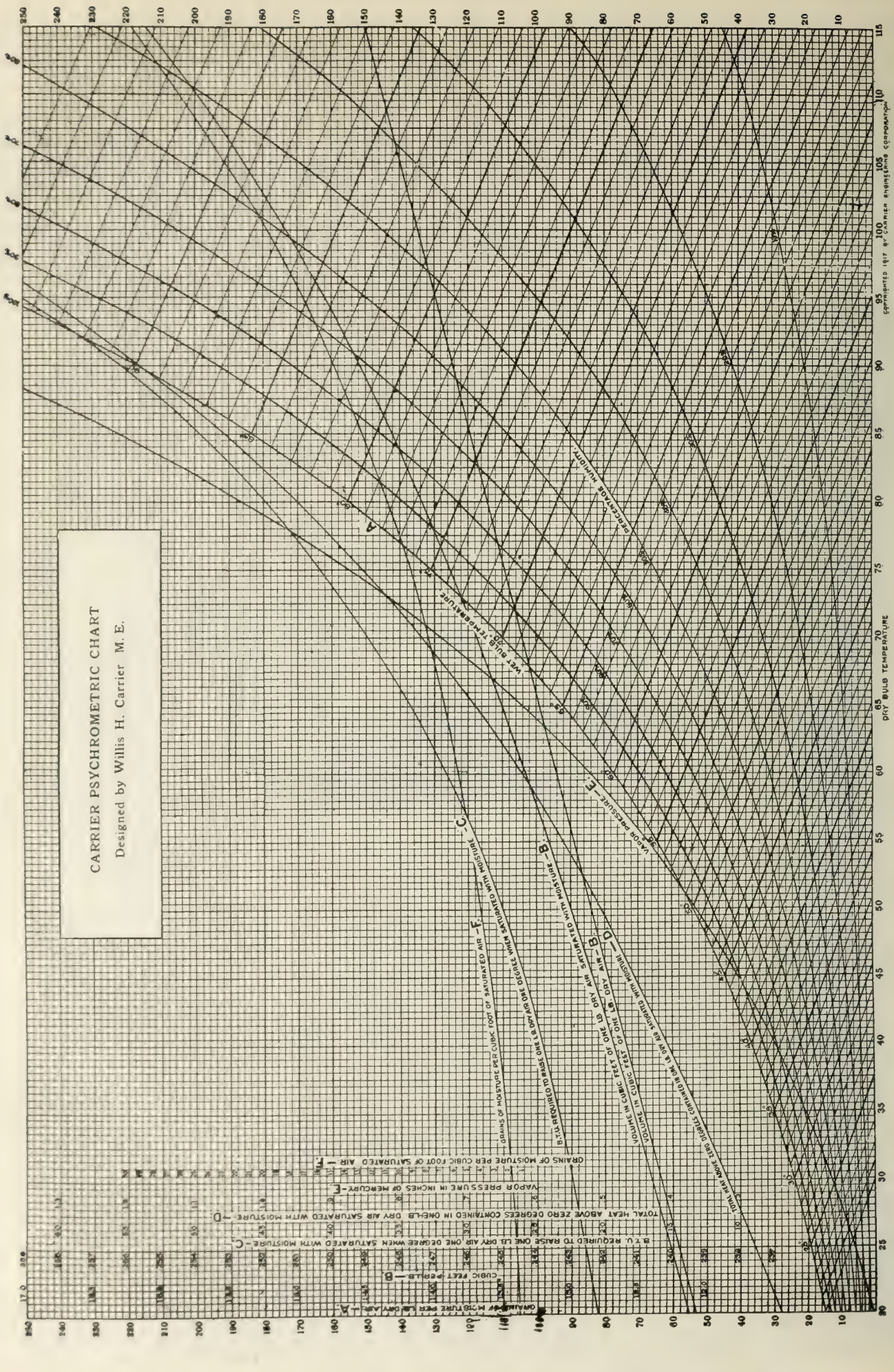
Absolute humidity is a function of the dew-point and may be expressed either ingrains per pound or dry air or in grains per cubic foot.

The grains of moisture per pound of dry air are represented by horizontal lines with values indicated on the scale A, "Grains of Moisture per Pound of Dry Air."

To find the grains of moisture per cubic foot for air under given conditions, first determine the grains per pound of dry air by finding the intersection of the (vertical) dry-bulb line and the (oblique) wet-bulb line and reading from there horizontally to scale A, "Grains of Moisture per Pound of Dry Air" at the left.

The volume in cubic feet per pound of dry air is represented by horizontal lines with values indicated by scale B, "Cubic Feet per Pound."

Find the points of intersection of the (vertical) dry-bulb temperature line with the curves B, "Volume in Cubic Feet of One Pound of Dry Air Saturated with Moisture" and "Volume in Cubic Feet of


CARRIER PSYCHROMETRIC CHART
Designed by Willis H. Carrier M. E.
DRY BULB TEMPERATURE
WET BULB TEMPERATURE
PERCENTAGE HUMIDITY
VAPOR PRESSURE
GRAINS OF MOISTURE PER LB. OF DRY AIR
CUBIC FEET PER LB.
B.T.U. REQUIRED TO RAISE ONE LB. DRY AIR ONE DEGREE WHEN SATURATED WITH MOISTURE
TOTAL HEAT ABOVE ZERO DEGREES CONTAINED IN ONE LB. DRY AIR SATURATED WITH MOISTURE
VAPOR PRESSURE IN INCHES OF MERCURY
GRAINS OF MOISTURE PER CUBIC FOOT OF SATURATED AIR
GRAINS OF MOISTURE PER CUBIC FOOT OF SATURATED AIR
B.T.U. REQUIRED TO RAISE ONE LB DRY AIR ONE DEGREE WHEN SATURATED WITH MOISTURE
VOLUME IN CUBIC FEET OF ONE LB. OF DRY AIR AND IT'S ASSOCIATED MOISTURE
TOTAL HEAT ABOVE ZERO DEGREES CONTAINED IN ONE LB. DRY AIR AND IT'S ASSOCIATED MOISTURE
COPYRIGHTED 1917 BY CARRIER ENGINEERING CORPORATION

One Pound of Dry Air." Follow these horizontally to the left and read the values on scale B. The difference in these two readings of volumes is the extra volume due to moisture at 100% humidity.

To obtain the direct volume of the moisture per pound of air under the given conditions, find the volume of water vapor for the given per cent. of humidity and add it to the volume of dry air.

Then grains of moisture per cubic foot or in other words the absolute humidity, is

$$\frac{\text{Grains per pound of dry air}}{\text{Cubic feet per pound of mixture}}$$

Example 8. Given: Dry-bulb temperature, 70°; wet-bulb temperature, 60°. Find the absolute humidity (grains of moisture per cubic feet).

Reading vertically on the 70° dry-bulb line and obliquely on the 60° wet-bulb line to the curve marked "Wet-Bulb Temperature," and from there horizontally to Scale A, the number of grains of moisture per pound of dry air is 61.

Then locate the points of intersection of the vertical dry-bulb line for 70° with the two curves B, and follow these horizontally to scale B at the left.

13.7 cu. ft.—Volume of one pound of dry air saturated with moisture.

13.38 cu. ft.—Volume of one pound of dry air.

0.32 cu. ft.—Extra volume due to moisture at 100% humidity.

(In instances where the air is saturated or dry, its volume may be found directly by locating the point of intersection of the [vertical] dry bulb line with the corresponding curve B and referring to the scale B.)

The percentage of humidity for air under the given conditions is indicated where the 70° dry and 60° wet-bulb lines intersect, which by interpolating between the 60° and 50° humidity curves is 57%.

57% of 0.32 is 0.1824 cu. ft., volume of moisture in the given air.

13.38 cu. ft.—volume of dry air.

0.1824 cu. ft.—volume of moisture.

13.5624 cu. ft.—volume of one pound of the given mixture.

$$\frac{61 \text{ gr. per lb.}}{13{,}5624 \text{ gr. per cu. ft.}} = 4.499 \text{ grains of moisture per cubic foot.}$$

Vapor pressure in inches of mercury depends upon the dew point and is represented by horizontal lines with values indicated by the scale E "Vapor Pressure in Inches of Mercury."

To determine the vapor pressure, read horizontally from intersection of (vertical) dry-bulb line with (oblique) wet-bulb line. Read through the wet-bulb temperature scale A and the "Vapor Pressure" curve E to the scale E at the left. The reading here is the vapor pressure. It should be noted when getting the reading for saturated air that the dew-point, wet and dry-blub temperatures are identical.

Example 9. Given: dry-bulb temperature 70°; wet-bulb temperature, 60°. Find the vapour pressure.

Reading vertically on the 70° dry-bulb line to the point of intersection with the (oblique) 60° wet-bulb line, and then horizontally through the wet-bulb temperature curve A, through the dew point and (wet-bulb reading is 53.5°) to the vertical scale E, "Vapor Pressure in Inches of Mercury." The vapor pressure for this point reads 0.405 inches.

To Find the Resulting Relative Humidity When Heating or Cooling Air Without Changing its Dew Point

Find the dew-point line for the given conditions which is the horizontal line through the point of intersection of the (vertical) dry-bulb line with the (oblique) wet-bulb line. Follow this line horizontally to the new dry-bulb temperature line and read the percentage of humidity for this point of intersection.

Exampe 10. Given: dry-bulb temperature, 70°; wet-bulb temperature, 60°. Find the resulting relative humidity when the air is heated to 80° (dry-bulb temperature).

The point of intersection of (vertical) 70° dry-bulb and (oblique) 60° wet-bulb lines indicates an existing humidity of 56%. Following the point of this indication horizontally to intersection with the (vertical) 80° dry-bulb line and the relative humidity reading on the curve is 40%.—Heating and Ventilating Magazine.

EFFICIENCY IN REFRIGERATION

By M. M.

Real efficiency, about which we hear so much nowadays, consists merely in attaining a certain predetermined result by the easiest, quickest and best method. For many years aboard ship the commissary was somewhat of a secondary consideration; in fact, on some vessels the scale dropped even lower, but in any event it was never considered a serious problem. Careful investigation has, however, proved that men do better work, stick by the ship better, and are generally more useful in every respect if they are given plain, nourishing food that has been kept in first-class shape under ideal or, at least, sanitary conditions. In order to maintain such in the food compartments a refrigerating machine or, as it is most generally spoken of, an "ice machine" is essential.

To prove this to your satisfaction, it is only necessary to visit a ship immediately upon her return from an extended trip and look at the interior of the ice box. You will find on the floor racks about one-half ton of ice or less mixed up with various meats of various kinds in different stages of health—some of them comparatively healthy and some of them rather under the weather. You will also probably find a few very much dilapidated fowls that are away off color and very soggy. This is not first-class grub, and the commissary departments are beginning to realize it, so that gradually the various boats of all kinds—freighters, tankers, passenger ships, tugs, etc., are being equipped with ice machines.

When you enter the freezing compartment of a mechanically-cooled box you will find a temperature of two to ten points below freezing point, the air crisp and clear; there are no disagreeable odors, the meat and the poultry are firmly frozen, and thereby immune to deterioration for a long period. This is the theoretical side of the question. Now to come right down to earth and talk about the most important phase of the whole subject, which is the "dollar and cents" side. On one line of steamers, where a very careful record is kept of the "per meal" cost, the actual saving per meal by mechanical refrigeration with a well known system over the old style of ice method of cooling was 3½ cents.

This freighter had thirty men aboard, which at 3½ cents showed a saving of $1.05 per meal, $3.15 per day, or $1,149.75 a year. The plant on their boat cost in the neighborhood of $2,000, so that the outfit was paid for in two years. This is an actual saving when all costs of operation against cost of ice, etc., are taken into consideration. In some cases the saving might be less; in some it might very well be more. The above is cited as an instance to show that in addition to the improved sanitary conditions that are obtained by mechanical refrigeration there is an actual saving in money. Another point in favor of mechanical refrigeration is that whatever you buy in the way of supplies is fully used. Meat with a system installed in a vessel can be carried to the Orient and back in first-class shape, but a ship is lucky that can carry meat half-way across the Red Sea where ice is used as a refrigerant.

GRAND RIVER IMPROVEMENT ASSOCIATION

FOR some years the Grand River Improvement Association has been urging that conservation dams be built to create storage reservoirs on the upper waters of the Grand and of the Speed Rivers.

Noulan Cauchon, the consulting engineer, of Ottawa, who, with W. F. Tye, C.E., consulting engineer of Montreal, has recently urged that the Grand River conservation be carried out not only for flood prevention but to enable the creation of high power and also the irrigation of large areas of the most fertile land in Canada.

Mr. Cauchon proposes a main canal for joint irrigation and power purposes, from a point about three miles below Galt, at the 900-foot level, through a natural pass for some three miles easterly, thence continuing across open level country to the 800-foot level on the escarpment above Dundas. This canal would be about fifteen miles in length. The drop at Dundas from elevation 800 to the Dundas marsh, elevation 245, would be 555 feet within 1¼ miles. The initial power so developed would be from 15,000 horsepower up, according and as fast as more conservation, more reservoirs, be completed.

The MacLean Publishing Company
LIMITED
(ESTABLISHED 1888)

JOHN BAYNE MACLEAN - - - - - - - President
H. T. HUNTER - - - - - - - - - Vice-President
H. V. TYRRELL - - - - - - - - - General Manager

PUBLISHERS OF

POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air, and Water Power, and to the design and operation of Refrigerating Machinery.

B. G. NEWTON, Manager.
J. M. WILSON, Editor. A. R. KENNEDY, Asst. Editor.
Associate Editors:
A. G. WEBSTER J. H. RODGERS (Montreal) W. F. SUTHERLAND

OFFICES

CANADA—
Montreal—Southam Building, 128 Bleury St., Telephone Main 1004.
Toronto—143-153 University Ave., Telephone Main 7324.
Winnipeg—1207 Union Trust Building, Telephone Main 3449.
Eastern Representative—E. M. Pattison.
Ontario Representative—S. S. Moore.

Toronto and Hamilton Representative, J. N. Robinson.

UNITED STATES—
New York—R. B. Huestis, 111 Broadway, New York, Telephone 8971 Rector.
Chicago—A. H. Byrne, 900 Lytton Bldg., 14 E. Jackson Street. Phone Harrison 1147.
Boston—C. L. Morton, Room 733, Old South Bldg., Telephone Main 1024.

GREAT BRITAIN—
London—The MacLean Company of Great Britain, Limited, 88 Fleet Street, E.C., E. J. Dodd, Director, Telephone Central 11960. Address: Atabek, London, England.

SUBSCRIPTION RATE

Canada, $1.00; United States, $1.50; Great Britain, Australia and other colonies, 4s. d., per year; other countries, $1.50. Advertising rates on request.

Subscribers, who are not receiving their paper regularly, will confer a favor by telling us. We should be notified at once of any change in address giving both old and new.

Office of Publication, 143-153 University Avenue, Toronto, Ontario.

Vol. XI. MAY, 1918 No. 5

PRINCIPAL CONTENTS

The Granby Auxiliary Steam Plant at Anyox, B.C., I. 115-118
General 118-119
Gas From Straw....Napthalene as a Motor Fuel....The Lubrication of Shafting.
Electricity and Hydraulics 120-126
Principles and Operation of Modern Electrical Equipment III.....Switch Gear Standardization; Necessity and Advantages....Electric Drive Saves 30 Per Cent.
General 126
The Distillation of Coal Under Pressure....Armature Burned Out.
Steam and its Generation 127-130
Conservation of Fuel....Modern Cooling Towers....Readers' Query re the Laying up of Boilers....Causes of Chimney Troubles....A Unique Electric Coal Conveyor.
How to Use a Psychrometric Chart 131-133
General 133
[illegible] in Refrigeration.
Editorial 134-135
Power, Combustion and Such-like....The Needs of Canada [illegible] Industrial Research.
Association and Personal 135
Annual Convention of the Canadian Association of Stationary Engineers.
The Operator's Point of View 136-137
Oxygen and Its Combustion....Correspondents' Discussions [illegible] Steam Hotter Than Live Steam?....A New Low Water Alarm....The Art of Firing.
Progress in New Equipment 138-139
A Plastic Refractory For Boiler Baffles....Ball Bearing Application to Vertical Motor....Electric Monorail Hoists [illegible] CO_2 Recorder.
The Operators' Instruction Course 141
Education Paper VII.
Selected Market Quotations 142
Trade Gossip, Catalogues (Advtg. Section) 46-48

POWER, COMBUSTION AND SUCH-LIKE

INVENTIVENESS is a trait which finds a peculiarly receptive home in the brain of power house engineers, be they designers or operators. The continuous association with mechanism and the study of the translation of forces from the latent state of nature to the active state of kinetic energy encourages the investigation of problems whose solution frequently necessitates the evolution of new forms of mechanism or the application of known apparatus in new ways.

The lure of perpetual motion has received more or less attention from most men at some time of their lives, and by the time they are of mature age they are, 99 and 9-10ths per cent. of them, reconciled to the fact that it is impossible.

The problem of converting the heat of the sun's rays in useful work is a different matter altogether, the problem there being to do in a short time what nature takes quite a while to do.

It does not take long for a cubic foot of wood to change into CO_2 at the right temperature and under the proper conditions of air supply. It does, however, take quite a while to change that CO_2 back into wood and air through the action of the sun's rays on a plant.

How does the plant do it? Does the "vegetable spirit" play the part of a catalyst by virtue of the life in it, so that the action of the sun's rays on air and air may become effective?

Destroy the "spirit" and the action ceases. All the elements are there as before but all are inactive. The quest of such a source of power is on a par with perpetual motion. The sun is perpetual enough in the ordinary sense of the word, and the two problems may well be classed as unattainable with our present knowledge.

Somewhat akin to these are attempts to use the oxygen in the air as a fuel wherewith to get cheap power. These are due to a misunderstanding of the function of oxygen. All substances which generate heat when uniting with oxygen are combustible. Oxygen is the "combuster." A clear perception of this would save much misspent effort.

THE NEEDS OF CANADA IN REGARD TO INDUSTRIAL RESEARCH

THAT scientific industrial research has proven its worth in cold cash as a business investment was stated by Professor F. C. Fields of Toronto, in a recent public address, although the initial cost of such expenditure is one of the chief obstacles to a more liberal attitude towards research on the part of many manufacturers.

Figures given by Professor Fields regarding such work in America are illuminative:

"In the case of one firm, an investment of $25,000 in two years had yielded assets of $200,000 and an annual profit of $1,000,000. In another case the same investment in 18 months was bringing a profit of $50,000.

"In one instance an investment of $25,000 in four months paid $1,500 per day."

Such instances of course are confined by the nature of circumstances to a limited number of firms, and in the broad national aspect are not of benefit to the population as a whole except via the sales department of the firm making the investment. All that is right and proper, but such a feature differs essentially from British practice which has been considerably accelerated of late.

The "State Department of Scientific and Industrial Research" in Great Britain has a fund of a million pounds sterling at its disposal and among its activities it has been founding co-operative laboratories for manufacturers in similar industries, the department defraying the costs.

The Council of Industrial and Scientific Research in Canada has ample precedent for its existence and while numerically its results may be less than those of similar bodies of other countries, it is a national necessity and as such should be kept closely in touch with by manufacturers throughout the Dominion.

Only by knowing what to look for can the efforts of such an institution be efficiently directed, and while natural resources offer many fields of application, the industrial life of the Dominion will become more consolidated if manufacturers once see the possible benefits to be derived by judicious consultation with the council.

Association and Personal

ANNUAL CONVENTION OF THE CANADIAN ASSOCIATION OF STATIONARY ENGINEERS

The annual convention of the Canadian Association of Stationary Engineers, which will be held at London, beginning June 25, holds promise of being an unusually interesting event.

The convention will be opened by Mayor Summerville on Tuesday, June 25, after which the appointment of the various committees will take place. The afternoon session will be adjourned early in view of the expected trip to Springbank Park, one of London's beauty spots, and well adapted to the holding of the entertainment which will be provided.

Wednesday morning will be given over to a business session, and after lunch an excursion has been arranged for, through the courtesy of the C.A.S.E. Exhibitors' Association, to Port Stanley. Refreshments, sports and games will be held at Port Stanley, and on the return to London in the evening an entertainment will be provided also by the Exhibitors' Association. The Thursday sessions will be fully taken up with election of officers and other business.

Special provision has been made for the entertainment of the ladies, and it is expected that several visits to local plants manufacturing household goods and provisions will be made.

G. W. Ketter has joined the staff of the Electric Furnace Construction Co., Philadelphia, having resigned his position with the British Forgings Co., Ltd., Toronto, Ont.

Herbert A. Jackson was recently elected president of the Chicago Pneumatic Tool Co., Chicago, to succeed W. O. Duntley, resigned. He was born in Bethlehem, Conn., July 7, 1881.

R. D. Smith has recently been appointed to the position of Steam Superintendent for the Wayagamack Pulp Mills at Three Rivers, Que. Previous to his leaving for Three Rivers, Mr. Smith was chief engineer at the Windsor Station, Montreal, Que.

John Hale, executive secretary of the Canadian Association of Stationary Engineers, Hamilton, Ont., has been in hospital for the past two weeks undergoing an operation. His early and complete recovery is hoped for by his wide circle of friends and acquaintances.

LIEUT. PEILER

Who has been reported prisoner, unwounded, in Germany.

Pte. Harold F. Fogarty, formerly on the editorial staff of POWER HOUSE, is in a hospital in France suffering from a gunshot wound in the chest. Pte. Fogarty went overseas with the 198th Battalion early in 1917, but was later transferred to another unit. His home is in Port Hope, Ont.

H. L. Peiler, general manager of the Mason Regulator and Engineering Co., Ltd., Montreal, has received word that his son, Second Lieutenant Maurice F. Peiler, R.F.C., is a prisoner, unwounded, in Germany. He had previously been reported missing on April 6. Lieut. Peiler was born in Montreal twenty-one years ago and was educated at the Montreal High School, Berthier Grammar School and Montreal Technical School. For two years he was with the St. Catherine Street branch of fthe Molsons Bank, and later accountant with his father's business. He went to Toronto July 6 last and was given his wing as a qualified scout pilot eleven weeks later, was in training in England at the end of October, requalified on November 23, and on the 30th of that month was in France on active service. On February 26 last he downed his first Hun 'plane and bagged two more enemy machines on the 13th of last month.

On April 25 the death in action of Captain Michael Chapman was announced. He was well known to the machinery and electrical trade in Canada, having been for some years a member of the firm of Chapman & Walker, Ltd., electrical engineers and dealers in machine tools and supplies. This business continued from 1909 until the outbreak of the war in 1914, when Mr. Chapman enlisted, taking his officer's course and getting a commission first as lieutenant, being advanced to the rank of captain afterwards. Deceased came to Canada from England, where he was formerly with Crompton & Co., at Chelmsford, Essex. On coming to this country he was for a time with the Canada Foundry Co., going into business with Mr. Walker at a later date. He was married, and is survived by a widow and two children, the family being in England at the present time.

The late Captain Chapman had been previously wounded in the war, and won the Military Cross for bravery in action during some of the heavy fighting in February. He was with the Grenadier Guards, a regiment to which he was attached shortly after entering the service. Not long ago he wrote to a close friend, part of his letter being as follows: "If I am killed I want you not to fret or mourn for me. It is a fine death for a great cause." Of him the Colonel of the regiment wrote: "The example he set everyone was glorious. He died more than upholding the honor of our great regiment."

OPERATOR ORGANIZATIONS

British Columbia Association of Stationary Engineers, Vancouver.—Subordinate Lodges at Vancouver, Victoria, New Westminster, Cumberland, Merritt, and Fernie.

North-West Association of Stationary Engineers, Edmonton, Alta.

Manitoba Association of Stationary Engineers, Winnipeg.

Canadian Association of Stationary Engineers, Hamilton, Ont.—Subordinate Lodges at Montreal, Toronto, Hamilton, Ottawa, Brantford, Guelph, Kitchener, Chatham, Ont.; St. John, N.B.; Owen Sound, London, Stratford, Belleville, Kingston, Sudbury, St. Thomas, North Bay, Port Arthur, Sarnia, and Windsor, Ont. The executive officers of the C.A.S.E. Grand Lodge are as follows:—

Past President—W. G. Forbes, Montreal, Que.
President—R. F. Gofton, Kitchener, Ont.
Vice-President—Wm. Cooke, Belleville, Ont.
Treasurer.—A. W. Heath, Hamilton, Ont.
Conductor—S. Balmforth, Toronto, Ont.
Doorkeeper—George Moll, London, Ont.
Secretary.—John H. Hale, Hamilton, Ont.

The Operators' Point of View

OXYGEN AND ITS COMBUSTION

IN criticising your article in February issue re oxygen for power engines, it was not my intention to open any useless controversy, but merely to question the accuracy of your correspondents information.

However, since Union Engineer has seen fit to question my knowledge of the subject, and incidentally my standing as an engineer, it devolves upon me to take up the cudgels in my own behalf, as unfortunately upon my reputation depends my bread and butter. So I must ask for more of your valuable space.

I might state for Union Engineer's benefit, that I am personally known to both the editors of this magazine, and also to the business agent of Local 152. Union Engineer asks, "Since when have we been dependent on combustibles for use in engines as a motive force?"

If a dictionary be consulted it will be found that combustible is a term which is applied to anything that will burn. So that the question is, since when have we been dependent on things that will burn for use in engines as a motive force?

As an answer to that question, I will ask another. Since when, (excepting wind and water power), have we not been dependent on things that will burn for motive power? True, steam and compressed air are not combustible, but the coal that was used to raise the steam must have been. So that for steam engines we certainly are dependent on combustibles for motive force.

But anyway, neither steam or compressed air are motive forces, they are simply the vehicles used to convey the power contained in the coal and liberated by its combustion to the engines in question.

Union Engineer certainly has some peculiar ideas regarding combustibles, when he says that gasoline is not combustible until mixed with air. Evidently he is confused with the terms combustion and explosion, or rather combustible and explosive. (By the way I wonder if Union Engineer, ever placed a lighted match in contact with gasoline and noted the result).

The same dictionary mentioned before would say that explosion was combustion so rapid as to be instantaneous. But whilst an explosion is combustion, combustion is not necessarily an explosion. An explosion only takes place when all the elements necessary for combustion are intimately mixed. So that a mixture of gas and air, gasoline vapor and air, oil, vapor and air, coal dust and air, and many others, are explosive mixtures.

Union Engineer, says that hydrogen and oxygen can be reduced to liquids, and expanded like steam, to drive engines in the same way as steam. Very true, but these would not be motive forces, but as in the case of steam and compressed air, simply vehicles; but anyway, where would U. E. get the power from to compress these gases, and what percentage of the power used to compress them would be available for use in the said engines?

When Union Engineer begins to study chemistry he will find that oxygen is a colorless, odorless gas which is not combustible, but which very strongly supports combustion. Further it forms one-fifth of the atmosphere by volume, eight-ninths of water by weight, and about 50 per cent. of the earth's crust by weight.

In the original article which started this controversy, oxygen was mentioned as taking the place of gas, oil, or gasoline in an "internal combustion" engine. Union Engineer seems to have lost sight of those two words, for in my opinion they presuppose the existence and use of some combustible.

In the ordinary internal combustion engine, oil, gasoline, gas, or alcohol, are combustibles most frequently used. However there can be no combustion without air, or rather oxygen, and as air is the cheapest source of oxygen, a mixture of the combustible (in vapor form) and air is used. As there could be no combustion without oxygen, neither could there be any combustion without the combustible. If there could be such a thing happen, we should be able to raise steam without burning coal.

Union Engineer presumes that the inventor intends to use oxygen from the air in the same way as gasoline is used, combining hydrogen with oxygen, etc, Very good, but there is no mention of hydrogen in the original article. Anyway, why use hydrogen, when oil and gasoline are already to hand and cheaper to obtain?

There would be no difficulty in regulating a mixture of hydrogen and oxygen gases in an engine cylinder, nor is there any difficulty in the way of using acetylene:—if—they were cheap enough. If the present engine designs are not suitable for these gases, it is quite possible to obtain some which would be.

In regard to the activity of nitrogen possibly the following combustion equations might enlighten U. E. a little.

Combustion of Carbon—

$$\underset{\text{Carbon}}{C} + \underset{\text{Air}}{(4\,N_2 + O_2)} = \underset{\text{Carbon Dioxide}}{CO_2} + \underset{\text{Free Nitrogen}}{4\,N_2}$$

Acetylene—

$$\underset{\text{Acetylene}}{2\,C_2H_2} + \underset{\text{Air}}{5(4\,N_2 + O_2)} = \underset{\text{Carbon Dioxide}}{4CO_2} + \underset{\text{Water}}{2H_2O} + \underset{\text{Nitrogen}}{20N_2}$$

Black Powder—

$$\underset{\text{Potassium Nitrate}}{2\,KNO_3} + \underset{\text{Carbon}}{3C} + \underset{\text{Sulphur}}{S} = \underset{\text{Potassium Sulphide}}{K_2S} + \underset{\text{Carbon Dioxide}}{3\,CO_2} + \underset{\text{Nitrogen}}{N_2}$$

Nitroglycerin—

$$\underset{\text{Nitroglycerin}}{2C_3H_5(ONO_2)_3} = \underset{\text{Carbon Dioxide}}{6\,CO_2} + \underset{\text{Water}}{5\,H_2O} + \underset{\text{Nitrogen}}{6N} + \underset{\text{Oxygen}}{O.}$$

As I understand the term "active element," it means that the element readily combines with other elements to form compounds. With this in mind, the equations given do not show nitrogen to be a very active element, as in every case free nitrogen was evolved. I would like to cay that as far as I am concerned the subject is closed, as it is not my intention to write again on this subject.

Union Engineer's remarks, whilst of interest have failed to remove my original doubts, although they have removed some others. But why does not Union Engineer come from out of his ambush, and use his own name? It is possible that he may be convinced that there is no push in oxygen used as a base like gasoline, for if he really studies the question he will find that is impossible.

In conclusion I would quote for Union Engineer's consideration that old saying attributed to the Duke of Wellington, "Be sure you are right; then go ahead."

S. BALMFIRTH.

Correspondent's Discussion

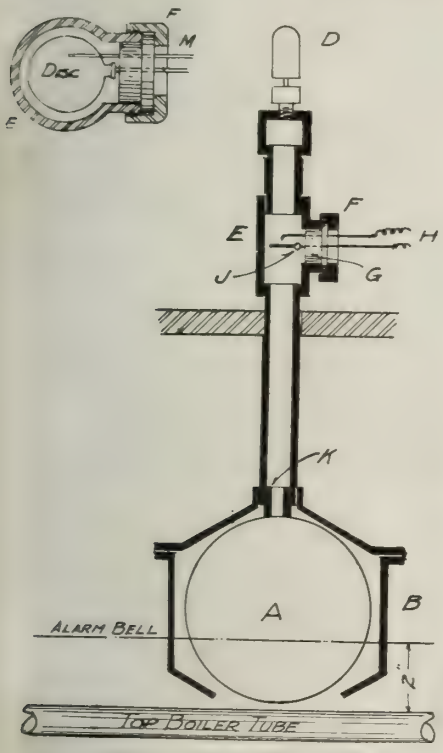
Attention of correspondents is drawn to the customary condition whereby the real name and address of contributors (not necessarily for publication) must accompany all articles. In view of this we are compelled to discontinue the above discussion, and also hold back several other articles.

IS EXHAUST STEAM HOTTER THAN LIVE STEAM?

When discussing power house problems with an engineer recently, the writer was asked the above question, and promptly replied "neither," presuming, of course that equal pressures existed. The question came up through the assertion that it was easier to keep a heating system in order with exhaust steam than by using live steam direct from the boilers; it took less steam, judged by the coal consumption of the boiler.

If any readers of POWER HOUSE have actual experience of such conditions it would afford interesting matter for discussion. Can you oblige?

Toronto J. W. MAXWELL



A NEW LOW-WATER ALARM

A NEW LOW-WATER ALARM

By John Port

The low-water alarm for steam boilers shown in the sketch is a new idea as to design. In Fig. 1 a seamless, heavy, copper or brass float ball is shown at A. It is held in place by an iron casing B; an extra heavy piece of iron pipe, ¾ inch, is screwed into the float casing and through the boiler shell. A brass seat piece is screwed into the pipe end at K; a sectional view of a tee is shown at E, and a plan view of the same tee in the upper view.

One end of the tee (the center) is filled with a strong insulating material at G; through this material passes two iron rods ,a brass disc is hinged to one of the rods at J (the top rod is shown to one side in Fig. 2 for clearness). To the outside ends of these rods the terminals of a bell-ringing outfit are connected, H; the bell can be in any place desired, such as the manager's office in some other building. Above the tee is a nipple and a small whistle, D. When the water in the boiler lowers to a dangerous level the float drops and steam passes up through the hole at K; it forces the disc against the other or top rod and rings the bell in the office, also the steam whistle blows. As soon as the water reaches a safe level the float raises and closes the vent at K, and the disc drops back. The principle of the ball and vent is the same as that used in a well-known steam trap, only it works in exactly the opposite way. The ball opens when the water is high in the steam traps. The ball closes the opening when the water is high in the alarm.

THE ART OF FIRING

By N. G. Near

W. H. A. says in the April number of POWER HOUSE, page 110:

"To be sure there is no great art in wheeling coal or shoveling it into the furnace. Where the art comes in is in putting it into the right place at the right time."

While it is true that in hand firing it is necessary to put the coal in the right place at the right time, the writer is inclined to question the completeness of this declaration. There are so many other things to be considered that in my mind these two little points sink into almost insignificance.

How about the air? Isn't it a fact that the regulation of air is about the most important point of all? Complete combustion means much more than that all of the coal be consumed. It is easy enough to burn up all the coal and have only ash remaining. What we want is efficient combustion, and the only way in which efficient combustion can be attained is by properly proportioning the air, by keeping the fire clean, by eliminating air-infiltration, by maintaining the correct thickness of fire, and that is perhaps all so far as combustion itself is concerned.

Then we have the soot question. No matter how careful the fireman is he is going to produce soot in greater or lesser degree and he must keep it off of the tubes as completely as possible. That is quite a job in itself. The old hand lance will do the work better than no cleaning method at all, but there is a more modern method these days—the installation of a permanent soot cleaner. And that isn't all either; the soot cleaner must be used. The mere installation won't help a bit unless the elements are swung around with steam turned on about three or four times per day, depending upon the kind of coal used, the load carried by the boilers, etc. The jets sweep down between the tubes from the right side and from the left, and in cyclonic fashion clean off the offending soot and ash deposits. A great deal of the matter adhering to or lying on the tubes is not soot at all, you know, but is some form of ash. It is really surprising the number of colors and kinds of ash that have been found in boiler tubes. The soot cleaner problem does not strictly come under the heading of "combustion," yet it is a part of the fireman's job to keep the tubes clean, and should be added to the "art" W. H. A. speaks of in the April number.

More closely associated with combustion is the CO_2 recorder. Combustion, you know, is a chemical process, that is why so few of us understand combustion. It is quite possible that nobody living understands combustion. We can talk and write about it glibly enough, the atomic and molecular theories sound perfectly plausible. It is learned that the elements combine in a certain way every time, that laws can be made which are followed to the dot by the combustion process, but beyond that we are helpless. The writing I am doing here is not adding one whit to our knowledge, either, but these thoughts are my own and I am always willing to trade thoughts and ideas for someone else's thoughts and ideas. So, we will simply leave it to the chemist to do the best he can in the matter of making a CO_2 machine for us that will automatically and continuously record the CO_2, for there is nothing more important in combustion than to maintain the proper percentage of CO_2.

Some engineers have the idea that the percentage of CO_2 should always be as high as possible, but not so. By making it too high there is danger of getting too little air, so we are told. It is better to run on a little less than the theoretical maximum by using a surplus of air than to use the exact theoretical mixture and consequent imperfect combustion. It takes time for the gases to mix in the burning process, and ordinarily, if a surplus of air is not admitted, the gases strike the comparatively cool tubes, the temperature of the gases drops below the temperature of combustion, good carbon is deposited on the tubes, good CO escapes up the chimney, and the owner is virtually throwing money away up the flue by attempting perfect combustion. A surplus of air hastens the combustion process, and even though there is a loss involved in wastefully heating the surplus air it is better to suffer that loss than to permit the greater one where CO escapes unburned.

The most modern method of handling the CO_2 question is to have a recorder in the chief's office which permits him to keep a constant eye on combustion efficiency, and at the same time keep a CO_2 indicator on the boiler front in full view of the fireman. It is the duty of the fireman to keep the CO_2 at the most economical point.

Lastly, the fireman who must use his good old muscle in feeding the furnace is handicapped in constantly maintaining the right percentage of CO_2. If he could throw the coal into the furnace without opening the fire doors it would be much nicer, but that method hasn't been invented yet, so far as the writer knows. When the door is opened the CO_2 drops. With an automatic continuous stoker it is a simpler matter to maintain constant CO_2.

Progress in New Equipment

A PLASTIC REFRACTORY FOR BOILER BAFFLES

THE principal loss of heat from a boiler furnace is in the flue gases, and is measured by the product of their weight multiplied by their excess of temperature over atmospheric temperature. High temperature of gases may be due to coming into contact with too little heating surface, to coatings of soot or scale upon the heating surface, which prevent the absorption of heat from the gases, but most commonly to defects in the baffling. Baffles may be improperly located, producing dead spaces where the gases do not circulate in the tube banks of water tube boilers, or the baffling may not provide for a sufficiently high velocity and long path of the gases of combustion.

Defective baffling is the most common cause of high chimney temperatures. The baffles may have fallen down or bricks or blocks may have slipped out from between the boiler tubes, allowing the short-circuiting of a large amount of gas.

The strongest reason for the installation of pyrometers to measure flue gas temperatures is that they serve to notify the operating force at once regarding baffle failures. Where abnormally high temperatures are found a broken-down baffle is always to be expected.

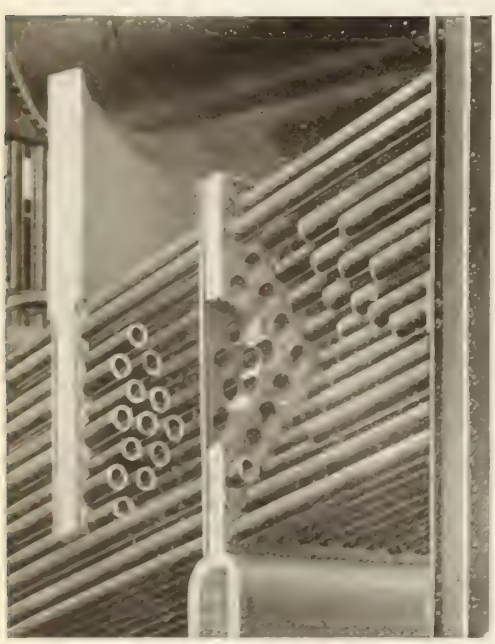


FIG. 1. BETSON PLASTIC FIRE BRICK BAFFLE IN A B & W VERTICAL HEADER BOILER.

Baffles for water-tube boilers have in the past consisted of tile, bricks or blocks of refractory material fitted in between the tubes. In cross-baffled boilers these tiles are introduced between the tubes by springing the latter, and naturally do not form very tight joints with one another or with the tubes, especially after the latter have become warped or sprung, as they invariably do, in service. It is also difficult to insure that blocks will remain where they are placed and will not slip or fall, leaving large openings. Due to the manner in which baffles are inserted in boilers, it is almost impossible to cement them together, besides which the difference in expansion and contraction of the boiler and baffling would break the joints apart. Brick and blocks also warp and twist, and are frequently split by the pinching effect of the tubes.

The accompanying illustrations show how jointless and, therefore, gas-tight baffles can be made by the use of a refractory known under the trade name of plastic fire brick, and manufactured by the Betson Plastic Fire Brick Co., of Rome, N.Y. This material was originally introduced for lining boiler furnaces, and is compounded of refractory materials so prepared as practically to eliminate expansion and contraction with changes in temperature.

The material is shipped in barrels in a moist, plastic condition, ready for use. In forming a cross baffle for a water-tube boiler of the B. & W. type the ordinary cast iron baffle plate is used as one side of the mould, while the other is made by thrusting slats in through the diagonals between the tubes, as shown in Fig. 2. The plastic material is then poked down through the diagonals to fill the space between the cast iron baffle plate and these slats. It is sufficiently plastic, so that it can be forced out sidewise around the tubes, fitting the latter sngly.

When this work has been completed the boiler is fired up slowly, the criss-cross of slats burns out, and the plastic material is dried and vitrified in place. This operation occupies only a few hours, after which the full load may be put upon the boiler. Inasmuch as the boiler comes up to full steam pressure before the material is thoroughly set, the expansion of the metal pushes away the soft material to the position which it should occupy when the boiler is hot, and while the boiler will draw away from the material in cooling off again, the baffles will always fit tightly when the boiler is under steam.

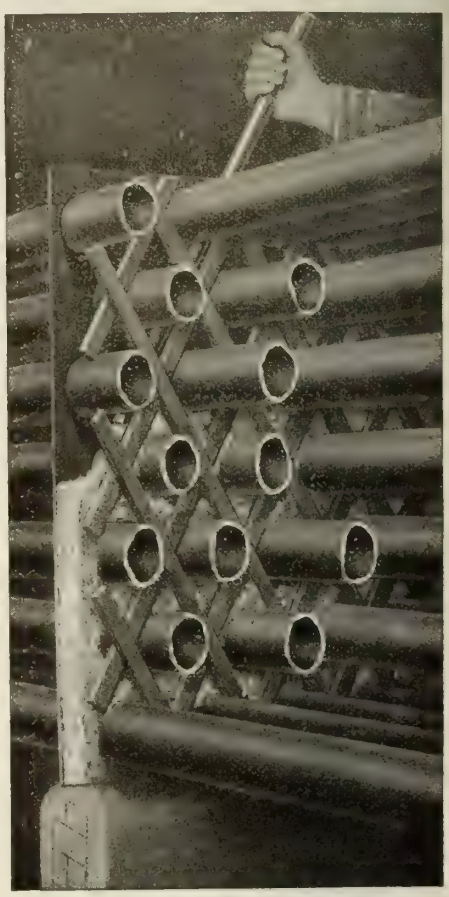


FIG. 2. METHOD OF PLACING AND COMPACTING THE MATERIAL, WHICH IS RETAINED IN PLACE BY A CRISS-CROSS OF SLATS UNTIL SET BY THE FIRE

In forming a longitudinal baffle blocks of wood are placed in between the tubes above and below the space which it is desired that the baffle shall occupy, thus confining the plastic material, which is shoved in from the side in the case of baffles in the middle of the tube bank, or from underneath or overhead in the case of the baffles at the bottom or top of the tube bank.

Referring to the illustration, Fig. 4, the slats (S) are placed in position between the tubes (T), as shown (second row), and are held in place by balls of the material jammed under them. This material is then pushed into the space (B) and rammed with the end of a piece of 2 by 4. Starting work on each side, the operator works towards the middle. As fast as a section is done the lower slat (S) is placed as shown until all slats are in place on the lower row. Fire

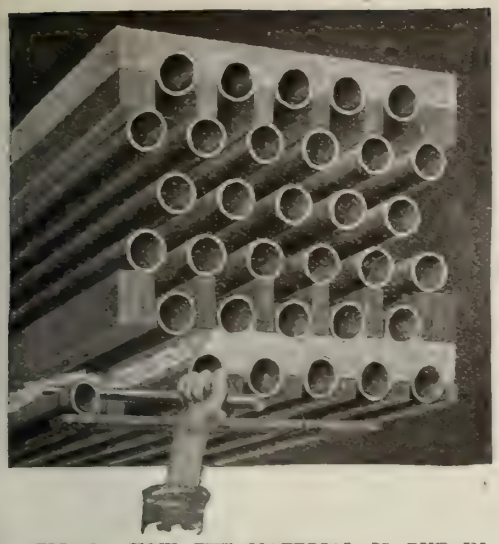


FIG. 3. HOW THE MATERIAL IS PUT IN PLACE TO FORM HORIZONTAL OR LENGTHWISE BAFFLES IN WATER TUBE BOILERS

slowly at first, as described under vertical baffles.

Where this material is used, there is no restriction upon the shape or size of the baffle, and the latter can, therefore, be arranged in any form desired. In cross-baffled boilers, for example, it is becoming the practice to slope or incline the baffles, so that the gas passage will contract progressively from the point where the gases enter the tube to the point where they leave, in order to maintain a uniform gas velocity, in spite of the shrinkage of gas volume with cooling. This is easily accomplished with the plastic material, whereas with the solid bricks or blocks a special block is required, which can be inserted and maintained in place only with difficulty, if at all.

This material also finds use as a substitute for special forms of bricks or blocks, as for example, where the front headers of horizontal water-tube boilers rest upon the front arch. Its use for lining furnace and combustion chambers, including front arch, side walls, bridge wall, rear arch, etc., has been described previously. The exacting tests to which it has been put in direct contact with the fuel bed and with the gases of combustion before they have been cooled by the boiler surfaces proves its ability to withstand high temperature gases and stresses such as are encountered in furnace construction for long periods without crumbling or otherwise deteriorating.

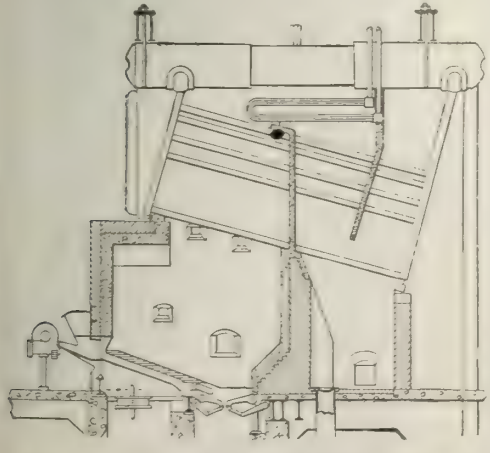


FIG. 4. THE PLASTIC MATERIAL CAN BE USED FOR SLOPING BAFFLES AND TAPERING GAS PASSAGES

POCKET CO_2 INDICATOR

A RELIABLE indication of the character of combustion in any furnace is the percentage of CO_2 in the gases of combustion. The higher the latter can be raised the greater will be the economy in fuel. For the complete combustion of coal, gas, oil, or any other fuel, a certain definite quantity of air is necessary. Too little air will result in a portion of the heat value of the fuel going up the stack unconsumed, and in being entirely wasted. The other extreme, however, is usually experienced in the average furnace. Too much air is supplied, which results in a cooling down of the furnace gases; at the same time the temperature of the excess air has to be raised from room temperature to that of the stack, usually 500° Fahr. or more, which is an absolute waste.

The curves in the chart, Fig. 1, show that for coal-fired furnaces, about 40 per cent. of excess air is necessary to obtain the most efficient combustion. This is indicated by the highest CO_2 contents obtained by this amount of air as shown by the two curves. A greater percentage of excess air reduces the CO_2 contents and therefore increases the fuel loss. Thus, for 300 per cent. excess air the CO_2 drops to 5 per cent., while the corresponding fuel loss becomes 21 per cent.

A portable CO_2 indicator has recently been placed on the market by the Bacharach Industrial Instrument Co., Pittsburg, Pa., and as will be seen from the accompanying illustrations it is much more convenient and simple than the bulky Orsat apparatus usually employed.

A test takes about 2½ minutes, and it is possible to go from boiler to boiler and make about 20 tests an hour.

With ordinary care an analysis can be made with a maximum error of plus or minus 0.2 per cent. The reagent is a solution of potassium hydroxide in water, and several hundred analyses can be made with one charge of caustic.

In using the indicator the two cocks A and B are first put in place and the glass jar F at the lower end removed and filled with the analyzing solution, after which it is screwed on again. The

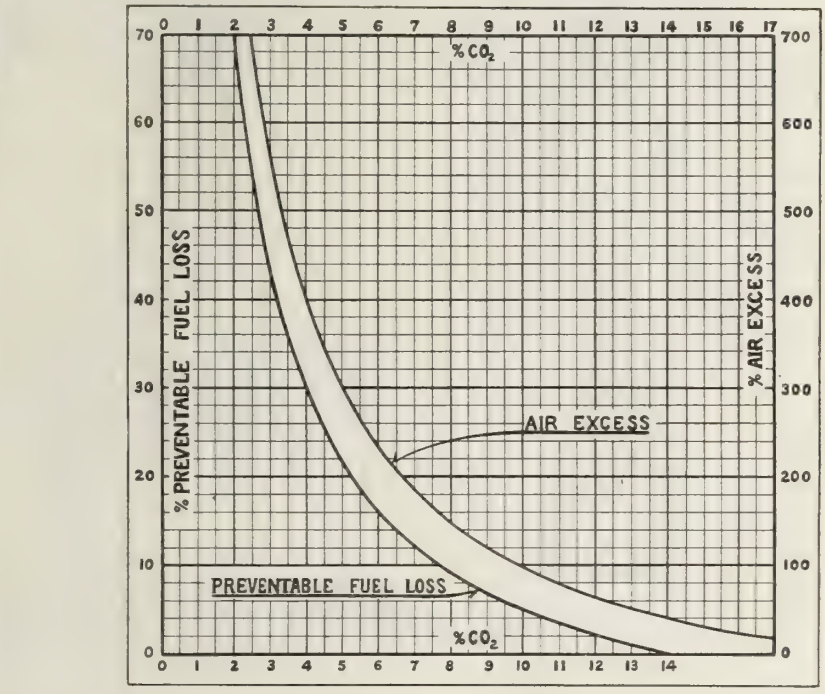


FIG. 1—CURVE SHOWING RELATION BETWEEN EXCESS AIR AND PREVENTABLE FUEL LOSS.

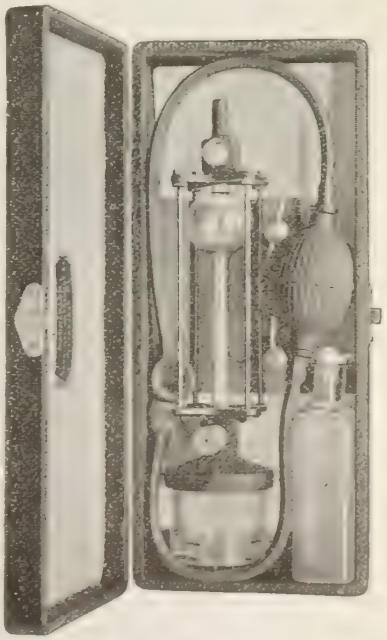


FIG. 2—CO INDICATOR IN CASE.

pump is attached to the open upper valve and the cock A of the lower valve turned so that the gas measuring tube H is open to the atmosphere through the hole C. The open end of the pump is then connected to the gas line from which the sample is to be taken, and the gas pumped in, a fair sample being taken, about 30 strokes of the pump be-

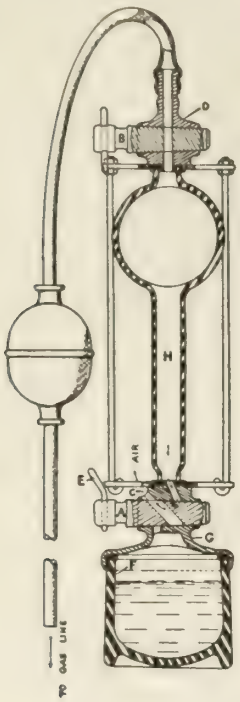


FIG. 3—APPARATUS IN POSITION FOR ADMISSION OF GAS SAMPLE.

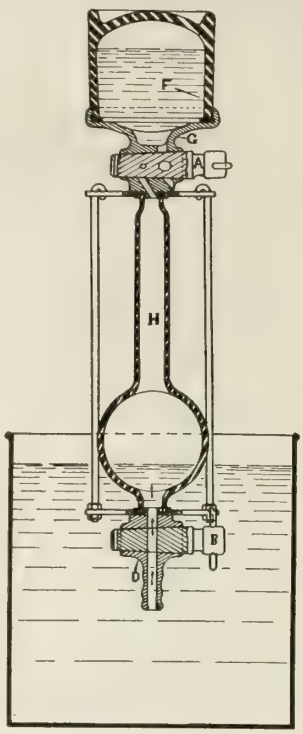


FIG. 5—ADMISSION OF WATER FOR MEASURING PURPOSES.

ing sufficient. The upper cock B is then closed.

The lower cock A is then turned 180° to permit the gas and KOH to come into contact for chemical action, the process being helped by holding the apparatus in an inclined position as shown in Fig. 4. When the solution has been drained

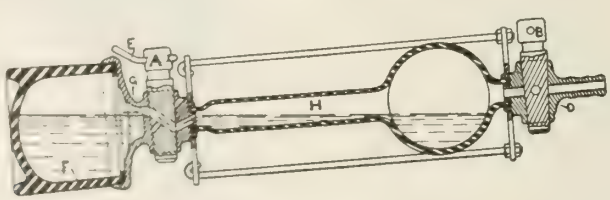


FIG. 4—APPARATUS HELD IN INCLINED POSITION.

back to the glass jar F the lower cock A is closed and the indicator held upside down and immersed in water, Fig. 5. The submerged cock B is opened and the ingoing water which takes the place of the absorbed CO_2 is levelled with that outside. The cock B is then closed, the indicator brought to its base, and the per cent CO_2 read off on the tube at water level. The water is emptied by opening the cock B and turning the apparatus upside down.

ELECTRIC MONO-RAIL HOISTS FOR HANDLING ASHES

THE three accompanying engravings show the electric mono-rail hoist as manufactured by the Link-Belt Co. of Chicago, Ill., in actual service as an ash conveyor in Fig. 1 and 2 and a coal conveyor for filling the stoker hoppers in Fig 3.

It is designed primarily to afford an ash handling system for old boiler houses whose construction does not provide the modern labor saving devices, nor room for same and which would not warrant the expenditure nor the maintenance involved in the installation of a very elaborate equipment.

In such instances the mono-rail hoist will appeal on the grounds of low first cost and maintenance, the greater ash handling capacity and ease of handling, the small space requirements and simplicity of installation, as well as the ease and efficiency of operation.

The machine consists of hoist carriage with trailer cage which runs on the lower flange of an I beam track. The operator controls the raising and lowering of the bucket as well as the travel of the hoist from the cage. The capacity of

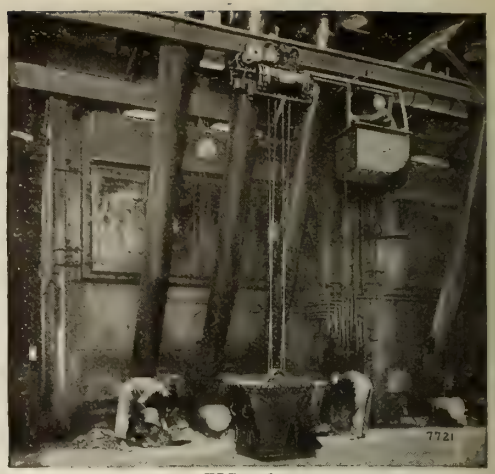


FIG. 1.

the bucket is 1¼ cubic yds. and the lifting capacity of the hoist is 2 tons. All the gears operate in oil and are entirely enclosed in housing as is necessary considering the material handled.

In many instances where it is advisable to instal stokers to increase the ca-

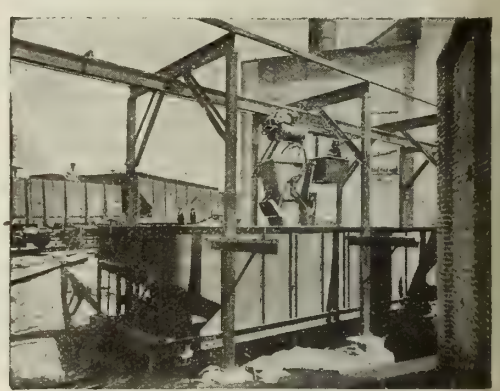


FIG. 2.

pacity of the plant, lack of space would militate against installation of overhead bunkers. It may then be practical to use the mono-rail hoist system to handle the coal as well as ashes. Cut No. 3 shows a tipping bucket about to discharge coal into a stoker hopper. A bucket with a small chute and under chute could be used to advantage for this work.

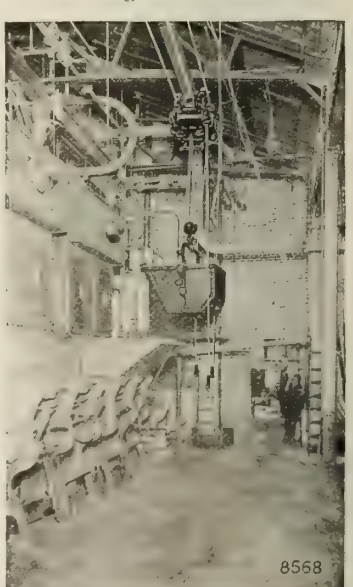


FIG. 3.

Operators' Instruction Course

EDUCATION PAPER VII

WHAT is the horsepower of a boiler 66 in. diameter, 16 ft. long, with 78 only 3½ in. tubes?

It is customary to allow 12 sq. ft. of heating surface to a boiler horsepower when dealing with horizontal return tubular boilers. The heating surface is taken to be the full area of the boiler tubes and one half the area of the shell. A 3½ in. tube has a heating surface of .9163 sq. ft. for each foot in length, and 78 tubes 16 ft. long will have an area of 78 x 16 x .9163=1,143.6 sq. ft. The heating surface (effective) of a 66 in. shell is 8.64 sq. ft. per ft. in length and so therefore a shell 16 ft. long has a heating surface of 8.64×16=138.24 sq. ft.

The total heating surface is 138.24+1,143.6=1,281.84 sq. ft.

The horsepower is 1,281.84÷12=107 nearly.

* * *

If the pressure shown on a gauge is 95 lbs. per sq. in. what is the height of the water?

The height of a column of water corresponding to a given gauge pressure may be found by multiplying the observed gauge pressure by 2.3. Therefore 95×2.3=218.5 ft.

* * *

What is the pressure at the column of water 250 ft. high?

The pressure in pounds per square inch corresponding to a given height in feet may be found by multiplying the given height in feet by .43. Therefore 250×.43=107.5 lbs. per sq. in.

* * *

What is the grate bar area of a furnace 5 ft. 5 in. wide by 6 ft. long?

The grate area is 5 ft. 5 ins.×6=32½ sq. ft.

* * *

How many gallons of water will be pumped in one hour by a duplex steam pump 6 in. in diameter by 10 in. stroke, running at 60 strokes per minute, allowing 10 per cent. slippage?

The area of a circle 6 in. diameter expressed in square feet is .1963 and the volume of water pumped in one stroke of the pump is .1963×10÷12=.1635 cu. ft. The volume pumped in one hour, taking into consideration the 10 per cent. slippage will be .1635 x 60 x 60×90/100 =529.74 cu. ft., or 529.74×6¼=3,311.4 imperial gallons.

* * *

What is the horsepower of an engine 25 in. by 50 in., running 65 revs. per min., with a m.e.p. of 51.5 lbs.?

The horsepower of an engine is given by the formula:

$$\frac{\text{PLAN}}{33{,}000}$$

Where—

P=the mean effective pressure in pounds per square inch
A=Area of piston in square inches
N=Number of strokes per minute.
L=Length of stroke in feet.

The area of a 25 in. cylinder is 490.874 sq. ins., the length of stroke is 4.125 ft., and the number of strokes is 130 per min. Substituting in the formula we obtain, 51.5×490.874×4.125×130÷33,000=410.8 indicated horsepower.

BITUMINOUS COAL OUTPUT SHOWING STEADY INCREASE

THE United States Geological Survey issues the following report on the production of bituminous coal and the causes of loss of working time for the week ending May 4, 1918:

The week ended April 27 recorded not only the highest rate of production of bituminous coal during the past 12 months but the third successive week of rising production.

Production of bituminous coal (including lignite and coal made into coke) is estimated at 11,668,000 net tons, an increase of 5.7 per cent. over the preceding week. The average production per working day is estimated at 1,946,000 net tons compared with 1,840,000 net tons last week, and 1,680,000 net tons during April, 1917.

Production for the month of April, 1918, is estimated at 46,478,000 net tons, an increase of 4,400,000 net tons or 10 per cent over April of last year. Production for the four months ended April, 1918, is estimated at 181,992,000 net tons, an increase of over 5,000,000 net tons or 3 per cent compared with the same four months of 1917.

The production of beehive coke during the week ended April 27 is estimated at 652,000 net tons, compared with 614,000 the week previous. The average daily production is estimated at 109,000 net tons, an increase of 7 per cent over last week. Anthracite shipments slightly increased during the week of April 27, nine roads reporting 39,522 carloads compared with 39,130 during the preceding week.

POWER DEVELOPMENT NEAR MONTREAL

IN view of the present interest in the power development in Montreal and Quebec province and the apparent need of further development in the near future, the fact that Montreal Power can develop 300,000 horse power against the 240,000 which it will have by midsummer will be of interest.

The present capacity of Cedar Rapids is 100,000 horse power, though the water power development is 180,000 horse power; units to develop 20,000 horse power are now being installed, and will be completed by the end of July, when the power from the plant will be 120,000 horse power units, for the remaining 60,000 horse power will be installed as required.

Lachine and Soulanges plants develop from 12,000 to 15,000 horse power. The contract with Shawinigan would give the Power 65,000 to 75,000 horse power.

The situation is that in a couple of months the company will have a nominal capacity of 240,000 horse power hydro-electric for distribution, and may increase this to 300,000 horse power hydro-electric simply by adding necessary units. In addition, its auxiliary steam plants have a capacity of 30,000 horse power available at any time.

This may be divided approximately, as follows:

	H. P.
Power Co's. Chambly plant	20,000
Power Co.'s Lachine plant (12,000 to 15,000)	12,000
Power Co's. Soulanges plant (12,000 to 15,000)	13,000
Power Co's. Cedars Rapids by July 31	120,000
Shaw W. & P. on contract	75,000
Hydro-electric power available by August	240,000
Cedars Rapids additional unit capacity	60,000
Hydro-Electric, totals	300,000
Capacity Co's. steam auxiliaries	30,000

FOR some time a fairly regular aerial mail service has been established between Italy and Sicily, in lieu of the former somewhat unsatisfactory combination of railroad and ferry. The trip by aeroplane occupies some three hours, and by leaving Naples in the morning the aeroplane can return from Palermo in the early afternoon.

SELECTED MARKET QUOTATIONS

A Record of Prices Current on Raw, Semi-finished, and Finished Materials Entering Into the Manufacture and Operation of Power Plant Equipment

BOILER TUBES

Size	Seamless	Lapwelded
1 in.	$36 00	$.....
1¼ in.	40 00	.....
1½ in.	43 00	36 00
1¾ in.	43 00	36 00
2 in.	50 00	36 00
2¼ in.	53 00	38 00
2½ in.	55 00	42 00
3 in.	64 00	50 00
3¼ in.	.....	58 00
3½ in.	77 00	60 00
4 in.	90 00	75 00

Prices per 100 feet, Montreal and Toronto.

PLATES

	Montreal	Toronto
Plates, ¼ to ½	$10 00	$9 00
Heads	10 30	9 25
Tank plates, 3-16 in.	10 10	9 10

WROUGHT PIPE

Effective Jan. 7, 1918.
Standard Buttweld.

Size.	Black Per 100 feet	Galvanized Per 100 feet
⅛ in.	$ 6 00	$ 8 00
¼ in.	5 16	7 29
⅜ in.	5 16	7 29
½ in.	6 55	8 12
¾ in.	8 28	10 41
1 in.	12 24	15 39
1¼ in.	16 56	20 82
1½ in.	19 80	24 89
2 in.	26 64	33 49
2½ in.	42 72	53 53
3 in.	55 85	70 00
3½ in.	70 84	87 86
4 in.	83 93	104 10
Standard Lapweld		
2 in.	29 60	36 08
2½ in.	44 46	54 70
3 in.	58 14	71 53
3½ in.	72 68	90 62
4 in.	86 11	107 37
4½ in.	97 79	122 56
5 in.	114 00	142 82
6 in.	147 80	185 28
7 in.	192 80	241 57
8 in.	202 50	253 75
9 in.	233 30	292 32
10L in.	259 50	379 18
10 in.	259 20	324 80
	333 70	418 18

Prices—Ontario, Quebec and Maritime Provinces

WROUGHT NIPPLES

4" and under, 45%.
4½" and larger, 40%.
4" and under, running thread, 25%.
Standard couplings, 4" and under, 35%.
4½" and larger, 15%.

IRON PIPE FITTINGS

Malleable fittings, class A, 20% on list; class B and C, net list. Cast iron fittings, 25% off list. Malleable bushings, 25 and 7½%; cast bushings, 25%; unions, 45%; plugs, 20% off list. Net prices malleable fittings: Class B black, 24½c lb.; Class C black, 15¾c lb.; galvanized, Class B, 34c lb.; Class C, 24½c lb. F.O.B. Toronto.

COLD ROLLED SHAFTING.

At mill ..... list plus 40%
At warehouse ..... list plus 50%
Discounts off new list. Warehouse price at Montreal and Toronto.

FINISHED IRON AND STEEL

Per lb. to Large Buyers	Cents
Iron bars, base, Toronto	$5 25
Steel bars, base, Toronto	5 50
Steel bars, 2" to 4" base	6 00
Iron bars, base, Montreal	5 25
Steel bars, base, Montreal	5 50
Reinforcing bars, base	5 25
Small shapes	5 75

SHEETS

	Montreal	Toronto
Sheets, Black, No. 28.	$ 8 00	$ 8 25
Sheets, Black, No. 10.	10 00	9 50
Canada plates, dull, 52 sheets	9 00	8 65
Canada plates, all bright	9 50	9 50
Apollo brand, 10¾ oz. galvanized	....	....
Queen's Head, 28 B.W.G.	....	....
Fleur-de-Lis, 28 B.W.G.		
Gorbal"s Best, No. 28.		
Colborne Crown, No. 28	....	....
Premier, No. 28 U.S.	....	8 95
Premier, 10¾ oz.	....	9 25

PROOF COIL CHAIN B

¼ in.	$12 00
5-16 in.	11 50
⅜ in.	11 15
7-16 in.	10 90
½ in.	10 70
9-16 in.	10 70
⅝ in.	10 50
¾ in.	10 40
⅞ in.	10 25
1 in.	10 10
Extra for B.B. Chain	1 20
Extra for E.B.B. Chain	1 80

ELECTRIC WELD COIL CHAIN B.B.

⅛ in.	$15 50
3-16 in.	11 70
¼ in.	8 40
5-16 in.	7 40
⅜ in.	6 35
7-16 in.	6 35
½ in.	6 35
⅝ in.	6 35
¾ in.	6 35

Prices per 100 lbs.

FILES AND RASPS

	Per Cent.
Great Western, American	50
Kearney & Foot, Arcade	50
J. Barton Smith, Eagle	50
McClelland, Globe	50
Whitman & Barnes	50
Black Diamond	37½
Delta Files	37½
Nicholson	37½
Globe	50
Vulcan	50
Disston	50
P.H. and Imperial	50

OILS AND COMPOUNDS

Castor oil, per lb.	....
Royalite, per gal., bulk	18
Palacine	21
Machine oil, per gal.	26½
Black oil, per gal.	15
Cylinder oil, Capital	45½
Cylinder oil, Acme	36½
Standard cutting compound, per lb.	06
Lard oil, per gal.	2 50
Union thread cutting oil antiseptic	88
Acme cutting oil, antiseptic	37½
Imperial quenching oil	39½
Petroleum fuel oil	13½

BELTING—No. 1 OAK TANNED.

Extra heavy, single and double	30-5%
Standard	40%
Cut leather lacing, No. 1	$1 95
Leather in sides	1 75

COAL AND COKE.

Solvay Foundry Coke	.....
Connelsville Foundry Coke	.....
Steam Lump Coal	.....
Best Slack	.....

Net ton f.o.b. Toronto.

BOLTS, NUTS AND SCREWS

	Per Cent.
Coach and lag screws	25
Stove bolts	55
Plate washers ..... list plus	20
Machine bolts, 7-16 and over	net
Machine bolts, ⅜ and less	10
Blank bolts	net
Bolt ends	net
Machine screws, fl. and rd. hd., steel	27½
Machine screws, o. and fil. hd., steel	10
Machine screws, fl. and rd. hd., brass ..... add	20
Machine screws, o. and fil. hd., brass ..... add	25
Nuts, square blank ..... add	$1 50
Nuts, square, tapped ..... add	1 75
Nuts, hex. blank ..... add	1 75
Nuts, hex. tapped ..... add	2 00
Copper rivets and burrs, list plus	30
Burrs only list plus	50
Iron rivets and burrs	15
Boiler rivets, base ¾" and larger	$8 50
Structural rivets, as above	8 40
Wood screws, flat, bright	72½
Wood screws, O. & R., bright	67½
Wood screws, flat, brass	37½
Wood screws, O. & R., brass	32½
Wood screws, flat, bronze	27½
Wood screws, O. & R., bronze	25

MISCELLANEOUS.

Solder, strictly	0 47
Solder, guaranteed	0 50
Babbitt metals	18 to 70
Soldering coppers, 3 to 6 lbs.	0 64
Putty, 100-lb. drums	4 55
White lead, pure, cwt.	15 20
Red dry lead, 100-lb kegs, per cwt.	15 50
Glue, English	0 35
Gasoline, per gal., bulk	0 31½
Benzine, per gal., bulk	0 30½
Pure turpentine, single bbls., gal.	0 74
Linseed oil, raw, single bbls.	1 36
Linseed oil, boiled, single bbls.	1 39
Lead wool, per lb.	0 15
Plumbers' oakum, per cwt.	9 00
Sandpaper, B. & A. ..... list plus	20
Emery Cloth ..... list plus	20
Sal Soda	0 03½
Sulphur, rolls	0 05
Sulphur, commercial	0 04½
Rosin "D," per lb.	0 03
Rosin "G," per lb.	0 03½
Borax crystal and granula.	0 13
Wood alcohol, per gallon	1 80
Whiting, plain, per 100 lbs.	2 20

COPPER PRODUCTS

	Montreal	Toronto
Bars, ½ to 2 in.	$42 50	$43 00
Plain sheets, base 16 oz. and heavier	46 00	44 00
Copper sheet, tinned, 14x60 in., 14 oz.	48 00	48 00
Copper sheet, planished, base 16 oz. and heavier	57 00	45 00
Braziers' in. sheets, 6x4 base	45 00	44 00
Tubing T.P.S., base ¾ in. up to 3 in.	60 00	60 00

Above prices are full sheets and bars. Cut sheets and bars are 5c per lb. higher.

BRASS PRODUCTS.

Brass rods, base ½" to 1" rd.	$0 43
Sheets 24 oz. and heavier base	0 48
Brass tubing, seamless	0 55
Tubin, I.P.S., 1" base	0 55

POLISHED DRILL ROD.

Discount off list, Montreal and Toronto ..... Net

RUBBER BELTING

Standard	10%
Best grades	15%

WASTE

White.	Cents per lb.
XXX Extra	21
Peerless	21
Grand	19¾
Superior	19¾
X L C R	18½
Atlas	18½
X Empire	17¼
Ideal	17¼
X press	16
Colored.	
Lion	15
Standard	13½
No. 1	13½
Popular	12
Keen	10½
Wool Packing	
Arrow	25
Axle	20
Anvil	15
Anchor	11
Washed Wipers	
Select White	11
Mixed colored	10
Dark colored	09

This list subject to trade discount for quantity

MILLED PRODUCTS

	Per Cent.
Set screws	25
Sq. & Hex., Head Cap Screws	20
Rd. & Fil Head Cap Screws	Net
Flat & But. Hd. Cap Screws plus	Net
Fin. & Semi-fin. nuts up to 1 in.	25
Fin. and semi-fin. nuts, over 1 in., up to 1½ in.	20
Fin. and semi-fin. nuts, over 1½ in., up to 2 in., list plus	10
Studs	20
Taper pins	40
Coupling bolts, pins	10
Planer head bolts, without fillets ..... list plus	10
Planer head bolts, with fillet list plus 10 and	10
Planer head bolt nuts, same as finished nuts.	
Planer bolt washers	net
Hollow set screws..list plus	20
Collar screws..list plus 30,	10
Thumb screws	20
Thumb nuts	65
Patch bolts ..... add 40,	10
Cold pressed nuts to 1½ in. ..... add	$4 50
Cold pressed nuts over 1½ in. ..... add	$7 00

METALS

	Montreal	Toronto
Lake copper	$30 00	$28 00
Electro copper	30 00	28 50
Castings, copper	29 00	28 00
Tin	98 00	99 00
Spelter	10 50	10 00
Lead	10 00	9 00
Antimony	17 50	16 00
Aluminum	55 00	50 00

Prices per 100 lbs...

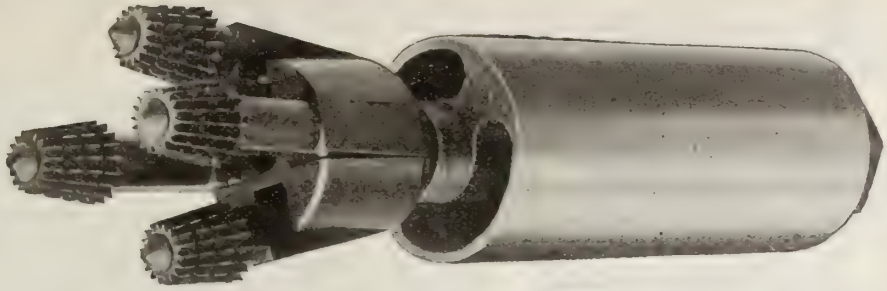
ROPES AND PACKING

Packing, square braided	0 34
Packing, No. 1 Italian	0 40
Packing, No. 2 Italian	0 32
Pure Manila rope	0 39
Transmission rope, Manila	0 45
Drilling cables, Manila	0 41

LEAD SHEETS

	Montreal	Toronto
Sheets, 3 lbs. sq. ft. lb.	$12 00	$13 25
Sheets, 3½ lbs.	12 00	13 25
Sheets, 4 to 6 lbs.	13 00	12 50

Cut sheets, ¾c per lb. extra.
Cuts sheets to size, 1c per lb. extra.



The "BULLDOG" Cleaner for straight tubes—3½ and 4 in. sizes

Engineer Duke was so sure of his "Bulldog's" ability that—

but read this fact story yourself

Frank K. Duke is a prominent Philadelphia engineer. At a plant near his own they decided to buy a boiler tube cleaner that was not a "Bulldog."

Mr. Duke had a "Bulldog" and to him it was the **only** tube cleaner worth having.

"Hold on!" he said to his neighbor. "Try another make of cleaner if you want to but try my 'Bulldog' in comparison with it—and don't buy before you do try."

He actually sent his "Bulldog" Cleaner over to them, loaned it to them for the trial—

And as usual, the "Bulldog" Cleaner proved its superiority. It emerged from that trial indisputably the winner.

We don't know of any more convincing experience than this in proving not only that the "Bulldog" is as good a scale remover as you'll find anywhere, but also that no one appreciates that fact so well as the engineer who uses a "Bulldog." When are you going to purchase yours?

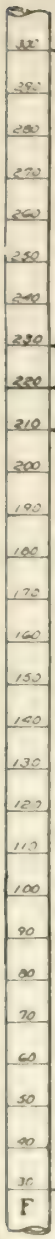
If you want some real definite information on scale fighting, send for our Catalogue "H." It describes the "Bulldog," also all types of Liberty Cleaners—a Cleaner for every purpose and every condition.

Liberty Manufacturing Company

6904 Susquehanna Street

Pittsburgh Pennsylvania

The "BULLDOG" Cleaner for bent tubes—3 and 3¼ in. sizes.



SARCO Is Set for YOUR Work at Any Point—Range 30 degrees to 300 degrees Fahrenheit

Change SARCO at Will to Suit Variations in Conditions—Range 20 degrees —10 degrees Up or Down

SARCO Temperature Regulator HOLDS Temperature Set

Our engineers study your own particular Temperature Regulator problems. Then we furnish SARCO Temperature Regulator, set to suit your work; 30 to 300 degrees F. for regular SARCOS. Extra ranges made at slight extra expense. First step of SARCO Service.

But we also give you a range of 10 degrees above or below the point at which SARCO is set to change the operating point. Simply turn the regulating screw. Invaluable where a different lot of materials, or other causes, require variations in process. Second step in SARCO Service.

Once set, SARCO eternally holds the temperature point. Works instantly to correct variations. Saves heating or cooling mediums. Saves spoilage. Eliminates errors and the human equation. Lasting, unaffected by anything — except temperature. Third step in SARCO Service.

Then we furnish SARCO valves adapted to the circulating medium you use — water or other liquids; steam or gas.

Also Thermostats that resist corrosion in any place they are designed to be inserted. Durability, permanence. Fourth step in SARCO Service.

Why SARCO is so simple, durable and effective is owing to the scientific principles on which it is constructed. Fully explained in a booklet, Give SARCO a free trial.

Write for Booklet J-2.

Sarco Co., Inc.

Woolworth Bldg., New York City

Buffalo Philadelphia
Cleveland Chicago Detroit

Representatives in all principal cities
Canada: Peacock Brothers, Montreal

TRADE GOSSIP

Renfrew, Ont.—The Roberts Filter Mfg. Co., Philadelphia, have the contract for filters costing $6,000, for the City Council.

Galt, Ont.—The Grand River Railway, which has been operating by Hydro, has been ordered by Sir Henry Drayton to start its steam plant.

Springfield, Ont.—The Canadian Ice Machine Co., Toronto, have the contract for refrigerating plant for the Springfield Milk Co., who are receiving prices for the supply of piping for water, steam and air.

To Develop Power.—North Vancouver contemplates the purchase of power site of the Naire Falls Power Co. The figure will be approximately $75,000. The idea is to secure a supply for the domestic lighting and heating of Greater Vancouver.

Dodd Heating Systems Ltd., has been incorporated at Ottawa with a capital of $100,000 to manufacture heating, lighting and power appliances and apparatus, etc. at Toronto. The incorporators are John O'Neil, H. S. Dodd and J. Sheedy, all of Toronto.

Canadian Graton & Knight, Ltd. has been incorporated at Ottawa by R. H. Jackson, F. P. Brais and J. Bruneau, all of Montreal, to manufacture leather belting and leather sundries of all kinds. The capital stock is $100,000 and the chief place of business is Montreal.

Build New Plant.—The firm of Fred Thompson Co., Ltd., has recently constructed a new three-storey and basement brick building to take care of their increasing business. This firm is manufacturing all kinds of electrical supplies; the new location is at 9 St. Genevieve St., Montreal.

To Conserve Fuel.—In order to assist in the conservation of fuel the Grand Trunk Railway are considering the installation of a powdered fuel system in their shops at Point St. Charles. The problem has been carefully gone into by the officials, but final decision has not yet been made.

The New Brunswick Power Co. has during the past year made extensive additions to its plant, $72,112 being spent on power house, $14,543 on new railway equipment, and $11,803 for replacement of special work. In addition to this $24,477 was spent on additions and extensions in the electric and gas departments.

The Geo. F. Foss Machinery & Supply Co., Ltd., has been incorporated at Montreal, to do business as engineers and engine manufacturers, general contractors, bridge builders, boiler makers, machinists, tool makers, etc. Letters were granted to G. Davenport, L. Delarge, L. Potvin, J. Bernier, A. David.

Calgary, Alta.—It is understood that no more hard coal is to be permitted to be shipped into the Canadian West. Winnipeg will receive a small supply, but western points must depend upon the domestic supply. This decision is said to have been reached at a conference between Western coal operators and Fuel Control officials at Ottawa recently.

The Canadian National Carbon Co., Ltd., has been incorporated at Toronto, to deal in calcium carbide, and all gas producing materials and gas, especially acetylene gas, and machinery, etc., for purposes relating to the process. The incorporators are: H. Harrison, barrister-at-law, R. E. Laidlaw, W. Robertson and S. D. Gardiner, students-at-law, and J. F. Van-Lane, accountant, all of the City of Toronto.

New Incorporations. — Joint stock companies incorporated include the following: Zimmerman Manufacturing Company, Limited, Hamilton, capital $1,000,000; Perfection Manufacturing Company, Limited, Montreal, capital $100,000; Webster Motors, Limited, Sherbrooke, capital $75,000; the Perfect Shoe Company, Limited, Montreal, capital $50,000; Prest-o-lite Company of Canada, Limited, Toronto, capital $800,000; Homes Foundry Company, Limited, Sarnia, capital $500,000.

Trenton.—Trenton ratepayers endorsed two money bylaws, one for $16,000 to install modern fire-fighting apparatus, including a new motor fire engine and chemical extinguisher, the other for $21,000 to purchase a waterworks system from the Hydro-Electric Commission of Ontario, who acquired it from Seymour Power and Light Co., when that concern was absorbed by the Hydro. Both bylaws were carried by large majority in heaviest poll ever registered on money bylaws in Trenton.

Montreal, Que.—To aid fuel conservation the Bell Telephone Co. intend to make some changes in their power plant at the head offices in Montreal during the early summer. A steam turbine will be installed to operate the pumps that generate the power for the hydraulic elevators; one of these will be changed over to be run by electric power. Their electrical power is now generated by Robb horizontal steam engines; these are to be replaced by motors, belt connected to the generators.

Crane, Ltd. is the name taken in incorporating at Montreal a company to manufacture, merchandise, buy, sell and in every manner deal in and with all kinds of steam, gas, water, oil, mine, mill, foctory engineers; plumbers; railways, hardware and builders' supplies and materials of all kinds and agricultural machinery and supplies, and to carry on a general engineering business. The incorporators are E. G. Bennett, A. B. Wright, C. Arnold, A. Charers and A. Mathieu.

Conserve Natural Gas for Domestic Uses.—After hearing W. R. Nickle, a Government expert, explain the natural gas situation in Western Ontario, more than forty manufacturers of Windsor and adjacent border cities passed resolutions endorsing the Government's plan to conserve natural gas for domestic consumers by cutting off factories from the supply. It was decided, however, to send a

recommendation to the Ontario Railway and Municipal Board to allow manufacturers the use of gas in small quantities for certain processes until a supply of artificial gas is available.

Chatham, Ont.—A census of the Hydro power users in Chatham is being made by the Public Utilities Commission to ascertain just what power is being used and what might be wanted if there was an increase possible. A record is being made of the product of the various companies and other details connected with the plants. It is reported that similar reports are being compiled in other Western Ontario towns and cities and it is presumed the report will have some connection with the requests being made for more power, because of the order cutting off natural gas on July 1 next.

Price Bros. & Co. Develop Plants.—Sir William Price, president of Price Bros. & Co., in his report states that a new unit was added to the Kenogami mill during the year, bringing the capacity up to 200 tons of newsprint a day, while the Shipshaw Power development was also completed and is supplying the company with 10,000 h.p. The development includes a storage dam with a capacity of nearly seven billion cubic feet. As to general conditions, the president says: "The pulp and paper branches of the business have been somewhat hampered in their operations and supplies, and difficulties experienced in procuring necessary transportation for the finished product."

Shipments of Coal to Canada Restricted.—Plans for the restriction of the movement of anthracite coal from the United States to Canada during the present year have been formulated by the United States Fuel Administration in co-operation with the Fuel Controller of Canada. A representative of the former attended a recent conference of representatives of coal operators, coal miners and railways in Canada, at which this problem was discussed. The conference reached an agreement as to the movement of anthracite coal into Canada, embracing the following: Anthracite coal supplies to points in Western Canada will be materially restricted during the present coal year. No American anthracite will be available for shipment to points west of Winnipeg.

Regina, Sask.—The City Commissioners have been authorized to endeavor to arrange a thirty-day option on the $175,000 electric light unit which the council has been asked to purchase to ensure a sufficient supply of energy to meet the anticipated demands of the coming winter. The city has received offers of two American machines, one of which is ready for immediate delivery, consisting of a General Electric Co. turbine and a Westinghouse condenser, and the other, which will be ready for delivery about September, consisting of a Westinghouse turbine and a Wheeler condenser. The price of the two units is within $2,000 of the same figure. The officials reported that they would sooner have had a combination of one of the turbines with the other condenser, but

The Rising Cost of Power

There has been a big jump in the cost of coal and labor—in everything concerned in the generation of power. How much of your power are you wasting by allowing scale to form on the boilers?

DIXON'S PIONEER BOILER GRAPHITE

is one of the safest, simplest and most effective scale treatments known. It makes the scale soft and easy to remove, protects the metal and can be used with any feed water and in any type of boiler.

Dixon's Pioneer Boiler Graphite will help you lower your power costs.

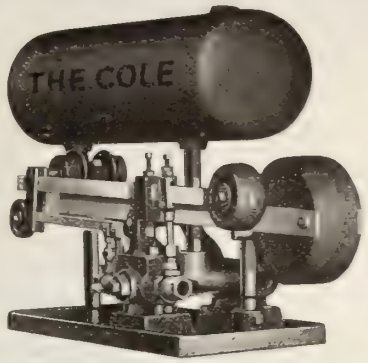
Write for Booklet 222-T.

Made in Jersey City, N.J., by the

JOSEPH DIXON CRUCIBLE COMPANY

ESTABLISHED 1827

Sole Canadian Representative:
CANADIAN ASBESTOS CO.
Montreal, Que.



The Co e Trap for Handling Condensation

You have seen this before.

Do you know what it is?

Send for a copy of our book entitled "Steam Condensation." It's free.

Write us. Watch our advts.

GEO. W. COLE, LIMITED
New Address: 2002 Dundas St. W.
Old Address: 838 Dundas St.
TORONTO

NON-CORROSIVE CYLINDER OIL

MANUFACTURED ONLY BY E. H. KELLOGG & CO. NOS. 242 & 244 SOUTH ST. NEW YORK, U.S.A.

FRICTION LOSS

An overload is often a necessity. But it is hard on an engine. To successfully carry an overload so that there will be no after effects on the engine a very careful selection of your oil should be made. An oil that is not free from impurities will cause a greater wearing on the bearings, a great friction loss will occur. You will need to fire the boiler more often because the engine will be harder to run. In this manner you lose out. You work harder, have larger operating costs, and less power all because of your oil. Do as a great many Canadian engineers have done—give Kellogg's "Non-Corrosive Cylinder Oil" a trial. Absolutely pure. Write us regarding it.

E. H. KELLOGG & CO.,
New York, U.S.A.

"Clean All" Feed WaterTreatment

Your Boiler Troubles are Solved and the Solution is Genuine.

We guarantee that "Clean All" if used according to directions:

To remove (not dissolve) scale already formed, and to stop further formation.

To stop pitting, corrosion and minor leaks.

To be absolutely harmless to metals, packings and fittings.

To remove oil and grease, and increase efficiency of boilers 100%.

Submit samples of water used and all particulars of conditions of boilers, etc., and let boiler specialists diagnose your case.

SOLD IN 30 or 50 GALLON LOTS UNDER 60-DAY TRIAL.

WILLIAM C. WILSON AND COMPANY

21 CAMDEN STREET TORONTO

CLASSIFIED ADVERTISEMENTS

SUCCESSFUL SALESMAN, MARRIED, 27 years old, catering to hardware trade east of Toronto to the Sydney's, desires connection with reliable concern. Have A1 connection and thorough knowledge of modern salesmanship. William Baldwin, 752 St. Valier St., Montreal, Que.

Engines For Sale

1—Allis Tandem Compound 18 x 32 x 42, 70-75 R.P.M. 350 to 400 H.P. 24" x 48" belt Run condensing with surface condenser.

1—Goldie & McCulloch, Wheelock Cross Compound 16 x 25 x 30. Run condensing or non-condensing. 110 R.P.M. 200 H.P. Steam. Wheel 15' x 20"

1—Brown Corliss L.H. Crank Engine, Simple 12 x 30. 8' x 8" Fly Wheel 100 R.P.M. 80 H.P. steam.

1—Allis Corliss Valve, L.H. Crank Engine, 13" x 30". 12' x 16' belt wheel. 100 R.P.M. 93 H.P. at 90 lbs. steam arranged for condensing with surface condenser

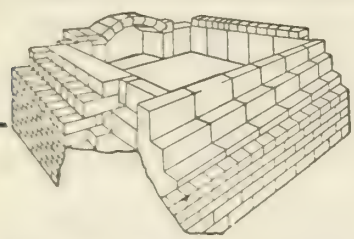
1—Side Crank, 20" x 36" Center Crank, 20" x 8" belt wheel. 150 R.P.M. 75 H.P. at 60 lbs. steam.

1—Robb Armstrong Highspeed Engine, 8½" x 8", Class B Automatic Center Crank, 36" x 8" belt wheel. 360 R.P.M. 42 H.P. at 100 lbs. steam.

A number of engines discarded owing adoption electric power. All in good operating condition and suitable for higher pressures than those now used.

We also have a number of large pulleys; several 100 x 125 H.P. Boilers suitable for 90 lbs. pressure.

Ogilvie Flour Mills Co., Ltd.
WINNIPEG



Gates Boiler Furnace
Patented 1916

Will last three times as long as ordinary good grade Fire Brick. These blocks are inter-locking, and made so that any handy man or fireman can renew them without disturbing any of the other brick work.

WRITE FOR PARTICULARS.

John W. Gates 2 St. James St., MONTREAL, QUE.

MacKINNON, HOLMES & Co.
Limited
MacKinnon Steel Co., Ltd.
SHERBROOKE QUEBEC

Engineers, Manufacturers and Erectors of Steel Structures

We Specialize in

Bridges, Buildings, Towers, Tanks, Penstocks, Roof Trusses, Columns, Smoke Flues and Stacks, Coal Bins, Ore Bins, Buckets, Refuse Burners, Stills, Air Receivers, etc.

WRITE FOR PRICES.

the owner of the equipment would not consider this proposal.

To Develop Peat.—In this week's "Gazette" announcement is made of the incorporation of the National Peat, Limited, with a capital of $100,000. The purposes of the company, as set forth in its charter, are: to carry on the business of treating, refining, concentrating, mining, excavating, reducing, precipitating, analyzing, manufacturing, buying and selling peat and all by-products thereof. The provisional directors of the company are: Edward Lindsey Middleton, Albert Edward Knox, Frances Morrow, Thomas Louis Monahan and Florina Berrini.

Walkerton.—Tenders will be received by the undersigned up to the 25th day of May instant, inclusive, for the construction of a concrete dam between 180 and 210 feet long, to replace the Saugeen Electric Light and Power Co,. Ltd., former wooden dam across part of the Saugeen River on the Company's mill property at Southampton, to connect with the concrete dam already erected thereon, and for the doing of certain excavation, filling and other work connected therewith. Plans and specifications may be seen at the Company's office at Walkerton, Ontario.

CATALOGUES

Metlskin Boiler Preservative.—A folder giving particulars of the Metlskin boiler preservative manufactured by the Metlskin Co. of Rochester, N.Y. The Canadian Fairbanks-Morse Co. are the Canadian distributors.

What It Means To You is the title of a bulletin being distributed to the trade by the Dodge Manufacturing Co., Toronto. The bulletin deals with the principal features of the Dodge standard wood split-pulleys and contains an illustration showing their construction. The bulletin contains a list of firms in Ontario who stock the Dodge transmission equipment.

The Link-Belt Co., Chicago, Ill., has recently distributed a new publication, No. 359, entitled "Chain Driven Motor Trucks and Tractors." The bulletin describes in detail the principal features and advantages of the Link-Belt chain-drive. It also contains particulars of the chain and a number of illustrations of tractors and trucks equipped with the chain drive.

Pumps for Any Service is the title of an 84 page catalogue just issued by Darling Brothers Ltd., engineers and steam specialists, 120 Prince street, Montreal. It describes in detail, both in illustrations and text, the many and varied lines of pumps and compressors manufactured by this firm. It also contains several pages dealing with important information for the benefit of intending purchasers of pumps. The book is well gotten up and is a credit to Darling Bros.

Power-Driven Air Compressors.—The Canadian Ingersoll-Rand Co., Ltd., Montreal, has issued recently bulletin K-301-A, describing two-stage, power-driven air compressors, of the duplex type, "PLB-2." This is a 16-page 6 x 9 pamphlet outlining notable features of construction, such as the "Circo" leaf valves, Haight 100 per cent. belt wheel joint, bath lubrication system, dust-proof frames and casings, etc., as well as the marked compactness of the design, yet easy accessibility of all parts.

Bakelite Micarta Gears.—Technical information regarding Bakelite Micarta D gears is contained in a pamphlet, A-2132, recently published by the Westinghouse Electric and Manufacturing Co. of East Pittsburgh. The distinctive features of this material for noiseless gears and pinions are listed together with its physical properties. Methods of turning and drilling and gear cutting are described and illustrated with many half-tones and drawings. Methods of attaching to the driving shaft, which have proved suitable for gears of all sizes, are shown, and tables of pitch, teeth and other gear data are also given. There are formulas for the horse-power rating, the amount of power which can be transmitted through press fit and for calculating other variables in gear practice. The book, which is of twelve pages, is a valuable addition to the library of anyone who has to do with noiseless gears. It will be sent on request to the company's nearest office.

CANADA SECURES ORDER FOR CABLES FOR AUSTRALIAN GOVERNMENT

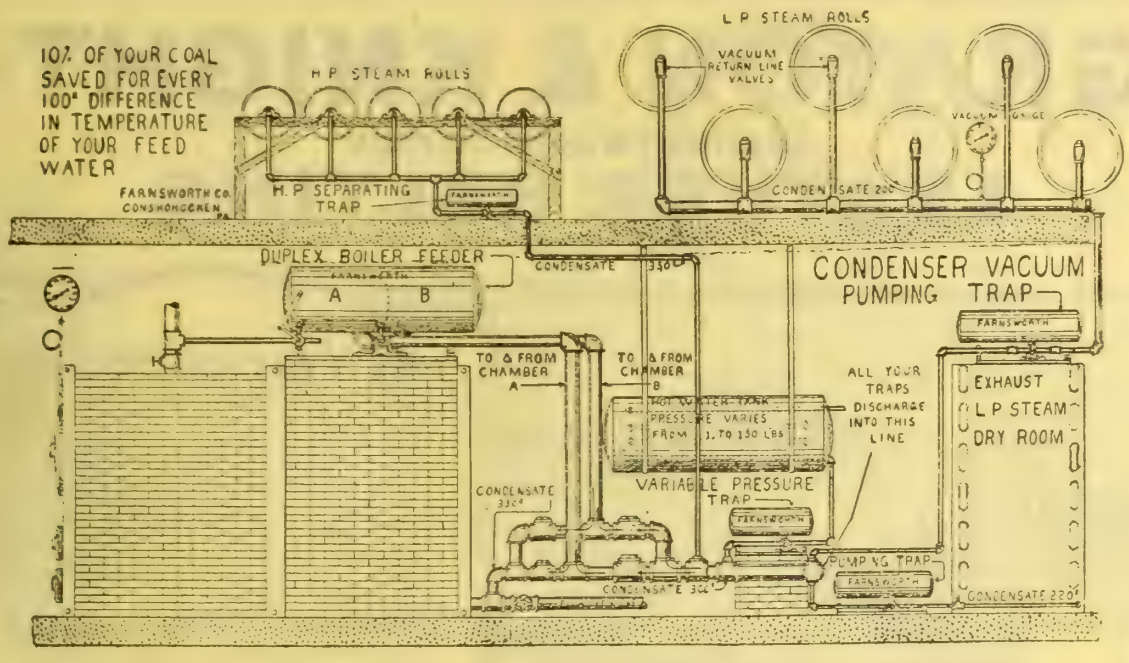
As a result of the efforts of Mr. D. H. Ross, Canadian Trade Commissioner in Melbourne, Australia, the Eugene F. Phillips Electrical Works, Limited, of Montreal, have received a contract for about 1,000,000 feet of insulated lead-covered telephone cable, required by the Post Office Department of the Government of Australia.

WALTER J. FRANCIS, C.E. M. Can. Soc. C.E. M. Am. Soc. C.E. M. Inst. C.E.
FREDERICK B BROWN, M.Sc M. Can. Soc. C.E. Mem. Am. Soc. M.E. Mem. A.I.E.E.

WALTER J. FRANCIS & COMPANY
CONSULTING ENGINEERS
Head Office, 232 St. James St., Montreal
Cable Address, "Walfran, Montreal"—W.U. Code.
Long Distance Telephone, Main 5643.

MONCRIEFF'S "UNIFIC" WATER GAUGE GLASSES
Stand in a Class by Themselves for Quality, Efficiency and Economy
A trial will convince you. Write for Catalog
W. J. WALL, 134-136 BLEURY ST., MONTREAL
(Canadian Representative)

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED


10% OF YOUR COAL SAVED FOR EVERY 100° DIFFERENCE IN TEMPERATURE OF YOUR FEED WATER
H P STEAM ROLLS
L P STEAM ROLLS
VACUUM RETURN LINE VALVES
FARNSWORTH CO. CONSHOHOCKEN
H. P SEPARATING TRAP
CONDENSATE 200°
DUPLEX BOILER FEEDER
A
B
CONDENSATE 330°
CONDENSER VACUUM PUMPING TRAP
TO & FROM CHAMBER A
TO & FROM CHAMBER B
ALL YOUR TRAPS DISCHARGE INTO THIS LINE
EXHAUST L P STEAM DRY ROOM
PRESSURE VARIES FROM 1 TO 150 LBS
VARIABLE PRESSURE TRAP
CONDENSATE 330°
PUMPING TRAP
CONDENSATE 220°

Farnsworth

Duplex Boiler Feeders

Feed Condensation directly into high-pressure or low-pressure boiler, eliminating receiving tanks.

Saves floor space, piping, valves, boiler feed pumps, etc.

Saves 75% of steam required by pumps.
Feeds hotter water than a pump can handle.
Packless swing joints.
No load on swing joints.
Tested to 350 lbs.

Hundreds of these machines are feeding boilers at temperatures over 300 degrees.

Farnsworth Duplex Boiler Feeder

Other Farnsworth Condensation Utilities

Duplex Condenser Vacuum Boiler Feed Pumps
Duplex Pumping Traps
Duplex Condenser Vacuum Pumping Traps
Direct Return Condenser Vacuum Traps
Direct Return Traps
Pumping Traps
Condenser Vacuum Pumping Traps
High Vacuum Traps
Separating or Non-Return Traps
Variable Pressure Traps
Variable Pressure Vacuum Traps

SOLE CANADIAN AGENTS:

The Canadian Fairbanks-Morse Co., Limited

St. John, Quebec, Montreal, Ottawa, Toronto, Hamilton, Windsor, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

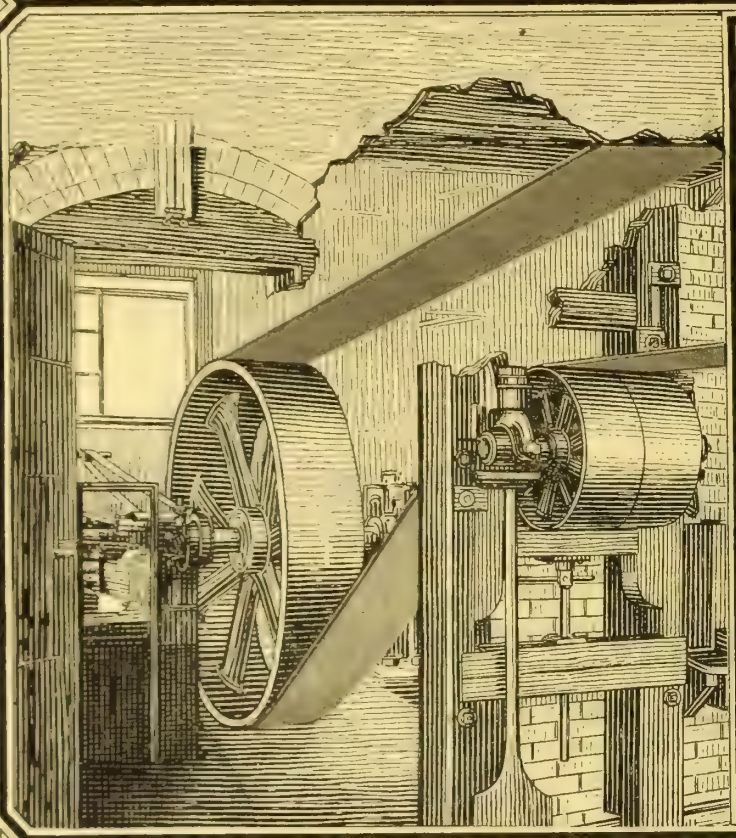
CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

GRATON & KNIGHT

Standardized Series

LEATHER BELTING

Tanned by us for belting use



47 Years of Service

20-inch and 26-inch Graton & Knight double belts in plant of A. G. Dewey Co., Quechee, Vt., the oldest satinet mill in the U.S. and the largest in the world.

ONE of these belts was installed in 1870 and the other in 1880. Both are still running, after an average of 42 years of service. Both give evidence of many future years of efficient work.

One of them has travelled ten hours a day continuously, a total of 3,250,000 Miles, and has never needed repair.

Fifty years ago, Graton & Knight Leather Belts were made to the highest standards then attainable. To-day their quality is actually better.

Write for information about Standardization as applied to Belting.

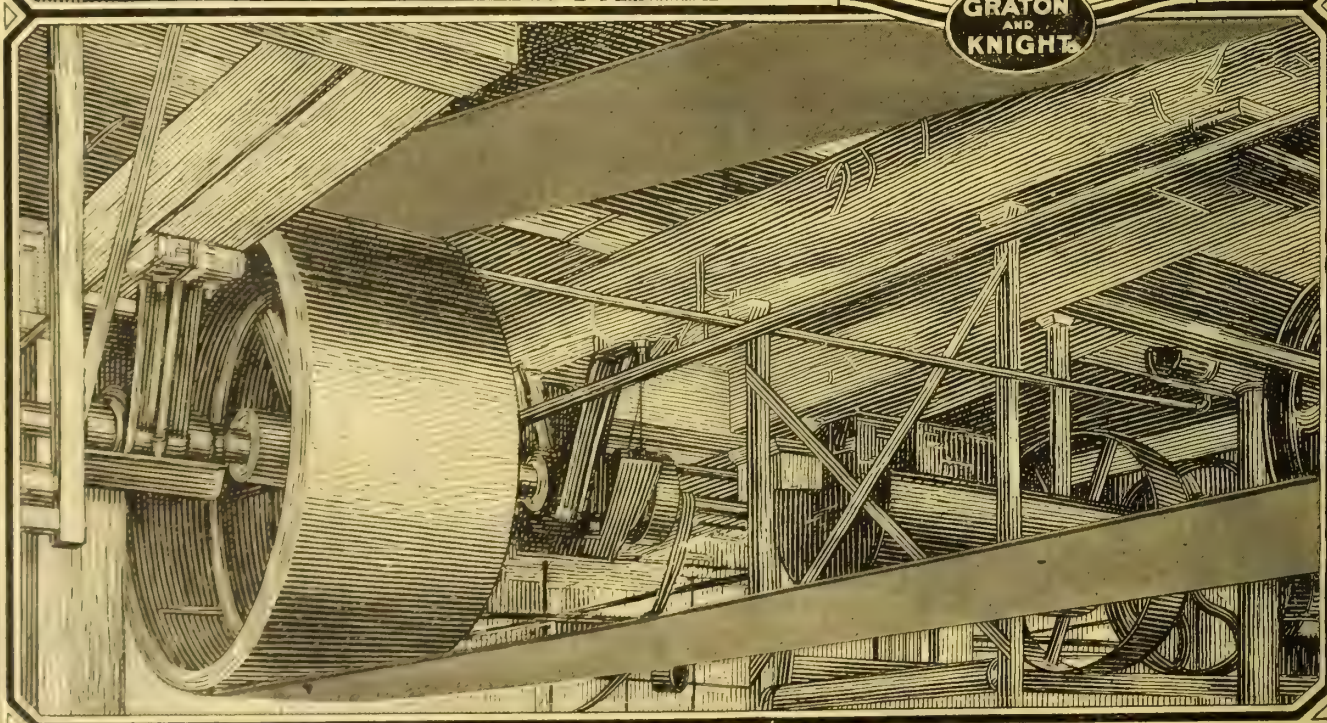
The Graton & Knight Mfg. Company

Worcester, Mass., U.S.A.

Oak Leather Tanners, Makers of Leather Belting, Lace Leather, Packings and Specialties

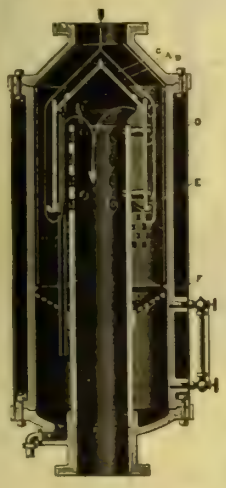
Canadian Representatives: The Canadian Fairbanks-Morse Co., Limited, St. John, Montreal, Ottawa, Toronto, Hamilton, Quebec, Calgary, Edmonton, Vancouver, Windsor, Winnipeg, Victoria.

GRATON AND KNIGHT



THE CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED

III IMPORTANT THINGS
TO CONSIDER ABOUT A SEPARATOR.



I. THE PLAN—Is it sensible, will it work, no matter how large the Separator or how well made?

II. THE SIZE—Is it big enough regardless of plan, will it hold a good dose of water?

III. THE CONSTRUCTION—Is it strong enough, are flanges heavy, how will it look by the side of a nicely finished engine? Send for catalog and note these points in

Sweet's Separators

DIRECT SEPARATOR COMPANY
820 Geddes Street - SYRACUSE, N.Y.

General Sales Agents:
Canadian Fairbanks Morse Company, Limited
St. John, Montreal, Quebec, Ottawa, Toronto, Hamilton, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria

FOR Steam or Air Drill, Pneumatic Tools, Boiler Flue Cleaning, Syphon Connections, Suction Lines.

For all kinds of Oil, Gasoline, Paints, Hydraulics, Gas.

"PENFLEX" METAL HOSE
INTERLOCKING

An all Metal Flexible Hose. Manufactured in Bronze or Galvanized Steel. Will withstand highest pressures. Is unsurpassed for durability and pressure resisting qualities.

Large Stock Carried in Canada
Pennsylvania Flexible Metallic Tubing Co.
Philadelphia, Pa.

Canadian Agents:
The Canadian Fairbanks-Morse Co., Limited
St. John, Quebec, Montreal, Ottawa, Toronto, Hamilton, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria

METLSKIN BOILER PRESERVATIVE
Neither "Compound" nor "Cure-all"

Even if "compounds" and "curealls" have made you a skeptic

learn the facts about METLSKIN. It has produced results for many of the country's representative concerns. It will prove a real economy in **your** boiler-room. Clip the coupon opposite, and let us send literature, prices and GUARANTEE BOND. The 60-Day Trial Offer has convinced the most skeptical. METLSKIN will not contaminate the steam.

The Canadian Fairbanks-Morse Co.
LIMITED
St. John, Quebec, Montreal, Ottawa, Hamilton, Toronto, Windsor, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria.
Calgary, Vancouver, Victoria.
Rochester, N.Y.

Save stationery. Use this handy Coupon

GENTLEMEN;

☐ What will METLSKIN's cost be per month?

☐ What assurance have we against injury to our boilers?

Our boilers are _____ type

_____ number, _____ h.p.

We operate ____ no. hrs. per day

Please send along your literature without obligation to us.

SIGNED _____

POSITION _____

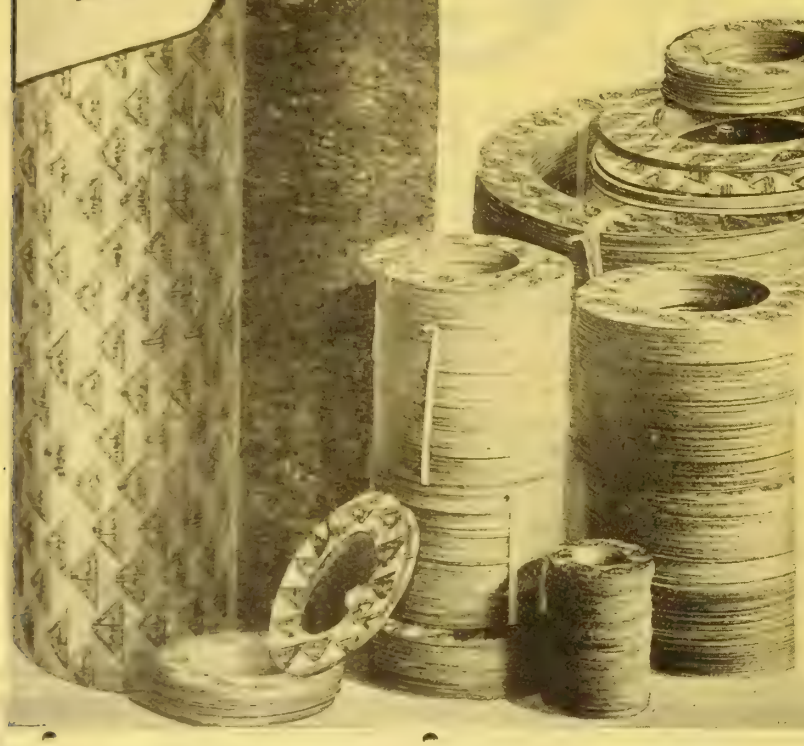
FIRM _____

ADDRESS _____

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

DURABLA



When Buying Gaskets Insist on DURABLA

Recognized by Engineers in every Industry as Standard. Guaranteed to make Any Joint Permanently Tight. We carry a large stock of the DURABLA Sheet and Gaskets in All Sizes and Thicknesses. Standardize on Durabla.

Durabla Manufacturing Company
NEW YORK

Distributors for Canada:
The Canadian Fairbanks-Morse Co., Ltd.

What is Steam Trap Service?

It consists of operation, day in, day out, year in and year out, without leakage of steam and without the necessity of constant attention of steam fitter.

Such is the service given by

The American Ideal Steam Trap

Let us help you select the proper size for your needs.

Canadian Agents: CANADIAN FAIRBANKS-MORSE CO., Limited
Montreal, Quebec, St. John, Calgary

AMERICAN STEAM GAUGE AND VALVE MFG. CO.
New York Chicago BOSTON Atlanta Pittsburgh

P&C CO

Valves—Asbestos Packed Cocks
for Every Purpose and Pressure

Pratt & Cady valves and cocks make good where others fail because they remain leak-proof under the most severe strains. Put your toughest job up to Pratt & Cady valves and cocks. Get our catalog and full information.

Pratt & Cady Co., Inc., Hartford, Conn.

Canadian Agents:
Can. Fairbanks-Morse Co., Ltd., Toronto, Montreal
St. John, Quebec, Ottawa, Hamilton, Windsor, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria.

THE CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED

"PALMETTO"

PACKING

CAN HELP YOU
TO SAVE THE STEAM
THAT THE
COAL SHORTAGE
HAS MADE EXPENSIVE

Scarce and High Priced Fuel

demands that every pound of steam produced performs service and does not leak through poor packing in the stuffing box.

"PALMETTO" is a packing that can be absolutely depended upon to keep the stuffing boxes steam tight, because it's made of the right materials and in a manner necessary for **LONG SERVICE.**

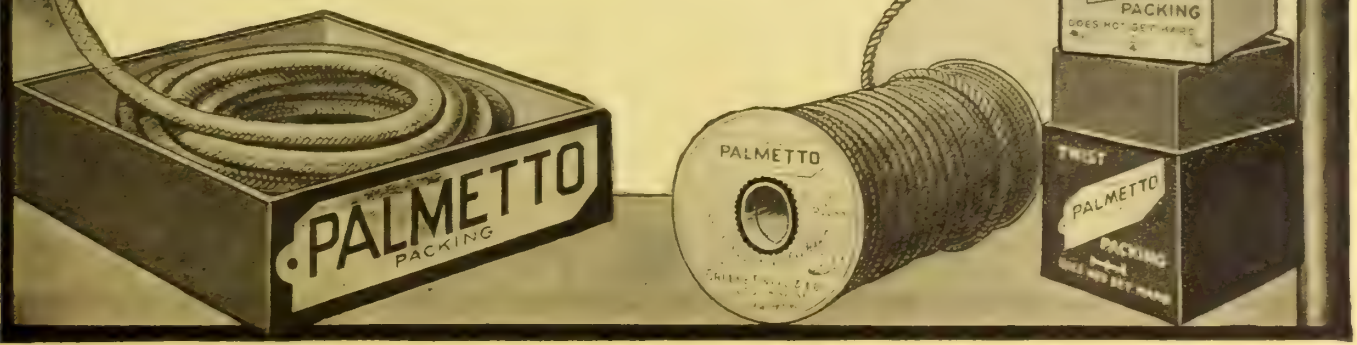
Working samples to prove unusual quality—No charge.

GREENE, TWEED & CO.

SOLE MANUFACTURERS

109 Duane St. - NEW YORK

The Canadian Fairbanks-Morse Co., Limited, St. John, Toronto, Quebec, Hamilton, Montreal, Ottawa, Vancouver, Victoria.



THE CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

ALBERGER HEATERS

Get the MOST Out of Steam

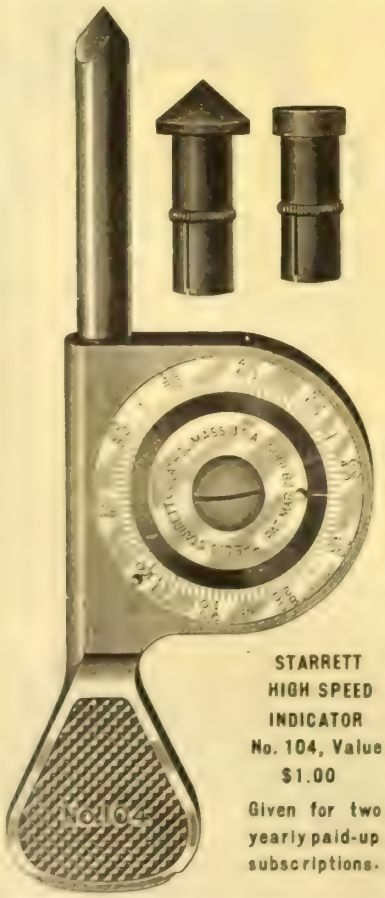
STEAM costs you too much to have it wasted by inferior heater equipment. The Alberger Multi-Head Water Heater, with its small, corrugated tubes of pure copper, transmits 50% more heat than plain tube heaters of equal size. **We can prove it.**

Furthermore, the Alberger "floating" heads, into which the corrugated tubes expand perfectly, allow for contraction and expansion, and the tubes themselves, because pure copper, never split.

Many Types. Write.

ALBERGER HEATER COMPANY, BUFFALO, N.Y.

GENERAL SALES AGENT:
CANADIAN FAIRBANKS-MORSE COMPANY, Limited
St. John Montreal Ottawa Toronto Hamilton Quebec Calgary
Windsor Vancouver Winnipeg Victoria



STARRETT HIGH SPEED INDICATOR No. 104, Value $1.00
Given for two yearly paid-up subscriptions.

You May Have This Speed Indicator without Spending a Cent

if you are a subscriber to "POWER HOUSE." If you are not a subscriber, send in your own subscription together with two others, and the indicator you are entitled to will be mailed to you immediately.

To subscribers who send us two NEW yearly paid-up subscriptions we will send this $1.00 indicator.

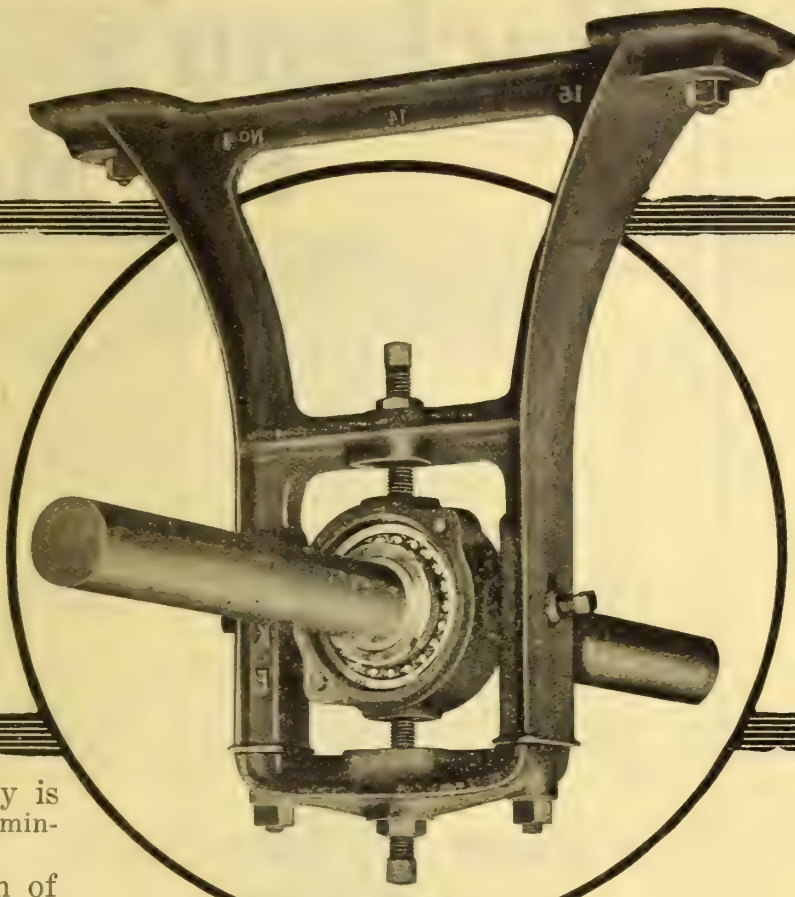
"POWER HOUSE" is designed to give Canadian Engineers, Superintendents and Power Users all the latest and best information in the engineering field. A little work among your engineer friends and acquaintances will earn for you this handy indicator without any trouble. Try it and see how easy it will be.

PUBLISHED MONTHLY AT $1.00 PER YEAR
Start in TO-DAY to earn one of these Handy Tools

POWER HOUSE 143 University Ave., **Toronto**

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

Supporting the Line of Industry



The industrial problem of the day is how to save power and conserve the diminishing fuel supply.

Transmission losses due to friction of plain bearings amount to from 20% to 40% of the total power used in the plant.

SKF Ball Bearing Hangers will reduce these losses over 33%. This saving alone will make their installation a profitable investment. Then, too, the lubricant savings and the impossibility of hot bearings is an item to consider.

We have a special catalog describing their use in your line of business. Send for a copy.

CANADIAN SKF COMPANY LIMITED

TORONTO, ONT. 128 Coristine Bldg., Montreal, Que.

Canadian Agents

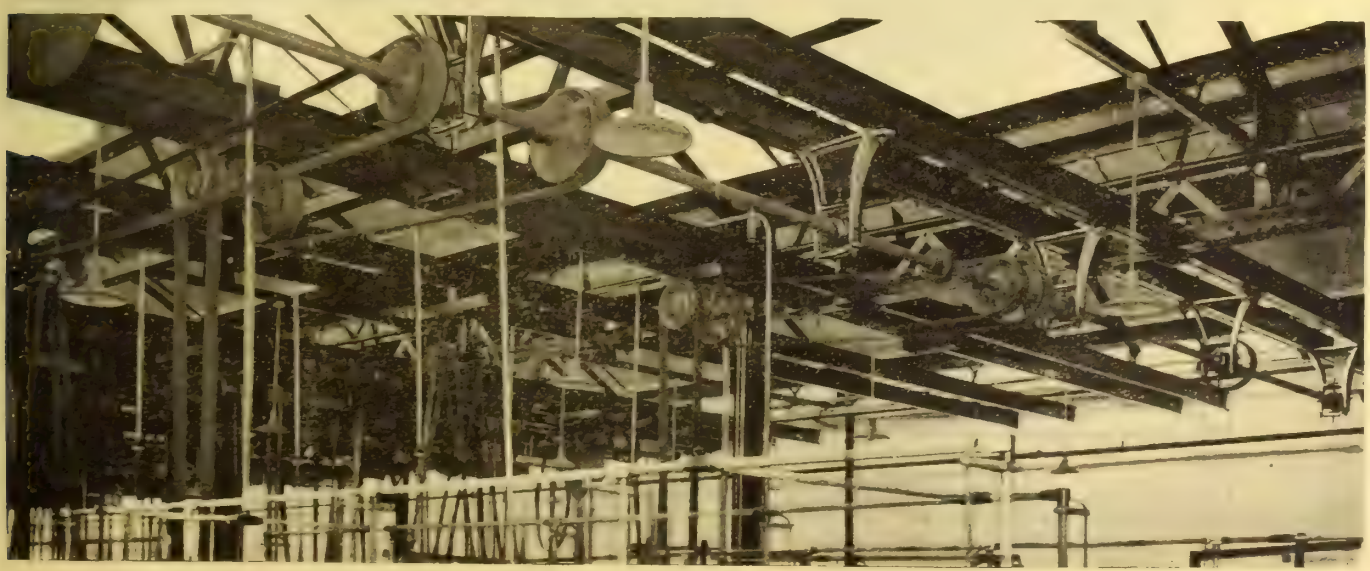
THE CANADIAN FAIRBANKS-MORSE CO., Limited

St. John Quebec Montreal Ottawa Toronto Hamilton Windsor Winnipeg Saskatoon Calgary Vancouver Victoria

SKF

BALL BEARINGS

Automatically self-aligning and fitted in oil tight housings which prevent oil leakage



MacLean's Magazine For MAY

Canada at the Peace Conference

THE British Empire will have a representative or representatives at the Peace Conference. The question is—Who? Who will be Canada's choice? Will Canada have any part in that conference of momentous import? H. G. Wells, one of the greatest writers of the age, has written on the subject of who is to represent the Empire at the Peace Conference. He has written this article for MACLEAN'S MAGAZINE and it appears in the May issue. (Mr. Wells parcelled this manuscript and addressed it himself, for MACLEAN'S MAGAZINE.)

How Does a Retreating Army Behave?

GEORGE EUSTACE PEARSON tells how in the May MACLEAN'S. Mr. Pearson is a Princess Pat man, and was gassed at St. Julien. He is now lecturing for the American Government in Texas and elsewhere. He is a Toronto man, and his war stories are of sensational interest. The **Saturday Evening Post** has published two of his stories, and other American magazines will. Mr. Pearson is well known to readers of MACLEAN'S MAGAZINE, and this wonderful contribution to the May MACLEAN'S will be read with intensest interest. Mr. Pearson is a wonderful delineator of war.

Robert W. Service in the May Number

Service is perhaps Canada's best known poet. He is at the front, and ever since going there two years ago his verse has been appearing in MACLEAN'S MAGAZINE—a fine compliment to Canada and MACLEAN'S. In the May number he has a stirring ballad—"The Twa Jocks"—great stuff!

Stephen Leacock is There, Too

Mr. Leacock likes MACLEAN'S. He is loyal to Canada. He gives to the Canadian people the children of his fancy—and he makes this gift through MACLEAN'S MAGAZINE. "May-time in Mariposa" is his contribution to the May MACLEAN'S. Lou Skuce illustrates it.

A. C. Allenson has a Story

MR. ALLENSON is another Canadian whom the editors of American magazines appreciate, and show their appreciation by buying his stories. Mr. Allenson remains loyal to MACLEAN'S which has been his cradle, as it were. We rejoice to be able to say that we shall have many stories from this Canadian short-story writer. His story in the May MACLEAN'S is "Drop Behind and Lose Two"—amusing and tender. W. B. King, a Saturday Evening Post illustrator, has made the drawings that accompany Mr. Allenson's story.

The Departments Everybody Likes

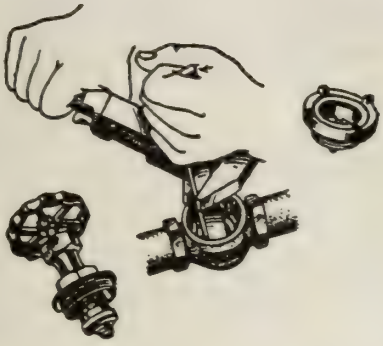
MACLEAN'S MAGAZINE is liked by many because it has an admirable **Review of Reviews Department.** This department condenses for busyreaders the best things appearing in the leading magazines and reviews of Great Britain and the United States. * * * **Women and Their Work** is a department that satisfies women. Women are bearing so many of the world's burdens nowadays that their fields of endeavor and interest deserve the recognition which they receive in MACLEAN'S. * * * **The Business Outlook, The Investment Situation** and **The Nation's Business** are departments valued by the business man.

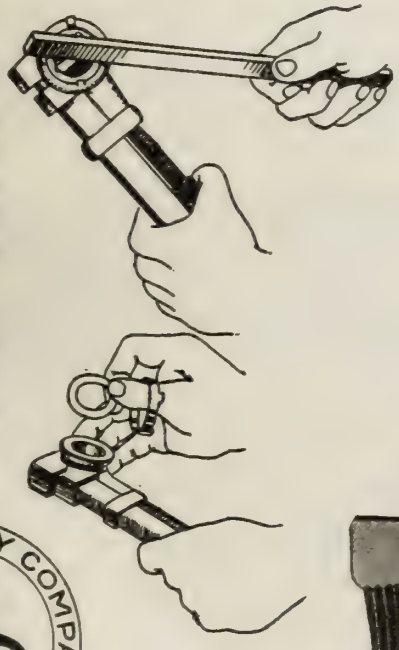
(Circulation of MACLEAN'S is now 60,000—10,000 more than it was six months ago.)

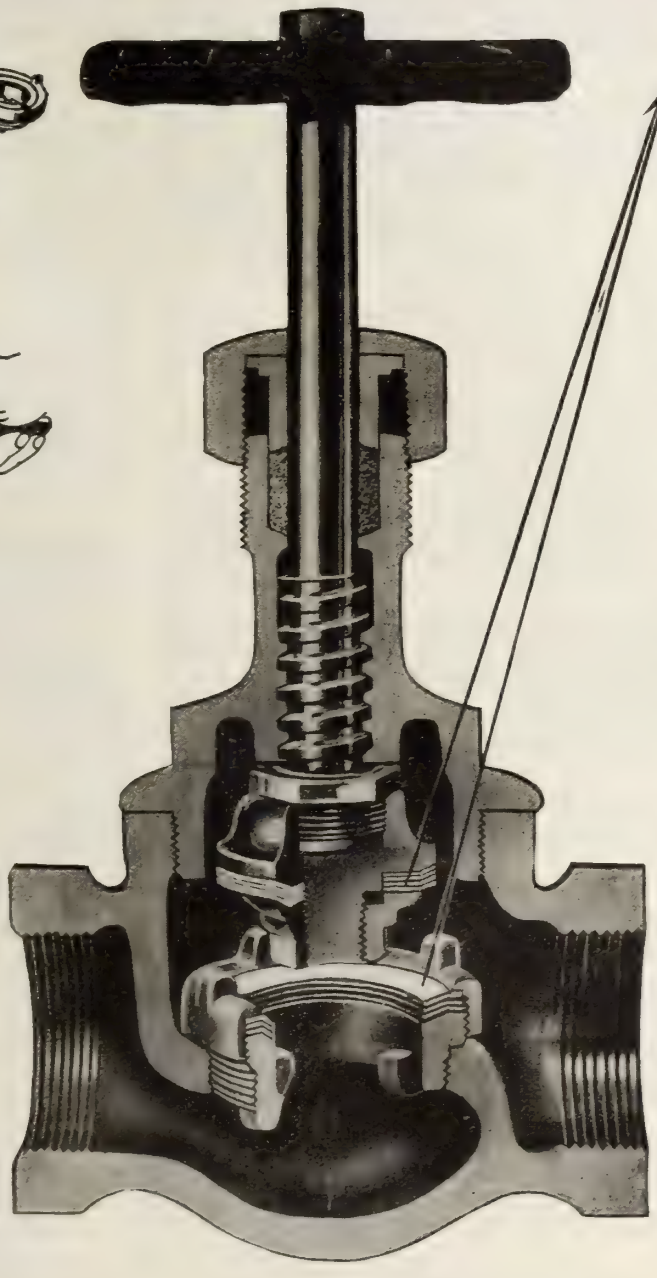
At All News Dealers : : 20c.

MULTIPLATE

"Valve Service"







By this method you do not take the valve out of the pipe line.

To remove plates see cuts opposite.

Note These Plates

When the valve leaks, simply take off the first pair of plates and throw them away; tighten up the other parts, and the valve is as good as new. This can be done till the plates are used up, then re-fill with new plates. No grinding.

CANUCK SUPPLY COMPANY LIMITED

Canadian Manufacturers

Canuck Supply Company, Limited

MONTREAL

TORONTO WINNIPEG VANCOUVER

Becoming a Bigger Man

WHAT is the difference between some men you know and others known to you? Why are some men earning $3,000 a year and some $30,000? You can't put it down to heredity or better early opportunities, or even better education. What, then, is the explanation of the stagnation of some men and the elevation and progress of others?

We are reminded of a story. A railroad man, born in Canada, was revisiting his home town on the St. Lawrence River. He wandered up to a group of old-timers who sat in the sun basking in blissful idleness. "Charlie," said one of the old men, "they tell me you are getting $20,000 a year." "Something like that," said Charlie. "Well, all I've got to say, Charlie, is that you're not worth it."

A salary of $20,000 a year to these do-nothing men was incredible. Not one of the group had ever made as much as $2,000 a year, and each man in the company felt that he was a mighty good man.

Charlie had left the old home town when he was a lad. He had got into the mill of bigger things. He developed to be a good man, a better man, the best man for certain work. His specialized education, joined to his own energy and labor sent him up, up, up. To put it in another way: Charlie had always more to sell, and the world wanted his merchandise—brain, skill and ability. Having more to sell all the time, he got more pay all the time.

Charlie could have stayed in the old home town; could have stagnated like others; could have been content with common wages. In short, Charlie could have stayed with the common crowd at the foot of the ladder. But Charlie improved himself and pushed himself, and this type of man the Goddess of Fortune likes to take by the hand and lead onward and upward.

Almost any man can climb higher if he really wants to try. None but himself will hold him back. As a matter of fact, the world applauds and helps those who try to climb the ladder that reaches towards the stars.

The bank manager in an obscure branch in a village can get out of that bank surely and swiftly, if he makes it clear to his superiors that he is ready for larger service and a larger sphere. The humble retailer can burst the walls of his small store, just as Timothy Eaton did, if he gets the right idea and follows it. It is not a matter of brain or education so much as of purpose joined to energy and labor. The salesman or manager or bookkeeper or secretary can lift himself to a higher plane of service and rewards if he prepares himself diligently for larger work and pay. The small manufacturer, the company director, the broker—all can become enlarged in the nature of their enterprise and in the amount of their income,—by resolutely setting themselves about the task of growing to be bigger-minded men.

Specialized information is the great idea. This is what the world pays handsomely for. And to acquire specialized information is really a simple matter, calling for the purposeful and faithful use of time. This chiefly.

One does not have to stop his ordinary work, or go to a university, or to any school. One can acquire the specialized information in the margin of time which is his own—in the after-hours of business. Which means: If a man will read the right kind of books or publications, and make himself a serious student at home, in his hours—the evening hours or the early morning hours—he can climb to heights of position and pay that will dazzle the inert comrades of his youth or day's work.

IF business—BUSINESS—is your chosen field of work, we counsel you to read each week THE FINANCIAL POST. It will stimulate you mentally. It will challenge you to further studious effort. It will give you glimpses into the world of endeavor occupied by the captains of industry and finance. With the guidance of the POST, and with its wealth of specialized information, you, a purposeful man, aiming to go higher in life and pay, will find yourself becoming enlarged in knowledge and ambition, and will be acquiring the bases and facts of knowledge which become the rungs of the ladder you climb by.

It is the first step which costs. But this cost is trivial—a single dollar. We offer you the POST for four months for a dollar. Surely it is worth a dollar to discover how right we are in our argument. If you have the will to go higher in position and pay, sign the coupon below.

THE MACLEAN PUBLISHING COMPANY, LIMITED,
143-153 University Avenue, Toronto.

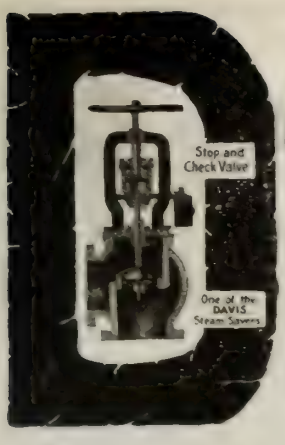
Send me THE FINANCIAL POST for four months for one dollar.

Money to be enclosed / remitted.

Signed .....

P.H.

.....



DAVIS SAFETY

protects you and your plant from the possible boiler explosion that may happen next year, next week or *tomorrow.*

Not only does the Davis Stop and Check Valve protect, but it equalizes the load by making each boiler do its share. Automatieally it will prevent a reserve flow of steam caused by sudden drop of pressure; will equalize the loss by cutting out the laggards; and will close tight when the fire is drawn. Reliable, efficient and absolutely dependable. Visible action—will not stick.

For your free copy of the new Davis Catalog, write the G. M. Davis Regulator Co., 434 Milwaukee Ave., Chicago.

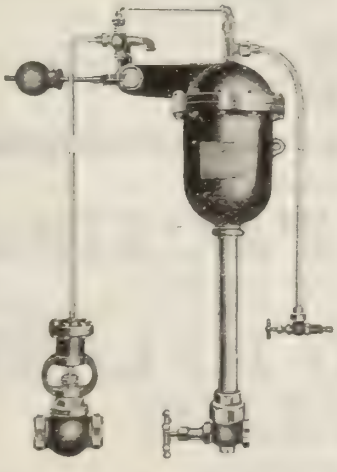
DAVIS VALVE SPECIALTIES

STEAM SAVERS SINCE 1875

With the

VIGILANT

On Guard You have Nothing to Fear



With the Vigilant Water-Feed Regulator on guard in your plant high and low water accidents will cease to be worry and care. Always on the job—always reliable. No blowing down the water-column with this machine. Perfectly automatic—requires no attention.

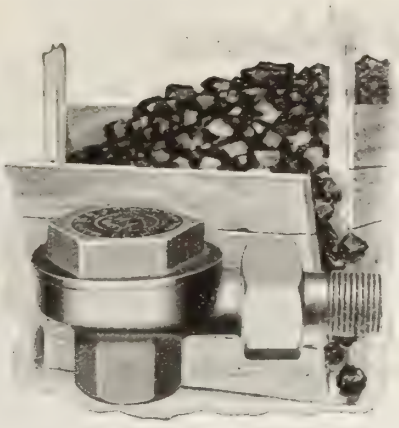
Saves 3 to 17% in fuel costs—very important feature these days.

Write for the Vigilant Catalog.

The Chaplin-Fulton Mfg. Co.

28-34 Penn Avenue, Pittsburgh, Penna.

Also Manufacturers of the Fulton Pump Governor



The Check on the Coal Bin

Where radiators are equipped with Dunham Radiator Traps there is a constant, dependable check on the coal bin. The Dunham Radiator Trap saves coal from being wasted. It gets every last bit of heat out of the fuel. It is more than doing its share in helping the Dominion save millions of tons of coal this year.

The Dunham Radiator Trap is a Proved Engineering Success

It is well and favorably known to architects, heating engineers and contractors, and steamfitters all over the country. It is manufactured by a company with an enviable reputation for pioneering the principle now utilized in the best heating systems that engineering skill can produce.

The Dunham Radiator Trap provides an opportunity which no enterprising engineer can afford to overlook—by equipping **coal wasting** heating systems with Dunham Radiator Traps you can convert it into a **coal saving** system.

This means greater heating efficiency at less cost which is a desirable factor in present-day operating expenses.

The Dunham Radiator Trap does away with all annoying adjustment of faulty return devices and air valves (there are no air valves required where Dunham Traps are used).

They save time for the operating engineer.

Write for full information about the Dunham Heating Service and about the Inspection Service we maintain for Heating Engineers, Contractors and Steamfitters.

The DUNHAM HEATING SERVICE

C. A. DUNHAM COMPANY, Ltd.

Toronto, Canada

Branch Offices: **Halifax, Montreal, Ottawa, Winnipeg Vancouver, Calgary**

Morehead
Back to Boiler
SYSTEM

Out of the 600,000,000 tons of coal mined in Canada and United States annually, about ten per cent. of it is needlessly wasted.

Unless you are delivering all the condensation back to the boilers, while it is HOT you are a contributor to this big waste. Coal is too scarce to let this waste continue. The **Morehead Back-to-the-Boiler System** will stop it. It delivers **hot** condensation back to the boiler as pure hot feed water, and thus saves valuable heat units.

The "Morehead System" works automatically, wastelessly, completely. It not only saves fuel it saves boilers and hard work too. Equally controlled temperature in your whole plant, freedom from the troubles of steam pumps, and many other advantages accrue from its use.

Adopt the "Morehead" and help stop a great national waste.

Canadian Morehead Mfg. Co., Limited, Woodstock, Ontario

PACKINGS
FOR
STEAM
HYDRAULIC
AIR

Belting Asbestos Goods
Engineers' Supplies

Thomson-Gordon Limited
Hamilton, Ont.

"VULCABESTON" RED FIBRE STEAM SHEET PACKING

Outlasts Them All

Because of the fact that it is strongly heat-resistant and is not affected by chemical action,

VULCABESTON
The RED-Fibre Sheet Packing

is the most enduring packing known, therefore the most economical.

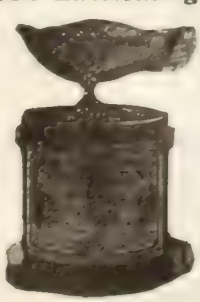
The **long fibre** of the asbestos guarantees that it will not pulp or squeeze out of the joint, and as it seats perfectly you are always sure of a tight joint—and one that will stay tight.

That leaky joint that has been making trouble can be quickly and easily cured with Vulcabeston. Try it!

The Johns-Pratt Company
Hartford, Conn., U.S.A.

SAFETY PLASTIC
METALLIC PACKING
FOR STEAM, WATER, AIR, GAS, ETC.

Self-Lubricating



In Bulk

Pat. Dec. 22, 1903 Highest Award World's Fair, St. Louis, 1904

GUARANTEED TO LAST THREE YEARS
WITHOUT RENEWAL

Drop us a line and let us tell you all about this Remarkable Packing.

STEEL MILL PACKING CO., WINDSOR, ONT. Established 1899

Practically Frictionless

In Cotton Tubes

JOHNS-MANVILLE ASBESTOS ROOFING

THIS fire-safe roofing covers a building in the heart of a great city. They used this kind of a roof because there were many stacks like yours all around—stacks belching forth smoke, soot and corrosive fumes.

And just as this Johns-Manville Asbestos Roof is impervious to destructive agents, so will a Johns-Manville Asbestos Roof on your plant be more than a roof covering. It will be a roof protection—safe from communicated fire. And it will be a roof with a minimum upkeep—you don't have to regravel the surface continually. For gravel—heavy, dirt-catching, and retarding the flow of water to the outlets—has no place on a Johns-Manville Roof.

There is a Johns-Manville Asbestos Roofing for every type of service. Ask any branch to tell you all about the one that fits your requirements.

Built-up Roofing for flat roofs. Ready Roofing for sloping roofs. Corrugated Asbestos for skeleton frames.

The Canadian H. W. Johns-Manville Co., Limited

Montreal, Toronto Vancouver Winnipeg
Hamilton London Ottawa

Niagara Power Co., Niagara Falls, N.Y. Floors protected with "R.I.W." Cement Filler and Cement Floor Paint.

"R.I.W." is the Foe of the Junk Man

It's cheaper to keep good machinery in repair than to be continually buying new. The scrap pile gets many a piece of machinery that might have been saved with

R.I.W. REMEMBER ITS WATERPROOF REG. U.S. PAT. OFF. MACHINERY ENAMEL

This remarkable product has stood the tests of hardest service on dynamos, transformers, steam and electric engines. It is heat-, steam-, and oil-proof. Easily applied cold with a brush and dries with a deep lustrous finish. Is made in any shade. Noted for retaining its beauty for years.

"R.I.W." Products are made for every possible use in factory, power house, or outside conditions. They are unparalleled for maintenance work.

Write to-day for valuable descriptive booklet. Dept. 59.

R.I.W. DAMP RESISTING PAINT CO.
TOCH BROTHERS
Gerrard St. and Carlaw Ave., Toronto, Ont.
Agents in—Vancouver, Winnipeg, Edmonton, Calgary, Montreal, Quebec, St. John, N.B.

R.I.W.
REMEMBER ITS WATERPROOF
STEEL NEED NOT RUST!
WOOD NEED NOT ROT!
NOR CONCRETE DUST!
REG. U.S. PAT. OFF.

Having Commutator Troubles?

The Jordan Commutator Truing Device will true your commutators without a shut-down.

Jordan Bros., Inc.
82 Beekman St. New York City, N.Y.
Canadian Representative :
CANADA SALES CO., 183 Church Street, Toronto, Canada

Keep Your Feet on the Floor

With a

Babbitt
—Adjustable—
SPROCKET RIM

attached to a valve, it isn't necessary to get off the floor to reach out-of-the-way valves.

Easy to reach. Easy to operate, and designed for your convenience.

At Your Dealer's, or send us your name and we will mail Illustrated Pamphlet

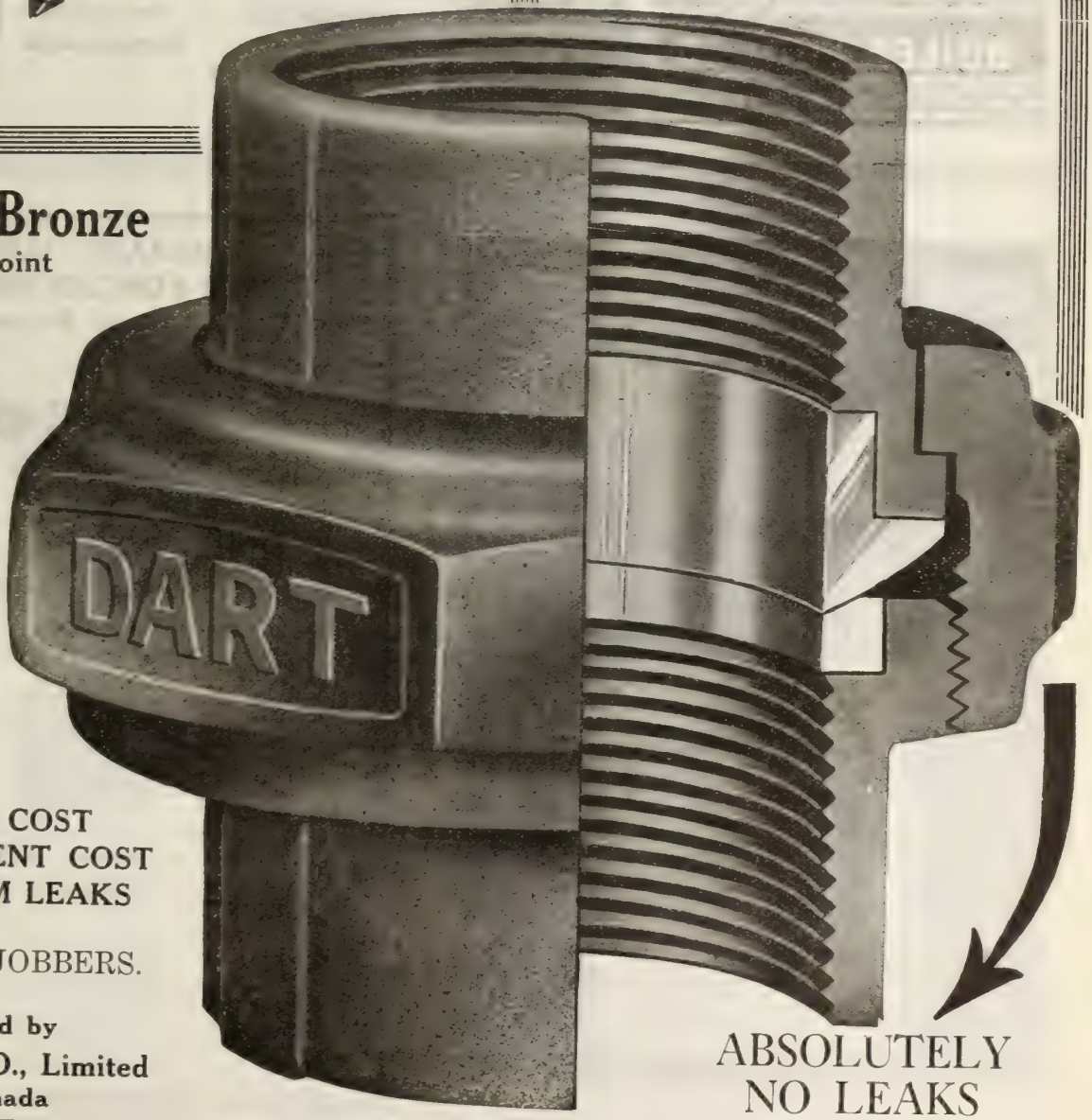
BABBITT
STEAM SPECIALTY CO.
NEW BEDFORD, MASS.
93-8

Manufactured in Canada under Canadian Patents, exclusively by the Engineering Specialties Company, Limited, 1080 King St. W., Toronto, Ont.

DART UNIONS

Your Protection Against Pipe Coupling Trouble

Leaks, upkeep and replacements costs become a thing of the past in your plant when Dart Unions are adopted. Never rust—never corrode — easily connected.



Bronze-to-Bronze
at the joint

The DART'S Efficiency is practically everlasting, because the Bronze faces cannot deteriorate and the heavy iron parts will not stretch or pull apart. The ball-shaped seat allows for an easily made and perfectly tight connection whether pipes are in or out of alignment.

A genuine guarantee goes with every Dart Union sold.

NO UPKEEP COST
NO REPLACEMENT COST
NO LOSS FROM LEAKS

SOLD BY ALL JOBBERS.

Manufactured by
DART UNION CO., Limited
Toronto, Canada

ABSOLUTELY NO LEAKS

If any advertisement interests you, tear it out now and place with letters to be answered.

We Carry a Complete Line of Boiler and Engine Mountings and Fittings

As Approved by the different Provinces of Canada

Manufactured by

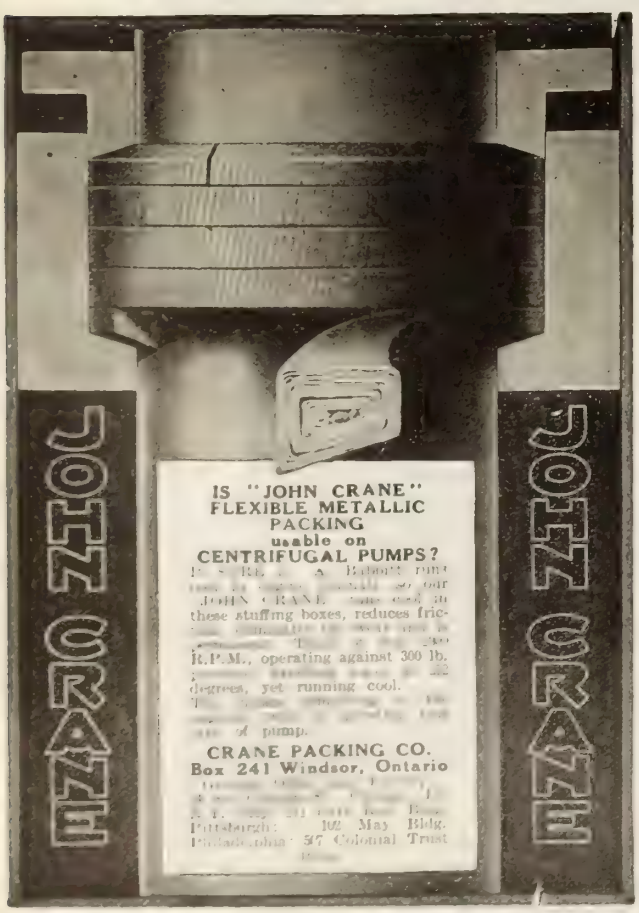
T. McAVITY & SONS

LIMITED

ST. JOHN, N.B.

Branches and Offices at

MONTREAL TORONTO WINNIPEG
VANCOUVER
LONDON (Eng.) DURBAN (S.A.)



WILLIAMS' SUPERIOR DROP-FORGED WRENCHES

For all Purposes

We have been making drop-forged Wrenches for nearly half a century and now carry in stock about 1000 sizes in 40 patterns.

When ordering specify "Williams' Wrenches" and get the best.

J. H. WILLIAMS & CO.

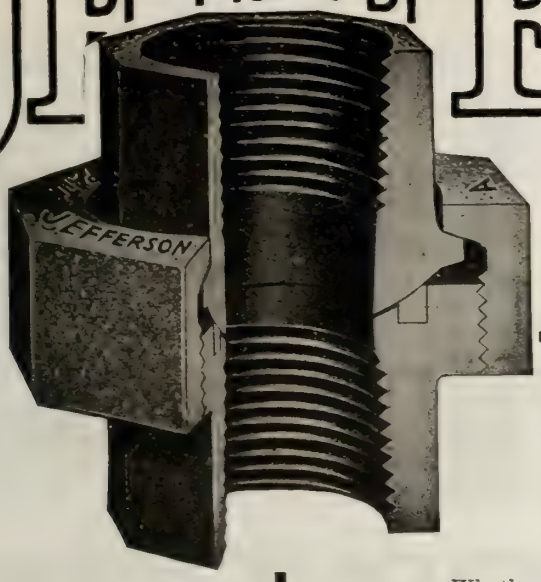
"The Wrench People"

The A. G. Low Co., Ltd., 78 Pacific Ave., Saskatoon, Sask. Agents for Manitoba, Saskatchewan, Alberta and British Columbia.

General Offices: 78 Richards St. Brooklyn, N.Y.

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

JEFFERSON



Test a Jefferson Union on your Toughest Job

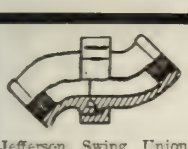
Whether your idea of severe union service is superheat or heavy pressure or corrosive action, you must actually try out a Jefferson before you can realize perfect union service.

Built by specialists, Jefferson Unions embody all qualities necessary for 100% efficiency on pipe line and power plant service. The Jefferson Union is unique in construction because we have protected ourselves with basic patents covering the essential features.

Take the drawn brass seat ring for instance. Now of course, every practical engineer knows that a brass-to-iron joint will not corrode (Point No. 1). But with an all-brass seat the expansion and contraction would be excessive, so in the Jefferson Union we embed the brass seat ring into the malleable iron by exerting enormous pressures—up to 40 tons. The seat ring cannot become dislodged under any conditions. (Point No. 2). Finally the seat ring is ground accurately to fit the spherical face of the other part of the union. This insures a tight joint even though the pipe is slightly out of line. Point No. 3).

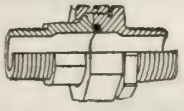
And so we could go right along with each Jefferson strong point, but these are all covered in detail in our new Catalog. Send for your copy to-day—we'll tell you where to find the nearest Jefferson Dealer.

JEFFERSON UNION COMPANY
Lexington, Massachusetts



Jefferson Swing Union. Allows connections, ranging from a slight offset up to 90 degrees, and many angle connections.

Union Elbow, all female. Takes the place of a straight union, nipple and an elbow. Also made male and female.



All Male Union. Saves two pipe joints between two female threaded parts.

MAIL THIS HANDY COUPON FOR THE JEFFERSON BOOK "UNIONS"

Jefferson Union Co.,
Lexington, Mass.
Please send me without obligation on my part, copy of your New Catalog.

Name .....
Firm Name .....
Address .....

P.H. 5-18

If any advertisement interests you, tear it out now and place with letters to be answered.

Most Efficient Boiler Feeder

LUNKENHEIMER AUTOMATIC INJECTOR

Will deliver more water per pound of steam and the capacity is diminished in a lesser degree by long lifts and hot feed water than any other Injector made.

This is due to the scientific design of the tubes, which are proportioned for maximum delivery, and it maintains its maximum delivery in service, because the tubes are made of a special **hard bronze** which is peculiarly resistive to the inevitable and severe erosive action of the saturated flow at high velocity. Besides, the Lunkenheimer design of "spill" eliminates the rapid wear of the combining tube.

The wide range of operation of the Lunkenheimer Injector; its instantaneous restarting after a temporary interruption of either the steam or water supply; its durability and the interchangeability of parts, are details which merit the consideration of every user.

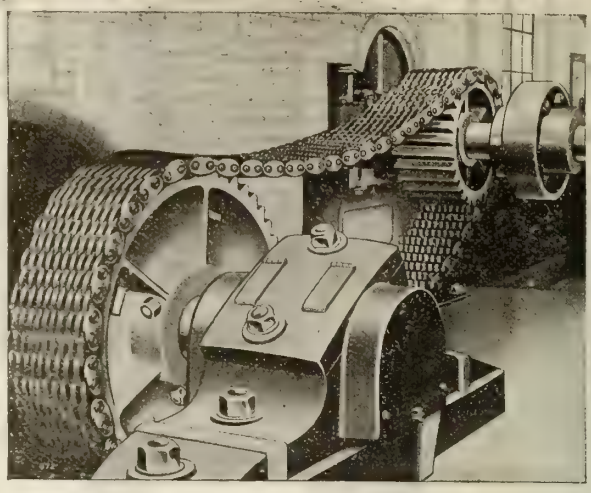
Write for descriptive Booklet No. 504 DJ, which contains valuable information on the use and operation of injectors.

THE LUNKENHEIMER CO.
"QUALITY"

Largest Manufacturers of High Grade Engineering Specialties in the World.

CINCINNATI, U.S.A.

New York Chicago Boston London



COVENTRY NOISELESS CHAINS

For all kinds of power transmission — Main and Countershaft Drives, Pumps, Fans, Air Compressors, and at all times 98 per cent. of power being transmitted.

Write for our handbook C-3 on chain gearing, post free for the asking.

Head Office and Works:

"THE COVENTRY" CHAIN CO., LTD.

COVENTRY, ENGLAND

Cables: Chains, Coventry.
Codes: A.B.C., 4th and 5th editions. Western Union.
London Office: 47 Victoria St., S.W. 1.
Agencies in all the principal countries in the World.

MUELLER

Globe and Angle Valves

BUILT from actual, practical experience. Made of the famous *MUELLER* steam metal and fully guaranteed against all defects in design and construction. Not a Valve, but *the* Valve.

¶ *MUELLER* globe and angle Valves can be repacked under pressure. The disc is so designed as to adjust itself to any position and still receive the thrust of the spindle on the center line; thus preventing any distortion to the seat or diaphragm. The pipe threads are full length, and are tapered to conform to I. P. Threads, insuring perfect joints.

¶ Full sized and unobstructed passages guarantee full service. The large Hexagons allow an excellent wrench grip and our design puts the strain where it belongs, so that there is no danger of distorting either the body or the bonnet. Furnished with enameled, Malleable iron wheel handles. Every *MUELLER* Valve tested to beyond unusual service conditions. Write for prices.

MUELLER **gate and check valves, steam cocks, etc. rank highest in every branch of exacting service.**

H. Mueller Mfg. Co., Limited

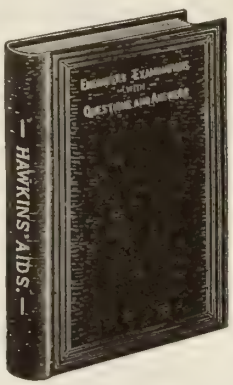
SARNIA, CANADA

If any advertisement interests you, tear it out now and place with letters to be answered.

Books for the Engineer's Library

Hawkins' New Catechism of Electricity

It contains 550 pages with 300 illustrations of electrical appliances; it is bound in heavy red leather, with full gold edges and is a most attractive handbook for electricians and engineers. One-third of the book is devoted to the explanation and illustrations of the dynamo, with particular directions relating to its care and management—$2.10 post paid.



Engineers' Examinations

By N. Hawkins, M.E.

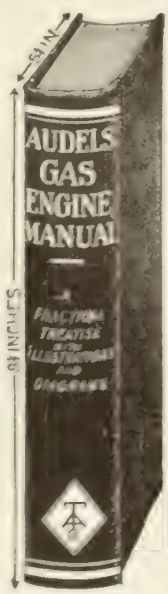
It presents in a condensed form the most approved practice in the care and management of steam boilers, engines, pumps, electrical and refrigerating machines, with examples of how to work the problems relating to the safety valve, strength of boilers and horse power of the steam engine and steam boiler.—$2.10 post paid.

Steam Turbines

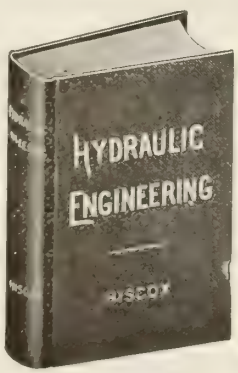
By Leland.

A reference work on the development, advantages and disadvantages of the steam turbine; the design, selection, operation and maintenance of steam turbine plants and turbo-generators. 135 pages. Illustrated.—$1.00.

Audel's Gas Engine Manual



A practical treatise relating to the theory and management of gas, gasoline and oil engines, including chapters on producer gas plants, marine motors and automobile engines.—$2.00.



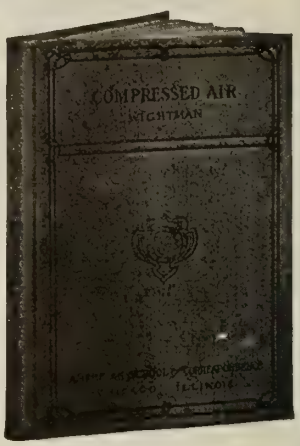
Hydraulic Engineering

By G. D. Hiscox.

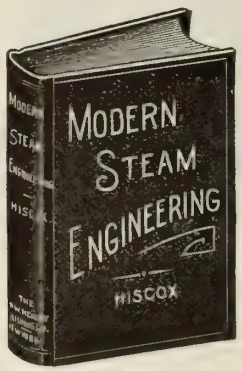
This comprehensive book of Hydraulics written by an experienced engineer, is a practical treatise on the properties, power and resources of water for all purposes, including the measurement of streams, the flow of water in pipes or conduits; the horse-power of falling water; turbine and impact water wheels; wave motors, etc. All who are interested in Water Works Development should have a copy. 320 pages, 305 illustrations. Price $4.15 post paid.

Compressed Air

By L. I. Wightman, E.E.



A reference work on the production, transmission and application of compressed air; the selection, operation and maintenance of compressed air machinery; and the design of air power plants. Illustrated.—$1.10.



Modern Steam Engineering in Theory and Practice

By Hiscox.

This book has been specially prepared for the use of the modern steam engineer, the technical students, and all who desire the latest and most reliable information on steam and steam boilers, the machinery of power, the steam turbine, electric power and lighting plants, etc. 450 pages. 400 detailed engravings.—$3.15 post paid.

Boiler Construction

By Kleinhans.

The only book showing how locomotive boilers are built in modern shops. Shows all types of boilers used; gives details of construction; practical facts, such as line of riveting punches and dies, work done per day, allowance for bending and flanging sheets and other data that means dollars to any railroad man. 421 pages, 324 illustrations, six folding plates.—$3.00.

Compressed Air, Its Production, Uses and Application. *By G. D. Hiscox, M.E.*

Comprising the physical properties of air from a vacuum to its liquid state, its thermodynamics, compression, transmission and uses as a motive power in the operation of stationary and portable machinery, in mining, air tools, air lifts, pumping of water, acids and oils and the numerous applicances in which compressed air is a most convenient and economical transmitter of power.—Price $5.15 post paid.

Boiler Accessories

By Walter S. Leland, S.B.

Assistant Professor of Naval Architecture, Mass. Institute of Technology, American Society Naval Architects and Marine Engineers. 144 pp., 80 illus. Cloth binding. A treatise giving complete descriptions of the various accessories of the boiler room and engine room essential to economical operation, such as evaporators, pumps, feed-water heaters, injectors, mechanical stokers, etc., with practical instruction in their use.—Price $1.10 post paid.

Technical Book Department

MacLean Publishing Company 143 University Ave., Toronto

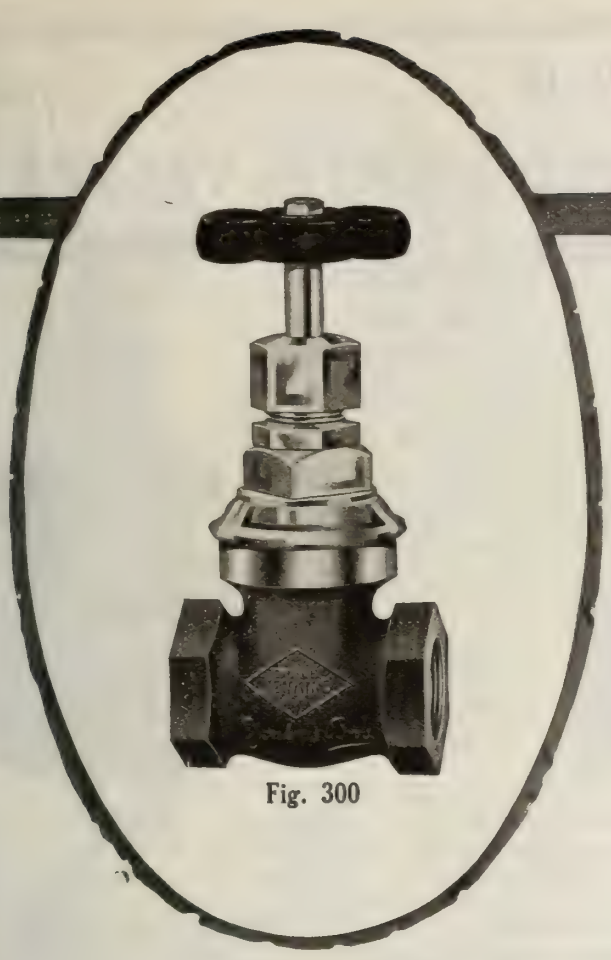


Fig. 300

TRADE JENKINS MARK

Jenkins Bros

Type "K" Brass and Iron Body Gate Valves

IF you are anxious to be "dead certain" of dependable valve service, install Jenkins Bros.' Type "K" Gate Valves—the valves with the DIAMOND Trade-Mark cast on body.

Type "K" Brass Gates are made of a superior grade of new metal. They excel in design and construction.

The body, trimmings and all the working parts are strong and well proportioned. Type "K" Iron Gates are "Leaders" in their class.

Jenkins Bros.' Type "K" Gate Valves are approved for use in Ontario and the Western Provinces by the Depts. of Public Works. Stocked by first-class dealers in all parts of the World.

Write for Catalogue No. 8. It's free for the asking.

TRADE JENKINS MARK Jenkins Bros

Jenkins Bros. LIMITED

Head Office and Works: 103 St. Remi Street, Montreal, Canada

Agencies in all Principal Countries of the World

European Branch: 95 Queen Victoria Street, London, E.C. 4, England

TRADE JENKINS MARK Jenkins Bros

If any advertisement interests you, tear it out now and place with letters to be answered.

KERR
("New KEYSTONE" Pattern) GATE VALVES

If you have not used any of these New Pattern Valves, specify "KERR" in your next order. We want you to get acquainted with the most reliable valve on the market.

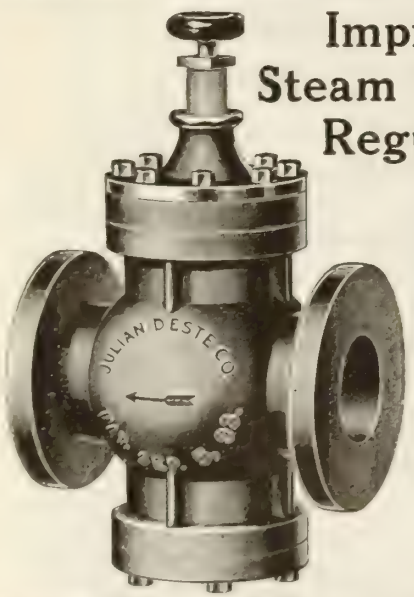
If you have been using them, we are confident that our satisfaction will bring us your repeat orders. These valves will never cause you or your customer the slightest trouble. Their high quality is consistent.

When you buy a "KERR" Valve you get a guaranteed article that is backed by a reliable firm. Many of the largest distributers of valves in Canada have sold "KERR" Valves for over 25 years, and are still recommending them as the "Best Valve." Write us for particulars.

Kerr Engine Co., Ltd., Valve Specialists **Walkerville, Ont.**

CURTIS Engineering Specialties

Improved Steam Pressure Regulator



For Universal Application to all the varied and various conditions under which a reduced pressure of steam, water or other fluid is required, this Regulator (see illustration) has no equal. It is compact and self-contained, without levers, weights or projections.

No glands or packing; no drip or leak of steam or water. Suitable for any boiler pressure; made entirely of metal; is a lock valve, very simple and sensitive.

The universality of use of this Regulator is one of its best features, but it is in Steam Heating that its use is most common and obvious. Send for leaflet fully descriptive of this Regulator (contains price list) to the manufacturers.

MANUFACTURED BY THE

JULIAN D'ESTE COMPANY

Main Office, 26 Canal St., Boston, Mass.

Agencies: 216 FULTON ST., NEW YORK CITY
174 N. MARKET. ST.. CHICAGO, ILL.

Save Yourself

from many expensive break-downs by adopting

Homestead Quarter-Turn Valves

They not only give perfect service, even under the most severe conditions, but records show them to possess an unequalled long life.

Homestead Valves are all constructed with the patent Homestead Principle which makes them seatless while the pressure is passing through, and which permits their being operated easily and safely.

Made in Straightway, Threeway and Fourway patterns, for all conditions of service.

Send for Catalog

Homestead Valve Mfg. Co.
HOMESTEAD, PA.

This Mark On Belting

STANDS FOR

D. K. McLAREN'S

BRITISH-OAK-TANNED
FLAWLESS BACK LEATHER

THIS OAK LEAF has been a guide to efficient and economical belt service for years to many of Canada's prominent industrial power plants.

Every D. K. McLaren Belt has the Oak Leaf Stamped plainly upon it. Let this trade mark guide you as it is guiding others to satisfactory belting service.

Minimum stretch, minimum slippage and fewer breaks are the results you can expect from the adoption of D. K. McLaren *British-Oak-Tanned* Belts.

GET IN TOUCH WITH SOME USERS. Just fill out the coupon below and we'll gladly furnish you with some names.

BACK LEATHERS—This is the best portion of the hide for belting purposes. Every inch of D. K. McLaren Belts represents Flawless Backs of the hides of the choicest steers.

BRITISH-OAK-TANNED—The most approved process known for preparing belts for hard service. Every bit of the hide's natural strength is preserved in D. K. McLaren's belts by the expert use of this famous process.

D·K·McLAREN LIMITED

HEAD OFFICE AND FACTORY:

351 ST. JAMES ST., MONTREAL, P.Q., CANADA

TORONTO, ONT.	ST. JOHN, N.B.	VANCOUVER, B. C.
194 King St. West	90 Germain St.	849 Beatty St.

D. K. McLAREN, Limited,
Gentlemen,—Please put me in touch with some users of your belting.

Name .....

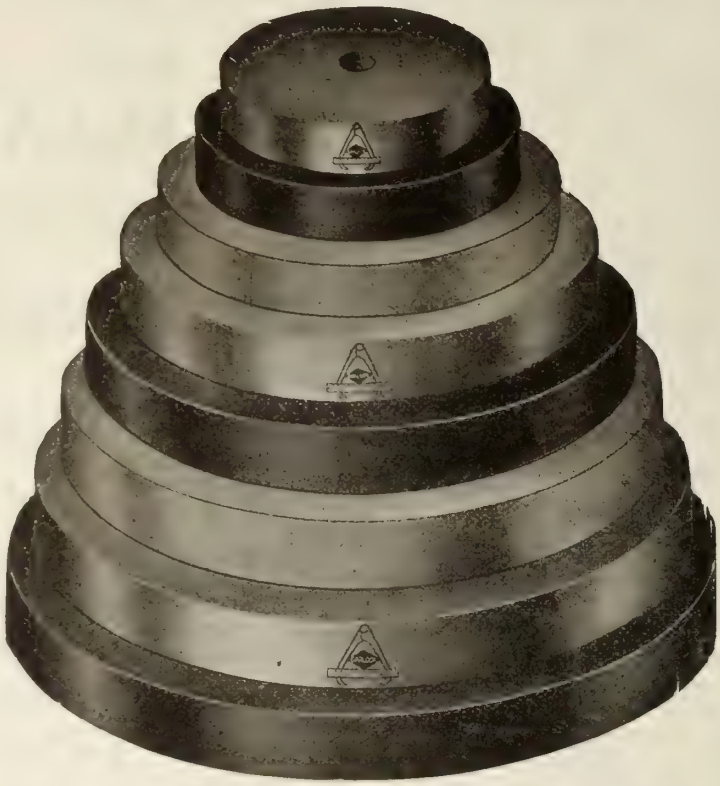
Address .....

Firm .....

If any advertisement interests you, tear it out now and place with letters to be answered.

GARLOCK

PUMP VALVES



The service of pump valves depends upon the compounds as well as the consistency and cure of the valves. The compounds used in Garlock pump valves have been established after years of trial in actual service and under the most severe conditions. Pump valves should always be used for the purposes for which they are intended. The following are a few of our leading styles and grades of valves:

Style	No.	139—For medium pressure cold water
"	"	175—For high pressure cold water
"	"	182—For warm or greasy water
"	"	108—For hot water
"	"	105—For boiling water
"	"	154—For air compressors and condensers

We guarantee our pump valves to give satisfactory service when used under conditions for which they are intended.

THE GARLOCK PACKING COMPANY

HAMILTON - ONTARIO

Branches:

Montreal, Quebec.....409 Shaughnessy Bldg.
Toronto, Ontario.....404 Continental Life Bldg.
Winnipeg, Manitoba.....Galt Bldg.

For More Than 50 Years

Albany Grease has given a lubrication service of great efficiency and economy on all bearings of power and industrial plant equipment. Albany Grease is the most universally used lubricant sold to-day.

ALBANY GREASE

will keep engines and all kinds of machinery and line shafting operating cool and easy at all times. It is sold by reliable hardware and mill supply stores—everywhere. We will gladly send samples upon request.

Albany Lubricating Co.

708-10 Washington St.
New York, U.S.A.

Established 1868

REMEMBER THE BOND

It cuts the danger of hot bearings to a minimum because it is equipped with an up-to-date and efficient ring oiling device that keeps the bearings constantly oiled, without wasting oil. The reservoir once filled requires no attention for at least six months. Any misalignment in the shaft line is easily corrected by the universal adjustment.

Our catalog on Power Appliances is full of pointers. Send for it to-day.

Canadian Bond Hanger & Coupling Co., Ltd.
ALEXANDRIA, ONTARIO

Dont Claim Exemption

—because the air is filled with dust,
—because this dust settles on the belts,
—because it makes a belt dressing "ball up"
are no reasons at all why your belts can't have the benefit of

CLING-SURFACE Belt Preservative

Just wipe the dust off first.

Then with the swab (as shown) treat the face of the belts **a little at a time.**

Your belts will absorb CLING-SURFACE very quickly, leaving a clean, **not sticky,** surface.

It will be smooth, velvety, and will not slip.

Nor will it hold the dust.

Your drives will last longer, do more work, cause no trouble, and can be run easy or slack under full loads.

They will never again have static electricity.

* * *

Results like these PAY.

Are you willing to try this treatment if such trial **costs you nothing?**

Then write to-day for the 25-pound can we have waiting for you.

Use it sixty days.

If you're satisfied, pay us for it. If not, we will take back what you have left, charge you nothing for what you've used, and pay the freight both ways.

ALL CHEERFULLY—no hard feelings!

Remember, use CLING-SURFACE and you won't need belt dressings.

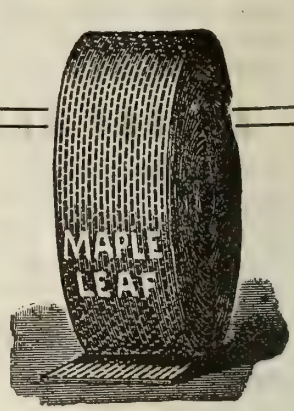
Cling-Surface Co
1057 Niagara Street
Buffalo New York
U S A

If any advertisement interests you, tear it out now and place with letters to be answered.

MAPLE LEAF BRAND

Stitched Cotton Duck

BELTING



Better and Cheaper Belting Service

In actual test Maple Leaf Brand Belting stood a breaking strain of 75% greater than leather, and 25% greater than rubber belting. It is sure grip, true running, and being waterproof, is not affected by dampness.

Maple Leaf Belt Dressing—The Best for all Kinds of Belts

Dominion Belting Co., Limited

HAMILTON, CANADA

Quebec Branch---51 Duluth Building, Montreal

WILL NEVER NEED RENEWING

ORIENTAL BREWING AND ICE COMPANY,
Manila, P.I.

Febr. 16, 1917.

Magnolia Metal Co.,

Gentlemen,—A little over 9 years ago I was sent from Chicago to Hongkong, China, to install all the machinery in a modern brewery and ice plant—all power used in brewery and bottling shop being furnished by two 40 K.W. D.C. 220 Volt Generators direct connected to high speed engines running at 360 R.P.M. Trouble was encountered at once with the outboard bearings heating up excessively, and as the lead was gradually increased it became necessary to change Generators every two hours. The best Oil that money could buy did not remedy the trouble. After exhausting my patience our Manager at last consented to buy me enough Magnolia Metal so I could reline the troublesome bearings.

This is now nine years ago. I had no lathe in which to turn up the new bearings and had to scrape them to fit. These two units were in constant operation in China for six years. They were then dismantled, sold and shipped to Manila, where they are installed in the Oriental Brewery & Ice Co. They are running with a heavy overload as high as 60% for hours at the time. During all these years the bearings lined with Magnolia Metal have never at any time given the least bit of trouble, and from all indications they will never need renewing during the rest of these units useful life.

Yours very sincerely,
M. LAUVITSEN,
Chief Engineer.

PRACTICAL ENGINEER POCKET BOOK:

Over 600 pages. A valuable reference work imported from England and sold as an advertising medium at the low price of 40c post paid.

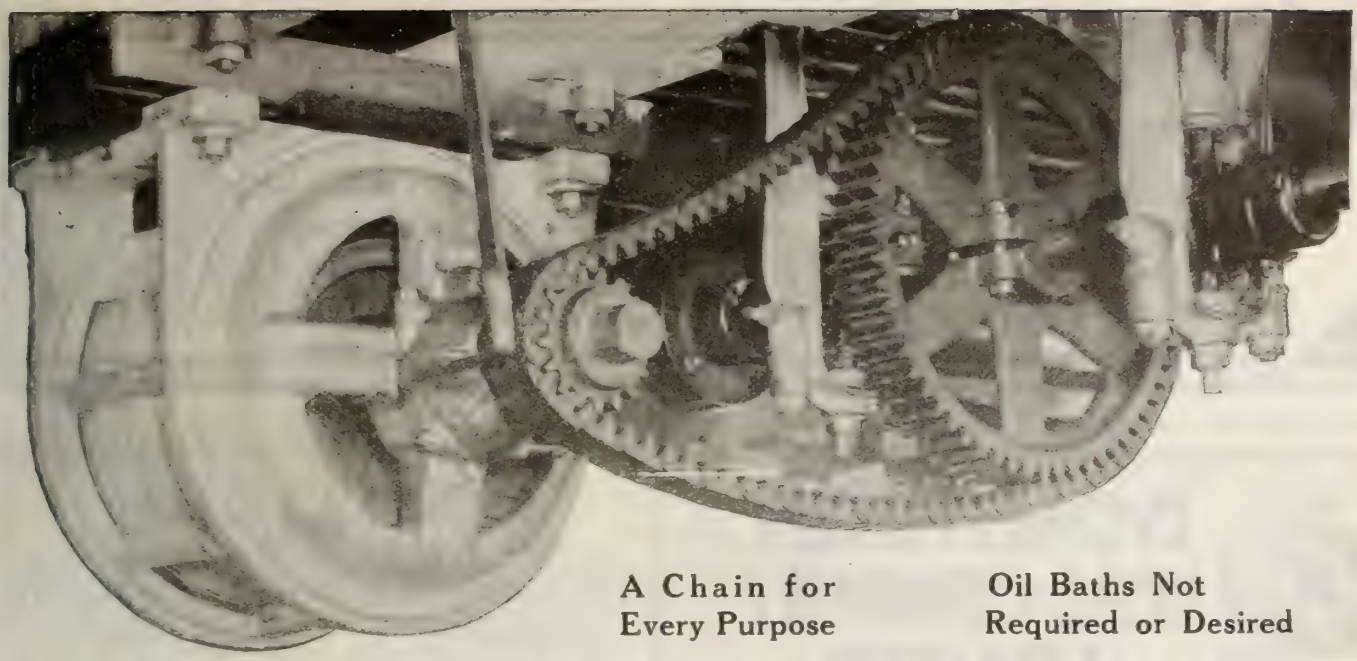
Address Montreal Office.

SOLD BY LEADING DEALERS EVERYWHERE OR BY

MAGNOLIA METAL CO.

OFFICE AND FACTORY:

225 St. Ambroise St., MONTREAL



A Chain for Every Purpose

Oil Baths Not Required or Desired

MORSE SILENT CHAIN DRIVES

POWER TRANSMISSION Must Be Figured in Terms of DOLLARS

Rate of Production. Replacement Costs. Breakage Losses.

Slipping Losses. Soiled Goods.

Keep the Wheels turning. There's a good reason for everything in a **Morse Rocker Joint Silent Chain** and its use puts co-ordination into every part and synchronizes all motions.

Send for INFORMATION, FACTS will Surprise You.

Speed up to the Aid of the Nation.

MORSE CHAIN CO. Largest Manufacturer of Silent Chains in the World ITHACA, N.Y.

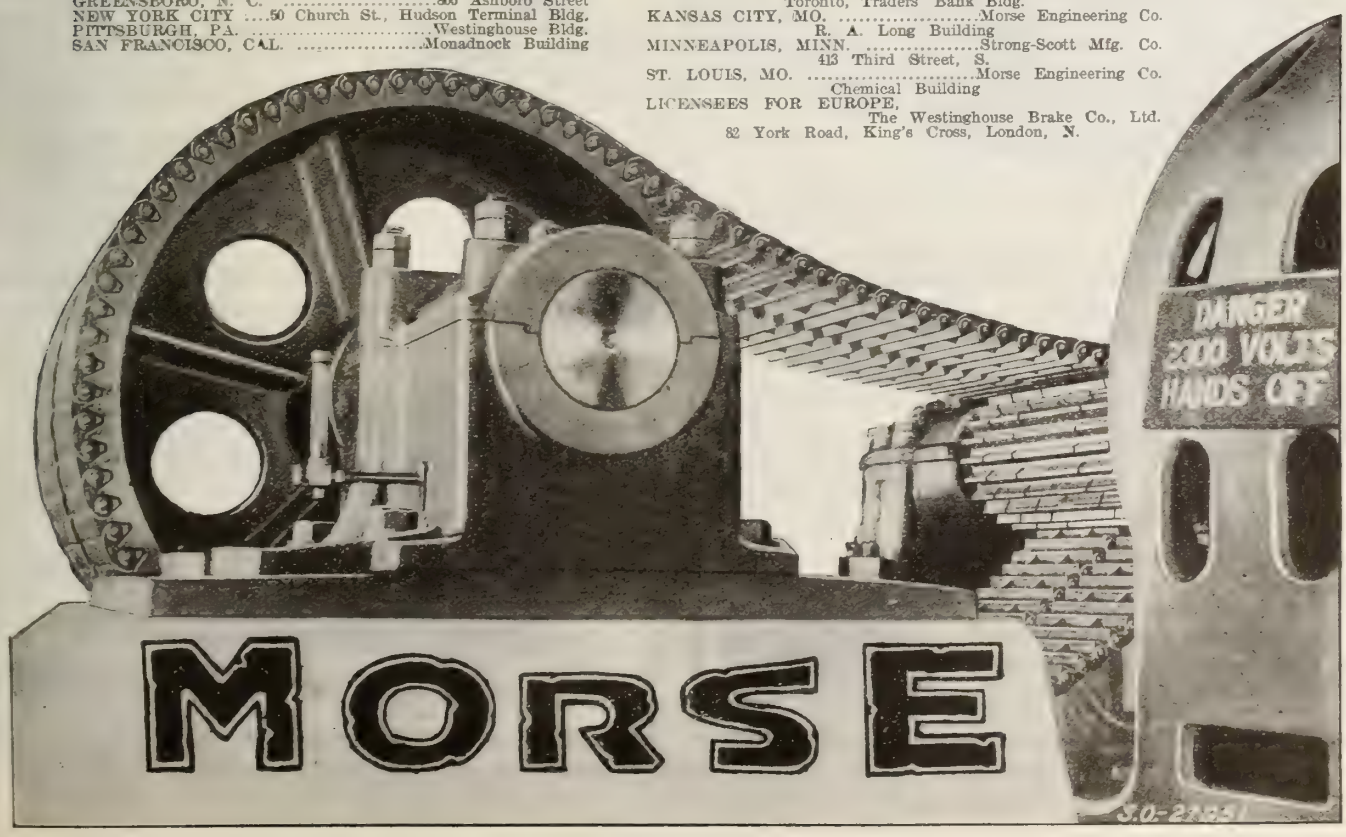
ADDRESS NEAREST OFFICE

SALES OFFICES

BOSTON, MASS. .....141 Milk Street
CHICAGO, ILL. .....Merchants Loan and Trust Bldg.
CLEVELAND, OHIO .....421 Engineers Bldg.
DETROIT, MICH. .....1006 Woodward Ave.
GREENSBORO, N. C. .....805 Ashboro Street
NEW YORK CITY ....50 Church St., Hudson Terminal Bldg.
PITTSBURGH, PA. .....Westinghouse Bldg.
SAN FRANCISCO, CAL. .....Monadnock Building

REPRESENTATIVES

ATLANTA, GA. .....Earl F. Scott, M.E.
702 Candler Building
CANADA .....Jones & Glassco, Regis'd
Montreal, St. Nicholas Bldg.
Toronto, Traders' Bank Bldg.
KANSAS CITY, MO. .....Morse Engineering Co.
R. A. Long Building
MINNEAPOLIS, MINN. .....Strong-Scott Mfg. Co.
413 Third Street, S.
ST. LOUIS, MO. .....Morse Engineering Co.
Chemical Building
LICENSEES FOR EUROPE,
The Westinghouse Brake Co., Ltd.
82 York Road, King's Cross, London, N.



HINTS TO BUYERS

DOMINION COAL COMPANY LIMITED

"Dominion" and "Springhill" BITUMINOUS STEAM and GAS COALS

GENERAL SALES OFFICE

112 St. James St. Montreal

NOTICE

TO

Stationary and Hoisting Engineers

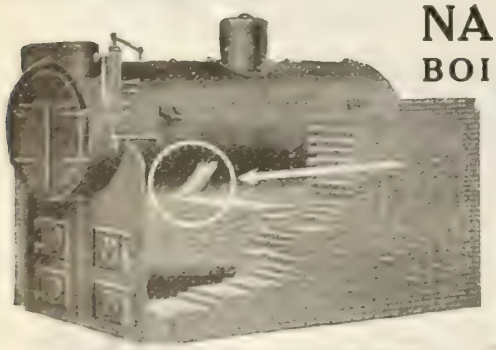
Everyone operating a STATIONARY steam plant of 50 h.p. or over in the Province of Ontario must hold a Stationary Engineer's Certificate from the Board of Stationary and Hoisting Engineers. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary and Hoisting Engineers' Act.

Everyone operating a HOISTING steam plant working at a pressure of 20 pounds or over, irrespective of horse power, and used for hoisting in structural operations or excavating purposes, in the Province of Ontario, must hold a Hoisting Engineer's Certificate from the Board of Stationary and Hoisting Engineers. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary and Hoisting Engineers' Act.

Application forms for obtaining STATIONARY or HOISTING Engineers' Certificates, may be had upon applying to the Chairman.

HON. F. G. MACDIARMID, Minister of Public Works and Highways.
W. C. McGHIE, Chairman of Board.
W. A. RIDDELL, M. A.; PH. D., Superintendent, Trades & Labour Branch.

NATIONAL BOILER SEAM PROTECTOR

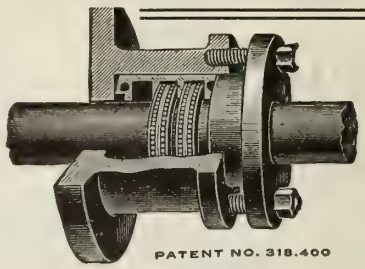


Stop that leakage at the seam — you are losing money! Use National Boiler Seam Protector. Saves boilers from mud cracks, fire cracks and blisters. Anyone can attach it in 30 minutes.

Free trial on request.

NATIONAL BOILER SEAM PROTECTOR CO. OF CANADA

Head Office: 910 New Birks Bldg., Montreal
Toronto Office: 568 Manning Ave., Toronto



PATENT NO. 318,400

PAT. NO.	500,899	PAT. NO.	829,116
" "	534,104	" "	830,530
" "	602,328	" "	856,103
" "	654,541	" "	878,238
" "	654,542	" "	894,537
" "	725,368	" "	895,791
" "	774,490	" "	898,066
" "	775,193	" "	905,103
" "	775,194	" "	934,629
" "	791,300	" "	979,206
" "	805,689	" "	1000,76.

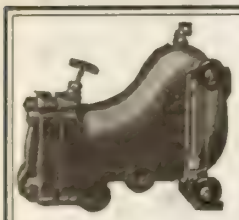
Why not Buy the Best, when in market for Packing?

HOLMES' Metallic Packing

Is Guaranteed 3 Years

Lasts many times longer. 30 days' trial. Less oil. No cutting. Easily applied to any Steam Engine, Air Compressor or Gas Engine. Satisfaction or no pay. Write us.

HOLMES METALLIC PACKING CO., Wilkes-Barre, Pa.
Incorporated 1897



McDANIEL IMPROVED STEAM TRAP

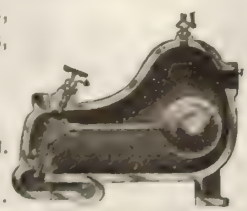
FOR HIGH OR LOW PRESSURE.

Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

MAY WE SEND ONE FOR TRIAL?

Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators.

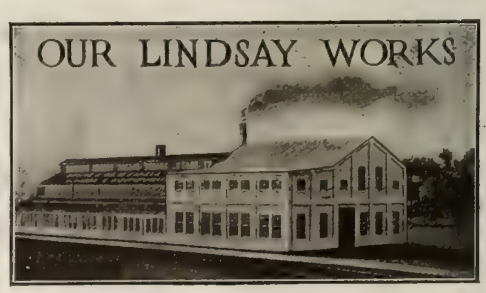
SEND FOR CATALOGUE.



THE GARTH COMPANY
26 Craig Street MONTREAL, CAN.

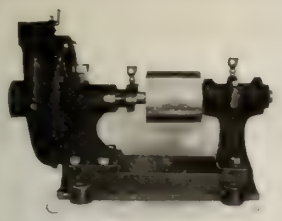
WATSON & McDANIEL CO.
No. 146 N. 7th Street. PHILADELPHIA, Pa.

Water Turbines, Hydraulic Governors, Centrifugal Pumps



Boving Hydraulic & Engineering Co., Limited
LINDSAY, ONTARIO

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

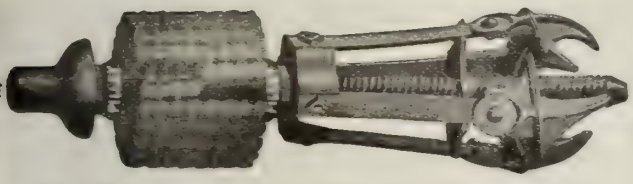


Buy for Long Satisfaction

It is assured when you place an order for

SMART-TURNER PUMPS

The Smart-Turner Machine Co., Limited
HAMILTON, CANADA



Looks like a good tool and it's just a little better than it looks. Adopted as standard by thousands of engineers who know from experience that it always gets results.

Pilleys Combination Flue Brush and Scraper

is adjustable to the tube—scraps and brushes thoroughly in one operation. Guaranteed against defective materials and that wires will not pull out or lay over. For sale by leading Canadian jobbers.

Eastern Office: 71 Fulton St., New York.

PILLEY PACKING & FLUE BRUSH MFG. CO.
623 South Third Street ST. LOUIS, MO.

BOILER INSPECTION

The Steam Boiler Act, Chapter 252 R.S.O., 1914 With Amendments Chapter 58—6, George V.

STEAM BOILERS.

All Steam boilers constructed for use in Ontario must be built from designs which have been approved and allotted a registration number by the Steam Boiler Branch.

Used boilers, boilers sold or exchanged, and unregistered boilers brought into the Province must be inspected prior to being put into operation.

Notice of repairs to steam boilers, stating the nature and extent of same, must be sent to the Steam Boiler Branch, and should such repairs be considered extensive by the Chief Boiler Inspector, the boilers will require to be inspected.

In each and every case the inspections must be made by Inspectors authorized to inspect boilers under the Steam Boilers Act, who are employed only by the Steam Boiler Branch of the Department of Public Works. Official certificates with the maximum working pressure stated thereon are issued to the owners of the boilers so inspected.

STEAM PIPING.

Drawings and Specifications of all high pressure steam piping must be approved and registered by the Steam Boiler Branch before any work of installation is commenced. The drawings submitted should show clearly the dimensions and layout of the main steam lines. Full particulars should be given as to the material used in the construction of the piping, and all valves and other fittings used in connection therewith must be of approved make.

Any deviation from the above requirements shall be deemed a violation of the Steam Boilers Act.

All communications in this respect should be addressed to the Steam Boiler Branch, Department of Public Works, Parliament Buildings, Toronto.

HON. F. G MACDIARMID, Minister of Public Works and Highways

W. A. RIDDELL, M.A. Ph.D., Supt. Trades & Labour Branch

D. M. MEDCALF,
Chief Inspector of Steam Boilers.

Reduce Fuse Costs 80%

THE stationary engineer who purchases or specifies electrical material has greatly to reduce fuse maintenance expense while providing more than adequate protection for his plant.

There are thousands of

Economy renewable Fuses

users and millions of Economy Fuses in use.

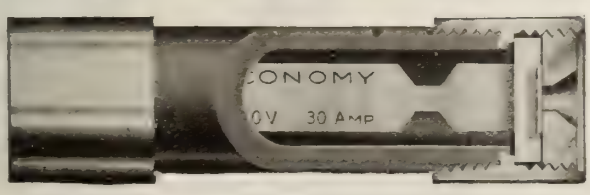
The famous "Drop Out" Renewal Link can be had only in **Economy renewable Fuses.** This link is responsible for the saving of 80% of the annual fuse maintenance cost.

Free samples of any desired types and capacities sent with Catalog 24.

Write to-day for yours.

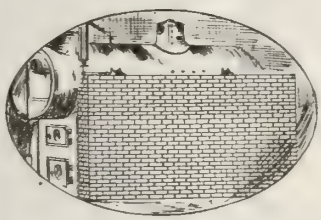
ECONOMY FUSE & MFG. CO. OF CANADA, LIMITED
UNITY BUILDING - MONTREAL

Manufacturers in Canada of "S.& C." High Potential Fuses,—to 150,000 Volts.



FIRE-BRICK WORK

in all its Branches



Your boilers need protection. Let me brick them up for you; this is my specialty. First-class, durable work—moderate cost.

Write for prices and particulars.

J. H. Wenting, Toronto, Ont.
Mason Contractor Phone Beach 1853 256 Lee Ave.

THE LADD VERTICAL WATER TUBE BOILER

The Goldie-McCulloch Co., Ltd.
Galt, Ontario

Canadian licencees under patents 162401 and 162402 dated May 4, 1915.

The George T. Ladd Company,
Pittsburgh, Pa.

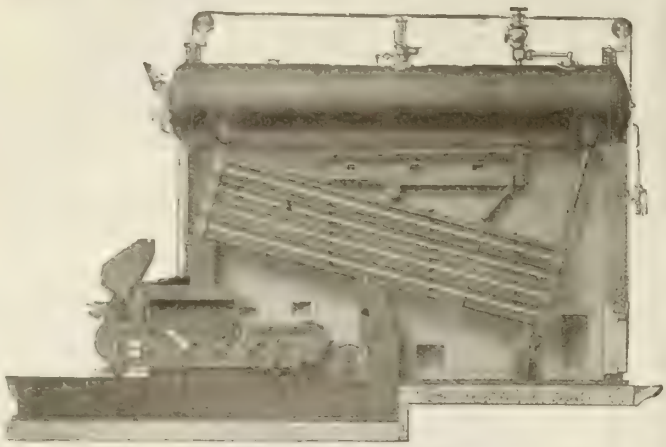
Owners and manufacturers for the United States.

Write for new Catalogue No. 17.

"ALL BRITISH"

"B.&W." PATENT WATER TUBE STEAM BOILERS

HIGHEST ECONOMY, SAFETY, DURABILITY. OVER 20,000,000 H.P. IN USE.



Babcock & Wilcox Patent Water Tube Steam Boiler, Superheater and Mechanical Stoker.

—ALSO—

Steam Superheaters
Mechanical Stokers
Coal-Handling Machinery
Piping, Feed Water Heaters
Water Softeners and Purifiers
and **ELECTRIC CRANES**

BABCOCK & WILCOX, Limited

HEAD OFFICE FOR CANADA - COLLEGE ST. (ST. HENRY), MONTREAL
TORONTO OFFICE, TRADERS BANK BUILDING

The right hack saw — that is a Starrett—

cuts quicker, thereby saving valuable time; it lasts longer—doesn't dull as quickly, doesn't break as easily, thereby saving money. On both counts you should use a Starrett.

Send for our Catalog No. 21 C.D. from which you can pick just the right kind of a saw for any job.

The L. S. Starrett Co.

The World's Greatest Toolmakers

Manufacturers of Hack Saws Unexcelled

ATHOL, MASS. 42-7-7

The Wrench of 25% Greater Efficiency

TRIMO PIPE WRENCH

Two new features have been recently added to the Trimo Pipe Wrench, namely Nut-Guards, in all sizes, and unbreakable steel frames, in leading sizes.

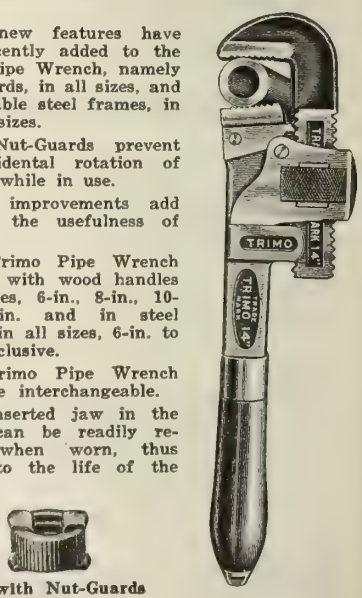
The Nut-Guards prevent the accidental rotation of the nut while in use.

These improvements add 25% to the usefulness of the tool.

The Trimo Pipe Wrench is made with wood handles in 4 sizes, 6-in., 8-in., 10-in., 14-in. and in steel handles in all sizes, 6-in. to 48-in. inclusive.

All Trimo Pipe Wrench parts are interchangeable.

The inserted jaw in the handle can be readily replaced when worn, thus adding to the life of the tool.



Nut with Nut-Guards

Inquiries from Importers and Dealers Solicited. Send for Catalogue No. 55.

TRIMONT MANUFACTURING CO.

Cable Address: Triwrench
Code: Western Union

Roxbury (Boston) Mass., U.S.A.

POWER HOUSE BUYERS' DIRECTORY

If what you want is not listed here write us, and we will tell you where to get it. Let us suggest that you consult also the advertisers' index facing the inside back cover, after having secured advertisers' names from this directory. The information you desire may be found in the advertising pages. This department is maintained for the benefit and convenience of our readers. The insertion of our advertisers' names under proper headings is gladly undertaken, but does not become part of an advertising contract.

AIR COCKS
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

AIR VALVES
Mueller Mfg. Co., H., Sarnia, Ont.

AMMETERS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. H. W. Johns-Manville Co., Toronto, Ont.

AMMONIA VALVES AND FITTINGS
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Frick Co., Waynesboro, Franklin Co., Pa.
Homestead Valve Mfg. Co., Pittsburgh, Pa.
York Mfg. Co., York, Pa.

AMMONIA PURIFIERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Mfg. Co., York, Pa.

AMMONIA TANKS
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford, Ont.

ARCHES, COMBUSTION CHAMBER
Canadian Fairbanks-Morse Co., Ltd. Montreal.

ASH CARRYING SYSTEMS
Babcock & Wilcox, Ltd. Montreal.
Waterous Engine Works Co., Brantford, Ont.

ASBESTOS SPECIALTIES
Durabla Mfg. Co., New York, N.Y.
Garlock Packing Co., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

AUTOMATIC ICE RECORDING DOORS AND CHUTES
Jamison Cold Storage Door Co., Hagerstown, Md.

BABBITT AND ANTI-FRICTION METAI
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Hoyt Metal Co., Toronto.
Magnolia Metal Co. Montreal.
Wm. C. Wilson & Co., Toronto.

BALL BEARINGS
Can. S K F Co., Toronto, Ont.

BALLCOCKS
D'Este Co., Julian, Boston, Mass.

BATTERIES AND ACCESSORIES
Can. H. W. Johns-Manville Co., Toronto, Ont.

BELT CEMENT
Graton & Knight Mfg. Co., Montreal.

BELT DRESSING
Cling Surface Co., Buffalo.
Jos. Dixon Crucible Co., Jersey City.
Dominion Belting Co., Hamilton, Ont.
Graton & Knight Mfg. Co., Montreal.

BELT LACING, LEATHER
Graton & Knight Mfg. Co., Montreal.

BELT TIGHTENERS
Waterous Engine Works Co., Brantford, Ont.

BELT PULLEYS
American Pulley Co., Philadelphia, Pa.
Waterous Engine Works Co., Brantford, Ont.

BELTING, BALATA
Federal Engineering Co., Toronto, Ont.

BELTING, LINK
Graton & Knight Mfg. Co., Montreal.
Waterous Engine Works Co., Brantford, Ont.

BELTING, STITCHED COTTON DUCK
Dominion Belting Co., Hamilton, Ont.

BELTING, LEATHER
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Garlock Packing Co., Hamilton, Ont.
Goodyear Tire & Rubber Co., Toronto.
Graton & Knight Mfg. Co., Montreal.
D. K. McLaren Ltd., Montreal.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

BELTING, RUBBER
Can. H. W. Johns-Manville Co., Toronto, Ont.
Goodyear Tire & Rubber Co., Toronto.
Jeffrey Manufacturing Co., Montreal.
Thomson-Gordon, Ltd., Hamilton, Ont.
United States Rubber Co., New York.

BELTING, WOVEN COTTON
Federal Engineering Co., Toronto, Ont.

BINS, COAL, COKE AND ORE
Jeffrey Manufacturing Co., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford, Ont.

BLOWERS
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Can. Sirocco Co., Windsor, Ont.
Coppus Eng. & Equip. Co., Worcester, Mass.

BOILER COMPOUNDS
Can. Economic Lubricant Co., Montreal, Que.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Metlskin Mfg. Co., Rochester, N.Y.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Wm. C. Wilson & Co., Toronto.

BOILER COMPOUND FEEDERS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Morehead Mfg. Co., Woodstock.
Lunkenheimer Co., Cincinnati, O.

BOILER FEED PUMPS
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Steam Boiler Equipment Co., Toronto, Ont.
Darling Bros., Ltd., Montreal, Que.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Laurie & Lamb, Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

BOILER FEED REGULATORS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Mason Regulator & Engineering Co., Montreal.

BOILER GRAPHITE
Joseph Dixon Crucible Co., Jersey City, N.J.

BOILER MOUNTINGS
Babcock & Wilcox, Ltd. Montreal.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Ltd., Montreal, Que.
Inglis Co., The John, Toronto, Ont.
Lunkenheimer Co., Cincinnati, O.
Mason Regulator & Engineering Co., Montreal.

BOILER PRESERVATIVES
Johns-Pratt Co., The, Hartford, Conn.
Metlskin Co., Inc., Rochester, N.Y.

BOILER HOUSE ACCESSORIES
Babcock & Wilcox, Ltd. Montreal.
Canadian Griscom-Russell Co., Ltd., Montreal.
Cole, Ltd., Geo. W., Toronto.
Mason Regulator & Engineering Co., Montreal.

BOILER SEAM PROTECTOR
National Boiler Seam Protector Co., Montreal.

BOILER SETTINGS
Beveridge Paper Co., Montreal.
Gates, John W., St. James St., Montreal.

BOILER TUBE CLEANERS
Babcock & Wilcox, Ltd. Montreal.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Cole, Ltd., Geo. W., Toronto,
Garlock Packing Co., Hamilton, Ont.
Liberty Mfg. Co., Pittsburg.
Laurie & Lamb, Montreal.
Pilley Packing and Flue Brush Mfg. Co., St. Louis, Mo.

BOILERS, HORIZONTAL, RETURN, TUBULAR AND WATERTUBE
Babcock & Wilcox, Ltd. Montreal.
Cole, Ltd., Geo. W., Toronto.
Goldie & McCulloch Co., Galt.
Frick Co., Waynesboro, Franklin Co., Pa.
Inglis Co., The John, Toronto, Ont.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Jones Underfeed Stoker Co., Toronto.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Ladd, The Geo. T., Co., Pittsburgh, Pa.
McAvity, T., & Sons, Ltd., St. John, N.B.
Waterous Engine Works Co., Brantford, Ont.

BOILERS, MARINE, LOCOMOTIVE AND VERTICAL
Babcock & Wilcox, Ltd. Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Goldie & McCulloch Co., Galt.
Inglis Co., The John, Toronto, Ont.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
John McDougall Caledonian Iron Works, Montreal.
Waterous Engine Works Co., Brantford, Ont.

BOOKS
Audel & Co., Theo, New York, N.Y.
MacLean Publishing Co., Toronto.

BOXES, FUSE AND METER
Johns-Pratt Co., The, Hartford, Conn.

BRASS FOUNDERS
McAvity, T., & Sons, Ltd., St. John, N.B.
D'Este Co., Julian, Boston, Mass.
Mueller Mfg. Co., H., Sarnia, Ont.

BRINE COOLERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

BRINE TANKS
Frick Co., Waynesboro, Franklin Co., Pa.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford, Ont.
York Manufacturing Co., York, Pa.

BUSHINGS
Steel Mill Packing Co., Windsor, Ont.

CABLE
Wm. C. Wilson & Co., Toronto.

CALORIMETERS
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Taylor Instrument Co., Rochester, N.Y.

CANS, OILY WASTE
Jas. Morrison Brass Mfg. Co., Toronto.

CAST IRON FITTINGS
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.

CASTINGS, BRASS AND IRON
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Lunkenheimer Co., Cincinnati, O.
John McDougall Caledonian Iron Works Co., Ltd., Montreal.
McAvity, T., & Sons, Ltd., St. John, N.B.
Mueller Mfg. Co., H., Sarnia, Ont.
Waterous Engine Works Co., Brantford, Ont.

CELLAR DRAINERS
Morrison Brass Mfg. Co., James, Toronto, Ont.
Mueller Mfg. Co., H., Sarnia, Ont.

CEMENT, HIGH TEMPERATURE
Beveridge Paper Co., Montreal.
Gates, John W., St. James St., Montreal.

CEMENT, PIPE JOINT
Wm. C. Wilson & Co., Toronto.

CEMENT MACHINERY
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Waterous Engine Works Co., Brantford, Ont.

CHAIN DRIVES
Coventry Chain Co., Coventry, England.
Morse Chain Co., Ithaca, N.Y.

CHAIN WHEELS
Babbitt Steam Specialty Co., New Bedford, Mass.

CHIMNEYS, STEEL
Babcock & Wilcox, Ltd. Montreal
MacKinnon, Holmes & Co., Sherbrooke, Que.

CHUTES, COAL
Can. Allis-Chalmers, Ltd., Toronto, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.

CLOCKS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Foxboro Co., The, Foxboro, Mass.

CLOSETS
Mueller Mfg. Co., H., Sarnia, Ont.

CLUTCHES
Waterous Engine Works Co., Brantford, Ont.

COAL
Dom. Coal Co., Montreal.

COAL AND ASH CONVEYORS
Babcock & Wilcox, Ltd. Montreal.
Jeffrey Manufacturing Co., Montreal.
Waterous Engine Works Co., Brantford, Ont.

COAL HANDLING MACHINERY
Babcock & Wilcox, Ltd. Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Jeffrey Manufacturing Co., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford, Ont.

COAL HOLE COVERS
Can. Allis-Chalmers, Ltd., Toronto, Ont.

COILS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

COLD STORAGE INSULATION
Armstrong Cork & Insulation Co., Montreal, Que.
Beveridge Paper Co., Ltd., Montreal, Que.

COMMUTATOR TRUING DEVICES
Jordan Bros., Inc., New York, N.Y.

CONDENSERS
Alberger Heater Co., Buffalo, N.Y.
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Toronto.
Belliss & Morcom, Birmingham, Eng.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Darling Bros., Ltd., Montreal, Que.
Goldie & McCulloch Co., Galt.
Laurie & Lamb, Montreal.
John McDougall Caledonian Iron Wks., Montreal.
Waterous Engine Works Co., Brantford.

CONDENSERS, AMMONIA AND STEAM
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

COLLECTORS, PNEUMATIC
Sturtevant Co. of Canada, B. F., Galt, Ont.

CONSULTING ENGINEERS
Walter J. Francis, Montreal.
Laurie & Lamb, Montreal.

COLD STORAGE DOORS AND WINDOWS
Jamison Cold Storage Door Co., Hagerstown, Md.

COMPRESSORS, AIR
American Steam Pump Co., Battle Creek, Mich.
Belliss & Morcom, Birmingham, Eng.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Darling Bros., Ltd., Montreal, Que.
Inglis Co., The John, Toronto, Ont.
Laurie & Lamb, Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Smart-Turner Machine Co., Ltd., Hamilton.
Taylor Instrument Co., Rochester, N.Y.

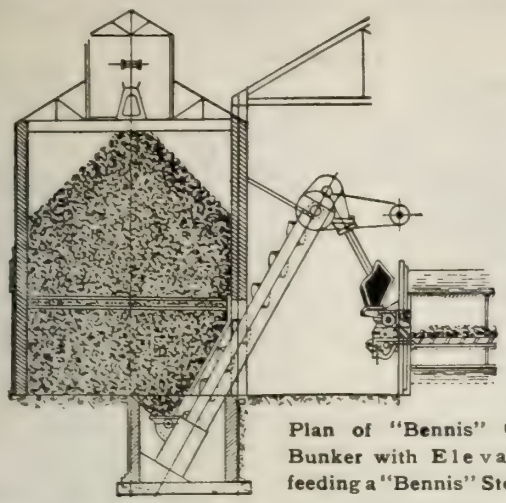
COMPRESSORS, GAS
Can. Allis-Chalmers, Ltd., Toronto, Ont.

CONDUITS
Can. H. W. Johns-Manville Co., Toronto, Ont.

CONDENSATION RECEIVER
Cole, Ltd., Geo. W., Toronto.
G. M. Davis Regulator Co., Chicago.

CONNECTIONS, FLANGED
Jefferson Union Co., Lexington, Mass.
Dart Union Co., Ltd., Toronto, Ont.

CONTRACTORS' STRUCTURAL STEEL
Canadian Fairbanks-Morse Co., Ltd. Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
CONVEYOR MACHINERY
Babcock & Wilcox, Ltd. Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Jeffrey Manufacturing Co., Montreal.
Waterous Engine Works Co., Brantford.
COOLER, DOORS
Jamison Cold Storage Door Co., Hagerstown, Md.
CORK INSULATION
Armstrong Cork & Insulation Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
COTTON HOSE
Garlock Packing Co., Hamilton, Ont.
COUNTERS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Foxboro Co., The, Foxboro, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
COUNTERSHAFTS
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
COUPLINGS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Jeffrey Manufacturing Co., Montreal.
McAvity & Sons, T., St. John, N.B.
COUPLINGS, BOILER, FLANGED PIPE, JOINT PIPE, UNION, STEAM PIPE
Jefferson Union Co., Lexington, Mass.
Dart Union Co., Ltd., Toronto, Ont.
COUPLINGS, SHAFT
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
CRANES, ALL KINDS
Babcock & Wilcox, Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
CRANES, ELECTRIC
Babcock & Wilcox, Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
CRANES, HAND POWER
Babcock & Wilcox, Ltd., Montreal.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Smart-Turner Machine Co., Ltd., Hamilton.
CRANES, OVERHEAD TRAVELLING
Babcock & Wilcox, Ltd., Montreal.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Smart-Turner Machine Co., Ltd., Hamilton.
CRANES, POST JIB
Babcock & Wilcox, Ltd., Montreal.
CRANES, SWING JIB
Babcock & Wilcox, Ltd., Montreal.
CRANES, WALL
Babcock & Wilcox, Ltd., Montreal.
CRANK AND CROSSHEAD PIN OILERS
Lunkenheimer Co., Cincinnati, O.
CRIMPS, LEATHER
Graton & Knight Mfg. Co., Montreal.
CRUSHING MACHINERY
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Jeffrey Mfg. Co., Columbus, Ohio.
CYLINDER OIL
E. H. Kellogg & Co., New York.
DAMPER REGULATORS
Babcock & Wilcox, Ltd., Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Darling Bros., Ltd., Montreal, Que.
G. M. Davis Regulator Co., Chicago.
D'Este Co., Julian, Boston, Mass.
Elliott Co., Pittsburgh, Pa.
Mason Regulator Co., Boston, Mass.
Jas. Morrison Brass Mfg. Co., Toronto.
DISCS, FIBRE
Beveridge Paper Co., Ltd., Montreal, Que.
Johns-Pratt Co., The, Hartford, Conn.
DISCS, LEATHER
Graton & Knight Mfg. Co., Montreal.
DISTILLING APPARATUS
Canadian Griscom-Russell Co., Ltd., Montreal.
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.
DOORS, COLD STORAGE AND FREEZER
Jamison Cold Storage Door Co., Hagerstown, Md.
DOUBLE PIPE CONDENSERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.
DRYING MACHINERY
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Sirocco Co., Windsor, Ont.
DUST SEPARATORS
Sturtevant Co. of Canada, B. F., Galt, Ont.
DYNAMOS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Sturtevant Co. of Canada, B. F., Galt, Ont.
ECONOMIZERS
Babcock & Wilcox, Ltd., Montreal.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Green Fuel Economizer Co., New York, N.Y.
EJECTORS
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.
Smart-Turner Machine Co., Ltd., Hamilton.
ELECTRICAL ACCESSORIES AND MACHINERY
Can. H. W. Johns-Manville Co., Toronto, Ont.
Beveridge Paper Co., Ltd., Montreal, Que.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Economy Fuse & Mfg. Co., Montreal, Que.
MacGovern & Co., Inc., New York.
ELECTRICAL SUPPLIES
Can. General Electric Co., Toronto, Ont.
Can. H. W. Johns-Manville Co., Toronto, Ont.
ELEVATORS
MacKinnon, Holmes & Co., Sherbrooke, Ont.
John MacDougall Caledonian Iron Works, Montreal.
ELEVATING MACHINERY
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Goldie & McCulloch Co., Galt.
Jeffrey Manufacturing Co., Montreal.
Waterous Engine Works Co., Brantford.
ENAMELWARE
H. Mueller Mfg. Co., Sarnia, Ont.
ENGINEERS' SUPPLIES
Beveridge Paper Co., Ltd., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Ltd., Montreal, Que.
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.
Jas. Morrison Brass Mfg. Co., Toronto.
ENGINES, AUTOMATIC AND DROP VALVE
Frick Co., Waynesboro, Franklin Co., Pa.
Waterous Engine Works Co., Brantford.
ENGINES, CORLISS AND ROCKING VALVE
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Waterous Engine Works Co., Brantford.
ENGINES, DIESEL
Can. Allis-Chalmers, Ltd., Toronto, Ont.
ENGINES, GAS AND GASOLINE
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Laurie & Lamb, Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
ENGINES, STEAM
Belliss & Morcom, Birmingham, Eng.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Can. Sirocco Co., Windsor, Ont.
Goldie & McCulloch Co., Galt.
Inglis Co., The John, Toronto, Ont.
Laurie & Lamb, Montreal.
John MacDougall Caledonian Iron Works, Montreal.
Waterous Engine Works Co., Brantford.
ENGINES, HOISTING, LOGGING, CABLEWAY
Can. Allis-Chalmers, Ltd., Toronto, Ont.
ENGINES, MARINE
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
ENGINES, SAW MILL
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Laurie & Lamb, Montreal.
Waterous Engine Works Co., Brantford.
ENGINES, SINGLE COMPOUND AND TRIPLE EXPANSION
Canadian Griscom-Russell Co., Ltd., Montreal.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Laurie & Lamb, Montreal.
John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Kerr Engine Co., Walkerville.
Waterous Engine Works Co., Brantford.
ENGINES, VERTICAL
Laurie & Lamb, Montreal.
ENGINEERING BOOKS
MacLean Publishing Co., Toronto
EXHAUST HEADS
Can. Sirocco Co., Windsor, Ont.
Darling Bros., Ltd., Montreal, Que.
Direct Separator Co., Syracuse, N.Y.
Elliott Co., Pittsburgh, Pa.
Jas. Morrison Brass Mfg. Co., Toronto.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Watson & McDaniel Co., Philadelphia.
EXPANSION JOINTS
Alberger Heater Co., Buffalo, N.Y.
Direct Separator Co., Syracuse, N.Y.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
FANS, VENTILATING
Can. Sirocco Co., Windsor, Ont.
C. T. Coe Co., 10 Johnson St., Newark, N.J.
Coppus Engr. & Equip. Co., Worcester, Mass.
Green Fuel Economizer Co., New York, N.Y.
Sturtevant Co. of Canada, B. F., Galt, Ont.
FEED WATER HEATERS
Alberger Heater Co., Buffalo, N.Y.
Babcock & Wilcox, Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Stewart Heater Co., Buffalo, N.Y.
Waterous Engine Works Co., Brantford.
FEED WATER PURIFIERS
Stewart Heater Co., Buffalo, N.Y.
FEED WATER REGULATORS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Chaplin, Fulton Mfg. Co., Pittsburg, Pa.
Elliott Co., Pittsburgh, Pa.
Laurie & Lamb, Montreal.
FILTERS
Bowser & Co., Inc., S. F., Toronto, Ont.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
FILTERS, WATER
Canadian Griscom-Russell Co., Ltd., Montreal.
Darling Bros., Ltd., Montreal, Que.
Frick Co., Waynesboro, Franklin Co., Pa.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Scaife & Sons, Wm. B., Pittsburgh, Pa.
York Manufacturing Co., York, Pa.
FIRE BRICK, PLASTIC
Gates, John W., St. James St., Montreal.
Wenting, J. H., Toronto.
FIREPROOF COLD STORAGE DOORS AND WINDOWS
Jamison Cold Storage Door Co., Hagerstown, Md.
FITTINGS, AIR, AUTOMOBILE, GAS, HYDRAULIC, PIPE, PIPE FLANGED, SCREWED PIPE, STEAM
Jefferson Union Co., Lexington, Mass.
Dart Union Co., Ltd., Toronto, Ont.
H. Mueller Mfg. Co., Sarnia, Ont.
FLANGED STEAM FITTINGS
Direct Separator Co., Syracuse, N.Y.
McAvity, T., & Sons, Ltd., St. John, N.B.
FLANGES
Dart Union Co., Ltd., Toronto, Ont.
Jefferson Union Co., Lexington, Mass.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
FLOORING COMPOSITION
Armstrong Cork & Insulation Co., Montreal, Que.
FLUE CLEANERS
Babcock & Wilcox, Montreal.
Liberty Mfg. Co., Pittsburg, Pa.
Pilley Packing and Flue Brush Mfg. Co., St. Louis, Mo.
William B. Pierce Co., Buffalo, N.Y.
Wm. C. Wilson & Co., Toronto.
FLUE GAS ANALYSIS INSTRUMENTS
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Uehling Instrument Co., New York.
Precision Instrument Co., Detroit, Mich.
Penberthy Injector Co., Windsor, Ont.
FLUMES, STEEL
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
FREEZER DOORS
Jamison Cold Storage Door Co., Hagerstown, Md.
FRICTION LEATHERS
Graton & Knight Mfg. Co., Montreal.
FURNACES, BOILER
Gates, J. W., Montreal, P.Q.
FURNACES, SMOKELESS
Babcock & Wilcox, Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Detroit, Mich.
FUSES
Can. H. W. Johns-Manville Co., Toronto, Ont.
Economy Fuse & Mfg. Co. of Canada, Montreal.
Johns-Pratt Co., The, Hartford, Conn.
GAS ANALYSIS INSTRUMENTS, ETC.
Penberthy Injector Co., Windsor, Ont.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Uehling Instrument Co., New York, N.Y.
GASKETS, RUBBER, ASBESTOS
Can. H. W. Johns-Manville Co., Toronto, Ont.
Durabla Mfg. Co., New York, N.Y.
Frick Co., Waynesboro, Franklin Co., Pa.
Garlock Packing Co., Hamilton, Ont.
Johns-Pratt Co., The, Hartford, Conn.
Peerless Rubber Mfg. Co., New York, N.Y.
Sarco Co., Inc., New York, N.Y.
Thomson-Gordon, Ltd., Hamilton, Ont.
GASKETS, LEAD, COPPER AND LEATHER
Graton & Knight Mfg. Co., Montreal, Que.
Shell Bar Boico Supply Co., Toronto, Ont.
Sarco Co., Inc., New York, N.Y.
Wm. C. Wilson & Co., Toronto, Ont.
GAS COLLECTORS
Precision Instrument Co., Detroit, Mich.
GAS PRODUCER PLANTS
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Laurie & Lamb, Montreal.
GAUGE COCKS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Garlock Packing Co., Hamilton, Ont.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.
W. J. Wall, Montreal.
GAUGE GLASSES
Wm. C. Wilson & Co., Toronto.
GAUGES, AMMONIA, OIL, GAS, AIR
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
GAUGES, PRESSURE, VACUUM, DRAFT AND RECORDING, AND MICROMETER
Babcock & Wilcox, Montreal.
Foxboro Company, Foxboro, Mass.
Lunkenheimer Co., Cincinnati, O.
Precision Instrument Co., Detroit, Mich.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.
GAUGES, WATER
Babcock & Wilcox, Montreal.
Jenkins Bros., Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
Penberthy Injector Co., Windsor, Ont.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
GEARS, FIBRE CUT
Beveridge Paper Co., Ltd., Montreal, Que.
GEARS, CUT, WORM, MORTISE
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
GENERATORS, STEAM TURBO
Can. General Electric Co., Toronto, Ont.
Laurie & Lamb, Montreal.
GENERATORS AND CONVERTORS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. General Electric Co., Toronto, Ont.
GOVERNORS, ENGINE
Escher Wyss & Co., Montreal, Que.
McAvity, T., & Sons, Ltd., St. John, N.B.
Waterous Engine Works Co., Brantford.
GRAPHITE, BOILER
Jos. Dixon Crucible Co., Jersey City.
Wm. C. Wilson & Co., Toronto.



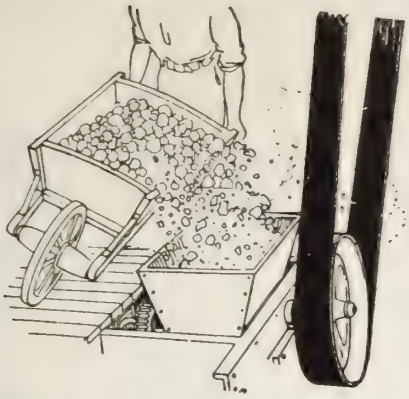
Plan of "Bennis" Coal Bunker with Elevator feeding a "Bennis" Stoker

Plants similar to the above have been installed in many of the new National Factories to ensure maximum output and rapid and efficient handling with the minimum of labour. "Bennis" Conveyors and Elevators are indispensable for the cheap and efficient transport of material in bulk. Schemes prepared to any requirements.

Write to-day for descriptive literature.

ED. BENNIS & CO., LTD.

Little Hulton, Bolton; 28 Victoria Street, S.W. London, Eng.



SCANDINAVIA BELTING

Is a Good Belt for Dusty Places

In cement plants and brick plants where there is lots of dust this belt is producing results that are very satisfactory for the mill operators.

You know how wearing grit is on a belt, and you want a belt that will not come apart when only partly worn through.

"Scandinavia" is this kind of a belt—there are no plies to come apart—it is solid woven. We have seen these belts still giving good service when the thickness was half worn through, and on the pulley side of the belt there were no frayed ends—the surface of the belt was smooth.

Mr. Plant Manager, you know what this means. If you require a belt for operating in a dusty place let us ship you one, please. It will be a pleasure to us both.

NOTE.—Do not use "bar" or "stick" belt dressing on textile belts.

Federal Engineering Co., Limited

172 John Street, Toronto

Oil is Too Expensive to be Wasted

Think of the price of oil to-day—and over half the oil you buy is wasted—lost on the floors, rags and waste.

Anderson Pressure Oil Filters

WILL ELIMINATE THIS WASTE.

It is simply a matter of collecting it in drip pans, properly located beneath the engine or machinery. After passing through the Anderson Filter it can be used over again for lubricating purposes on the finest bearings until actually consumed.

The Anderson Filter is the only one which treats the oil with the refiners process and is therefore the only filter which can deliver the oil just as clean and pure as the new oil you purchase.

Our catalogue gives full details. Drop a line for it now.

The V. D. Anderson Co.

West 96th St., CLEVELAND, OHIO

GRATES, DUMPING, ROCKING, STATIONARY
Babcock & Wilcox, Montreal.
Boiler Repair & Grate Bar Co., Toronto, Ont.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
C. T. Coe Co., 10 Johnson St., Newark, N.J.
Can. Steam Boiler Equipment Co., Toronto, Ont.
Galt Foundry Co., Galt, Ont.
Mason Regulator & Engineering Co., Montreal.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Waterous Engine Works Co., Brantford.

GREASE CUPS
Albany Lubricating Co., New York City.
Detroit Lubricator Co., Walkerville.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

GREASE AND OIL EXTRACTORS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Canadian Griscom-Russell Co., Ltd., Montreal.
Elliott Co., Pittsburgh, Pa.
Laurie & Lamb, Montreal.

GREASES
Albany Lubricating Co., New York City.
Can. Economic Lubricant Co., Montreal, Que.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Jos. Dixon Crucible Co., Jersey City.
Wm. C. Wilson & Co., Toronto.

HAND LEATHERS OR PADS
Graton & Knight Mfg. Co., Montreal.

HANGERS
Can. General Electric Co., Toronto, Ont.
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Can. S K F Co., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Goldie & McCulloch Co., Galt.
Waterous Engine Works Co., Brantford.

HEATERS
Alberger Heater Co., Buffalo, N.Y.
Babcock & Wilcox, Ltd., Montreal.
Can. Sirocco Co., Windsor, Ont.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
Laurie & Lamb, Montreal.
McAvity & Sons, T., St. John, N.B.
Scaife & Sons, Wm. B., Pittsburgh, Pa.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Waterous Engine Works Co., Brantford.

HEATERS, EXHAUST STEAM
Can. Allis-Chalmers, Ltd., Toronto, Ont.

HEATERS, METERING
Can. Allis-Chalmers, Ltd., Toronto, Ont.

HEATING SYSTEMS, FANS
Can. Sirocco Co., Windsor, Ont.

HOISTS, GRIP
Jordan Bros., Inc., New York, N.Y.

HOISTING AND CONVEYING MACHINERY
Babcock & Wilcox, Ltd., Montreal.
Waterous Engine Works Co., Brantford.

HOSE, METALLIC
Pennsylvania Flexible Metallic Tubing Co., Boston, Mass.

HOSE, STEAM, SUCTION AND WATER
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Asbestos Co., Montreal.
Garlock Packing Co., Hamilton, Ont.
Goodyear Tire & Rubber Co., Toronto.
Peerless Rubber Mfg. Co., New York, N.Y.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

HYDRAULIC ACCUMULATORS
Smart-Turner Machine Co., Ltd., Hamilton.

HYDRAULIC MACHINERY
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
John McDougall Caledonian Iron Wks., Montreal.

HYDRAULIC PRESSES
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

ICE MAKING MACHINERY
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Griscom-Russell Co., Ltd., Montreal.
Frick Co., Waynesboro, Franklin Co.
Linde Canadian Refrigeration Co., Montreal.
York Mfg. Co., York, Pa.

INDICATORS, ELECTRIC—ALL TYPES
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Uehling Instrument Co., New York, N.Y.

INDICATORS, STEAM AND GAS ENGINE
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Canadian Fairbanks-Morse Co., Montreal.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Uehling Instrument Co., New York, N.Y.

INDICATORS—AMMONIA, HYDRAULIC
Can. Detroit Lubricator Co., Walkerville, Ont.

INDICATORS, SPEED
L. S. Starrett Co., Athol, Mass.

INJECTORS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

INSULATING BRICK
Armstrong Cork & Insulation Co., Montreal, Que.
Beveridge Paper Co., Ltd., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.

INSULATING COMPOUNDS
Johns-Pratt Co., The, Hartford, Conn.

INSULATORS
Ed. Bennis & Co., Little Fulton, Bolton, Eng.
Beveridge Paper Co., Ltd., Montreal, Que.
Johns-Pratt Co., The, Hartford, Conn.

IRON FILLER
Can. H. W. Johns-Manville Co., Toronto, Ont.

LACE LEATHERS
Graton & Knight Mfg. Co., Montreal.
Wm. C. Wilson & Co., Toronto.

LAMPS, ARC
Canadian Fairbanks-Morse Co., Montreal.
Can. General Electric Co., Toronto, Ont.
Can. H. W. Johns-Manville Co., Toronto, Ont.

LAMPS, ELECTRIC
Wm. C. Wilson & Co., Toronto.

LAMPS, INCANDESCENT
Canadian Fairbanks-Morse Co., Montreal.
Can. General Electric Co., Toronto, Ont.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Can. Laco-Philips Co., Ltd., Toronto, Ont.

LAMPS, NITRO
Can. Laco-Philips Co., Ltd., Toronto, Ont.

LAMPS, TUNGSTEN AND NITRO
Can. General Electric Co., Toronto, Ont.
Can. Laco-Philips Co., Ltd., Toronto, Ont.

LEATHER STRAPPING
Graton & Knight Mfg. Co., Montreal.

LUBRICANTS
Albany Lubricating Co., New York City.
Canadian Economic Lubricant Co., Montreal.
Jos. Dixon Crucible Co., Jersey City.

LUBRICATORS, CYLINDER
Albany Lubricating Co., New York City.
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

LUBRICATORS, FORCE FEED
Can. Detroit Lubricator Co., Walkerville, Ont.
Darling Bros., Montreal.
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

LUBRICATORS, PLAIN
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

MACHINERY INSULATION
Armstrong Cork & Insulation Co., Montreal, Que.
Beveridge Paper Co., Ltd., Montreal, Que.

MANGENESITE PASTE
Wm. C. Wilson & Co., Toronto.

MECHANICAL STOKERS
Babcock & Wilcox, Ltd., Montreal.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Dertoit, Mich.

METERS, ELECTRIC
Can. H. W. Johns-Manville Co., Toronto, Ont.

METERS, STEAM
Can. Allis-Chalmers, Ltd., Toronto, Ont.

METERS, WATER
Allen General Supplies, Toronto, Ont.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Foxboro Company, Foxboro, Mass.
McAvity & Sons, T., St. John, N.B.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Precision Instrument Co., Detroit, Mich.

MIXING VALVES
Mueller Mfg. Co., H., Sarnia, Ont.

MILL AND MINING MACHINERY
Canadian Fairbanks-Morse Co., Montreal.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Goldie & McCulloch Co., Galt.
Waterous Engine Works Co., Brantford.

METER TESTERS
Mueller Mfg. Co., H., Sarnia, Ont.

MOTORS
Canadian Fairbanks-Morse Co., Montreal.
Can. General Electric Co., Toronto, Ont.

OAKUM
Wm. C. Wilson & Co., Toronto.

OFFICE RAILINGS
Jas. Morrison Brass Mfg. Co., Toronto.

OIL CUPS
Albany Lubricating Co., New York City.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

OILER, COMPOUND FEEDERS
Lunkenheimer Co., Cincinnati, O.

OILERS, GAUGE
Lunkenheimer Co., Cincinnati, O.

OILERS, MULTIPLE
Can. Detroit Lubricator Co., Walkerville, Ont.
Lunkenheimer Co., Cincinnati, O.

OIL FILTERS AND CIRCULATING SYSTEMS
Bowser & Co., Inc., S. F., Toronto, Ont.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
Jas. Morrison Brass Mfg. Co., Toronto.

OIL SEPARATORS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
Direct Separator Co., Syracuse, N.Y.
Elliott Co., Pittsburgh, Pa.
Leitch Co., Arthur S., Toronto, Ont.
Liberty Mfg. Co., Pittsburgh.
Jas. Morrison Brass Mfg. Co., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.

OILING SYSTEMS
Albany Lubricating Co., New York City.
Bowser & Co., Inc., S. F., Toronto, Ont.
Lunkenheimer Co., Cincinnati, O.

OILS, LUBRICATING
Albany Lubricating Co., New York City.
Can. Economic Lubricant Co., Montreal, Que.
Kellogg & Co., E. H., New York, N.Y.
Wm. C. Wilson & Co., Toronto.

PACKING, ASBESTOS
Johns-Pratt Co., The, Hartford, Conn.

PACKING ENGINE
Can. Asbestos Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Can. B. K. Morton Co., Toronto, Montreal.
Canuck Supply Co., Ltd., Montreal, Que.
Crane Packing Co., Chicago, Ill.
Garlock Packing Co., Hamilton, Ont.
Johns-Pratt Co., The, Hartford, Conn.
Peerless Rubber Mfg. Co., New York, N.Y.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING FIBRE
Beveridge Paper Co., Ltd., Montreal, Que.
Can. B. K. Morton Co., Montreal, Que.
Johns-Pratt Co., The, Hartford, Conn.
Wm. C. Wilson & Co., Toronto.

PACKING, HYDRAULIC
Can. Asbestos Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Can. B. K. Morton Co., Toronto, Montreal.
Crane Packing Co., Chicago, Ill.
Durabla Manufacturing Co., New York.
Garlock Packing Co., Hamilton, Ont.
Goodyear Tire & Rubber Co., Toronto.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, METALLIC
Can. B. K. Morton Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Crane Packing Co., Chicago, Ill.
Greene, Tweed & Co., New York.
Holmes Metallic Packing Co., Wilkesbarre, Pa.
Steel Mill Packing Co., Windsor, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, ROD
Can. Asbestos Co., Montreal, Que.
Can. B. K. Morton Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Crane Packing Co., Chicago, Ill.
Garlock Packing Co., Hamilton, Ont.
Canuck Supply Co., Ltd., Montreal, Que.
Steel Mill Packing Co., Windsor, Ont.
Peerless Rubber Mfg. Co., New York, N.Y.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, SHEET
Can. Asbestos Co., Montreal, Que.
Can. B. K. Morton Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Canuck Supply Co., Ltd., Montreal, Que.
Durabla Manufacturing Co., New York.
Garlock Packing Co., Hamilton, Ont.
Jenkins Bros., Ltd., Montreal.
Johns-Pratt Co., The, Hartford, Conn.
Peerless Rubber Mfg. Co., New York, N.Y.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, AMMONIA, STEAM AND WATER
Can. Asbestos Co., Montreal, Que.
Can. B. K. Morton Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Canuck Supply Co., Ltd., Montreal, Que.
Crane Packing Co., Chicago, Ill.
Garlock Packing Co., Hamilton, Ont.
Greene, Tweed & Co., New York.
Goodyear Tire & Rubber Co., Toronto.
Johns-Pratt Co., The, Hartford, Conn.
Steel Mill Packing Co., Windsor, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, LEATHER
Can. B. K. Morton Co., Toronto, Montreal.
Canuck Supply Co., Ltd., Montreal, Que.
Garlock Packing Co., Hamilton, Ont.
Graton & Knight Mfg. Co., Montreal.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING PISTON
Crane Packing Co., Chicago, Ill.

PACKING, VALVE STEM
Crane Packing Co., Chicago, Ill.
Johns-Pratt Co., The, Hartford, Conn.

PAINTS
Wm. C. Wilson & Co., Toronto.

PAINT, DAMP RESISTING
Toch Bros., Toronto, Ont.

PENSTOCKS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.

PILLOW BLOCKS
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Waterous Engine Works Co., Brantford.

PIPE COILS
York Mfg. Co., York, Pa.

PIPE COVERINGS, STEAM, BRINE, AMMONIA AND ICE WATER
Armstrong Cork & Insulation Co., Montreal, Que.

PIPE STEEL
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

PIPE VISES AND CUTTERS
Armstrong Mfg. Co., Bridgeport, Conn.

PIPE, GAS
Can. Allis-Chalmers, Ltd., Toronto, Ont.

PIPES, WATER
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

PIPING AND FITTINGS
Frick Co., Waynesboro, Franklin Co., Pa.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
York Mfg. Co., York, Pa.

PIPING, STEAM
Babcock & Wilcox, Ltd., Montreal.

PLATE WORK
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

PLUG COCKS
Homestead Valve Mfg. Co., Pittsburgh, Pa.

PLUMBING SUPPLIES
Mueller Mfg. Co., H., Sarnia, Ont.
Wm. C. Wilson & Co., Toronto.

Canadian Association of Stationary Engineers

Incorporated May, 1887 Incorporated at Ottawa, June, 1917

An organization having as its aims and objects:—

To promote the knowledge of its members in the art and science of Steam Engineering.

The dissemination of information beneficial to the members of the association in the discharge of their calling.

To further and protect the interests of competent engineers, and receive such as members of this organization.

To secure, through proper legislation, the greatest security in operation of steam plants.

To assist unemployed members to secure positions.

To maintain freedom of action between employer and employee.

The members of the Association subscribe to the above in the full belief that ability and knowledge of one's profession are necessary to insure the highest degree of success.

Labor Study Energy

These three essentials have been responsible for the success of the world's greatest men. They are no less essentiál for yours. We cannot all become great, but this fact does not lessen the necessity for the exercise of these essentials in our individual occupations. Cool, calm, calculating judgment characterizes the successful power house operator of to-day. The demands on the engineer of to-day are many, and the obstacles in his path are great. To assist in the overcoming of these and help the accomplishment of great works, material, moral and educational, is the desire of all our members.

The benefits accruing from association with members of his fraternity, the opportunity to benefit by their experience, and the inspiration to greater effort by reason of their success render membership in this association indispensable to all progressive engineers.

If you are interested in such an organization and live where less than fifteen engineers are located, send for a copy of our constitution and application blanks for admission to nearest branch lodge. If there are more than fifteen engineers in your community, get together and send for particulars regarding formation of a branch lodge.

J. H. HALE, General Secretary, C.A.S.E.

230 Caroline Street Hamilton, Ont.

POWER PUMPS
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
Waterous Engine Works Co., Brantford.
Garlock Packing Co., Hamilton, Ont.
Laurie & Lamb, Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.

POWER, TRANSMISSION MACHINERY
American Pulley Co., Philadelphia, Pa.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Goldie & McCulloch Co., Galt.
Jeffrey Manufacturing Co., Montreal.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
MacGovern & Co., New York.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Morse Chain Co., Ithaca, N.Y.
Waterous Engine Works Co., Brantford.

PRESSES
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

PRESSURE, BLOWERS, CENTRIFUGAL
Can. Sirocco Co., Windsor, Ont.

PULLEYS
American Pulley Co., Philadelphia, Pa.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Wm. Hamilton Co., Ltd., Peterboro.
Jeffrey Manufacturing Co., Montreal.
Waterous Engine Works Co., Brantford.

PULP MILL MACHINERY
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Jeffrey Manufacturing Co., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

PUMPING MACHINERY
American Steam Pump Co., Battle Creek, Mich.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Bawden Machine Co., Toronto.
Laurie & Lamb, Montreal.
McAvity & Sons, T., St. John, N.B.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.
Waterous Engine Works Co., Brantford.

PUMPING MACHINERY, ELECTRICAL
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Jeffrey Manufacturing Co., Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.

PUMPS, AIR
American Steam Pump Co., Battle Creek, Mich
Bawden Machine Co., Ltd., Toronto.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Montreal.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co. Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, CONTRACTORS'
Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
McAvity & Sons, T., St. John, N.B.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, ELECTRICAL
American Steam Pump Co., Battle Creek, Mich.

PUMPS, FEED WATER
Can. Allis-Chalmers, Ltd., Toronto, Ont.

PUMP GOVERNORS AND REGULATORS
Bawden Machine Co., Ltd., Toronto.
Darling Bros., Montreal.
G. M. Davis Regulator Co., Chicago.
D'Este Co., Julian, Boston, Mass.
Elliott Co., Pittsburgh, Pa.
Mason Regulator Co., Boston, Mass.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.
Watson & McDaniel Co., Philadelphia.

PUMP STRAINERS
Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Darling Bros., Ltd., Montreal.
Liberty Mfg. Co., Pittsburgh, Pa.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, HAND AND POWER
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Darling Bros., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, CENTRIFUGAL
American Steam Pump Co., Battle Creek, Mich.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Darling Bros., Montreal
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Pulsometer Engineering Co., Ltd., London, Eng.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Waterous Engine Works Co., Brantford.

PUMPS, DUPLEX
Can. Allis-Chalmers, Ltd., Toronto, Ont.

PUMPS, GEARED, COMPOUND
American Steam Pump Co., Battle Creek, Mich
Bawden Machine Co., Ltd., Toronto.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Montreal.
Inglis Co., The John, Toronto, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, HYDRAULIC, PRESSURE
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Darling Bros., Montreal.
Inglis Co., The John, Toronto, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.

PUMP LEATHERS
Beveridge Paper Co., Ltd., Montreal, Que.
Can. B. K. Morton Co., Toronto, Montreal.
Graton & Knight Mfg. Co., Montreal.

PUMPS, OIL
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Ltd., Toronto.
Bowser & Co., Inc., S. F., Toronto, Ont.
Can. Detroit Lubricator Co., Walkerville, Ont.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, STEAM TURBO
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Darling Bros., Montreal.
Escher Wyss & Co., Montreal, Que.
Pulsometer Engineering Co., Ltd., London, Eng.

PUMP TANK, RECEIVER
American Steam Pump Co., Battle Creek, Mich.
Smart-Turner Machine Co., Hamilton, Ont.

PUMPS, STEAM
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Ltd., Toronto.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
Inglis Co., The John, Toronto, Ont.
Laurie & Lamb, Montreal.
Leitch Co., Arthur S., Toronto, Ont.
McAvity & Sons, T., St. John, N.B.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, TRIPLEX
Smart-Turner Machine Co., Hamilton, Ont.

PUMPS, VACUUM
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Ltd., Toronto.
Laurie & Lamb, Montreal.
Leitch Co., Arthur S., Toronto, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PYROMETERS
Foxboro Co., The, Foxboro, Mass.
Jas. Morrison Brass Mfg. Co., Toronto.
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.

RADIATOR TRAPS
Sarco Co., Inc., New York, N.Y.

RADIATOR AIR VENTS
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

RAGS
Wm. C. Wilson & Co., Toronto.

REBOILERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

RECEIVERS, AIR
Can. Allis-Chalmers, Ltd., Toronto, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.

RECORDING INSTRUMENTS
Can. H. W. Johns-Manville Co., Toronto, Ont.
Foxboro Co., The, Foxboro, Mass.
Precision Instrument Co., Detroit, Mich.
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.

REFRIGERATOR DOORS, WINDOWS, ETC.
Jamison Cold Storage Door Co., Hagerstown, Md.

REFRIGERATING MACHINERY
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Griscom-Russell Co., Ltd., Montreal.
Frick Co., Waynesboro, Franklin Co., Pa.
Linde Canadian Refrigeration Co., Montreal.
Vilter Mfg. Co., Milwaukee, Wis.
York Mfg. Co., York, Pa.

REFUSE DESTRUCTOR
Canadian Griscom-Russell Co., Ltd., Montreal.
Laurie & Lamb, Montreal.

REGULATORS, PRESSURE
Chaplin-Fulton Mfg. Co., Pittsburgh, Pa.
D'Este Co., Julian, Boston, Mass.
Jas. Morrison Brass Mfg. Co., Toronto.
Taylor Instrument Co., Rochester, N.Y.

REGULATORS, TEMPERATURE
Sarco Co., Inc., New York, N.Y.
Taylor Instrument Co., Rochester, N.Y.

RETORTS
MacKinnon, Holmes & Co., Sherbrooke, Que.

REVOVLING DOORS FOR HARDENING ROOMS
Jamison Cold Storage Door Co., Hagerstown, Md.

ROOFING
Wm. C. Wilson & Co., Toronto.

ROPE
Wm. C. Wilson & Co., Toronto.

ROPE PRESERVATIVE
Cling Surface Co., Buffalo.

ROTARY CONVERTERS
Canadian Fairbanks-Morse Co., Montreal.

RUBBER HOSE
Can. H. W. Johns-Manville Co., Toronto, Ont.
Garlock Packing Co., Hamilton, Ont.
Liberty Mfg. Co., Pittsburg, Pa.
Thomson-Gordon, Ltd., Hamilton, Ont.

RUBBER MOLDS
Bawden Machine Co., Ltd., Toronto.

SAFES
Canadian Fairbanks-Morse Co., Montreal.
Goldie & McCulloch Co., Galt.

SCALE REMOVERS
Babcock & Wilcox, Ltd., Montreal.
Beveridge Paper Co., Ltd., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
William B. Pierce Co., Buffalo, N.Y.

SEAM PROTECTORS, GIRTH
National Boiler Protector Co. of Canada, Montreal, Que.

SHAFTING
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Waterous Engine Works Co., Brantford.

SHAKING AND DUMPING GRATES
Babcock & Wilcox, Ltd., Montreal.
Galt Foundry Co., Galt, Ont.
Waterous Engine Works Co., Brantford.

SMOKE BOXES, STACKS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

SMOOTH-ON
Wm. C. Wilson & Co., Toronto.

SPECIAL MACHINERY
Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Waterous Engine Works Co., Brantford.

SPEED INDICATORS
Foxboro Co., The, Foxboro, Mass.
Schaeffer & Budenburg Mfg. Co., Brooklyn, N.Y.
L. S. Starrett Co., Athol, Mass.

SPLICE PROTECTORS
Jordan Bros., Inc., New York, N.Y.

SPROCKET CHAIN ATTACHMENTS
Waterous Engine Works Co., Brantford.

SPROCKET RIMS
Babbitt Steam Specialty Co., New Bedford, Mass.

SPUR WHEELS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Waterous Engine Works Co., Brantford.

STACKS, STEEL
Babcock & Wilcox, Ltd., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.

STAND PIPES, STEEL
MacKinnon, Holmes & Co., Sherbrooke, Que.

STAYBOLTS, FLEXIBLE
Can. Allis-Chalmers, Ltd., Toronto, Ont.

STEAM SEPARATORS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Darling Bros., Montreal.
Direct Separator Co., Syracuse, N.Y.
D'Este Co., Julian, Boston, Mass.
Elliott Co., Pittsburgh, Pa.
Leitch Co., Arthur S., Toronto, Ont.
Penberthy Injector Co., Windsor, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Watson & McDaniel Co., Philadelphia.

STEAM SPECIALTIES
Alberger Heater Co., Buffalo, N.Y.
Canadian Fairbanks-Morse Co., Montreal.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
D'Este Co., Julian, Boston, Mass.
Liberty Mfg. Co., Pittsburg, Pa.
Lunkenheimer Co., Cincinnati, O.
Mason Regulator & Engineering Co., Montreal.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor.
Watson & McDaniel Co., Philadelphia.

STEAM TRAPS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Anderson Co., Y. D., Cleveland, O.
Canadian Fairbanks-Morse Co., Montreal.
Can. Sirocco Co., Windsor, Ont.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
Davis Regulator Co., G. M., Chicago.
D'Este Co., Julian, Boston, Mass.
Dunham Co., Ltd., C. A., Toronto, Ont.
Elliott Co., Pittsburgh, Pa.
J. T. Long, 84 Adam St., Montreal, Que.
Can. Morehead Mfg. Co., Woodstock.
Mason Regulator & Engineering Co., Montreal.
Nashua Mach. Co., Boston, Mass.
Sarco Co., Inc., New York, N.Y.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Watson & McDaniel Co., Philadelphia.

STEEL BARRELS
Smart-Turner Machine Co., Hamilton, Ont.

STEEL DRUMS
Smart-Turner Machine Co., Hamilton, Ont.

STEEL TANKS
Babcock & Wilcox, Ltd., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works, Brantford, Ont.

STOKERS
Babcock & Wilcox, Ltd., Montreal.
Ed. Bennis & Co., Little Fulton, Bolton, Eng.
Detroit Stoker Co., Detroit, Mich.
Galt Foundry Co., Galt, Ont.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Dertoit, Mich.

OIL FILTRATION EFFICIENCY

The efficiency of any Oil Filtering and Circulating System is measured by the saving which it effects in oil and labor, in addition to reducing friction to an absolute minimum. This in turn depends on the capacity of the System to remove from the circulating oil, all foreign matter which causes friction, performing these operations with the least possible attention and little or no "upkeep." The ability of the System to do this depends on the efficiency of the clarifying and filtering devices.

In a

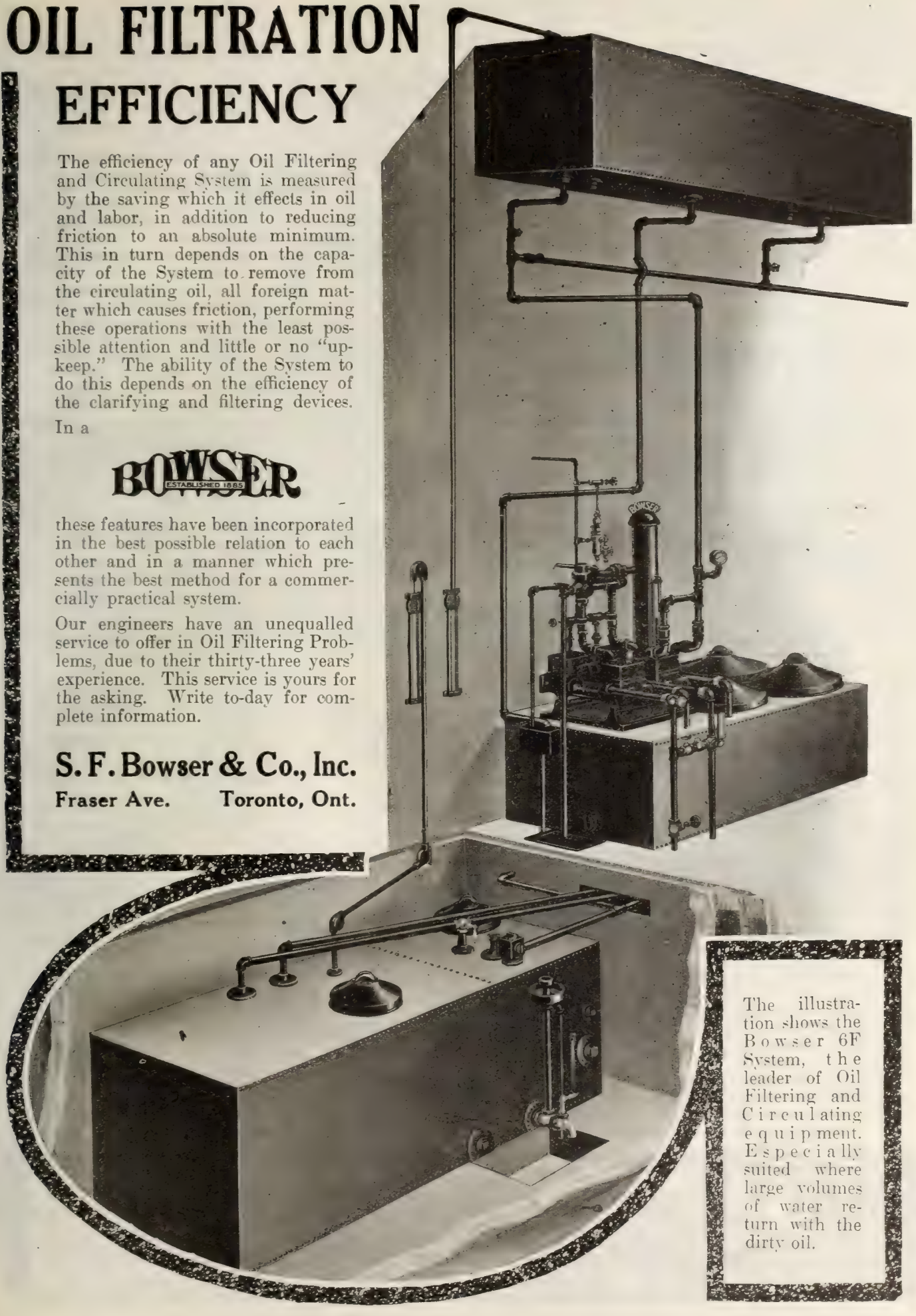
BOWSER
ESTABLISHED 1885

these features have been incorporated in the best possible relation to each other and in a manner which presents the best method for a commercially practical system.

Our engineers have an unequalled service to offer in Oil Filtering Problems, due to their thirty-three years' experience. This service is yours for the asking. Write to-day for complete information.

S. F. Bowser & Co., Inc.

Fraser Ave. Toronto, Ont.



The illustration shows the Bowser 6F System, the leader of Oil Filtering and Circulating equipment. Especially suited where large volumes of water return with the dirty oil.

STRAINERS
Babcock & Wilcox, Ltd., Montreal.
Bawden Machine Co., Ltd., Toronto.
Elliott Co., Pittsburgh, Pa.
Self-Cleansing Strainer Co., Chicago.

STRUCTURAL STEEL WORK
Babcock & Wilcox, Ltd., Montreal.
MacKinnon, Holmes & Co., Ltd., Sherbrooke, Que.

SUPERHEATERS, STEAM
Babcock & Wilcox, Ltd., Montreal.

SWITCHBOARDS
Can. General Electric Co., Toronto, Ont.

SWITCHES AND SWITCH BOXES
Can. H. W. Johns-Manville Co., Toronto, Ont.

TACHOMETERS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Foxboro Co., The, Foxboro, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

TANKS, BLOW-OFF
Darling Bros., Montreal.
John McDougall Caledonian Iron Works, Montreal.
Waterous Engine Works Co., Brantford.

TANKS, FREEZING, STORAGE AND WATER COOLING
Frick Co., Waynesboro, Franklin Co., Pa.

TANKS, OIL
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Bowser & Co., Inc., S. F., Toronto, Ont.
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

TANKS, WATER
Inglis Co., The John, Toronto, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

TAPPING MACHINES
Mueller Mfg. Co., H., Sarnia, Ont.

TECHNICAL BOOKS
MacLean Publishing Co., Toronto.

THERMOMETERS
Foxboro Co., The, Foxboro, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.

THERMOSTATS
Sarco Co., Inc., New York, N.Y.

TOOLS
Mueller Mfg. Co., H., Sarnia, Ont.

TRANSFORMERS
Can. General Electric Co., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.

TRANSMISSION MACHINERY
American Pulley Co., Philadelphia, Pa.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Goldie & McCulloch Co., Galt, Ont.
Jeffrey Manufacturing Co., Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Waterous Engine Works Co., Brantford.

TRAPS, STEAM AND WATER-LINE
D'Este Co., Julian, Boston, Mass.,

TRUCKS, FACTORY
Beveridge Paper Co., Ltd., Montreal, Que.
Canadian Fairbanks-Morse Co., Montreal.

TUBE CLEANERS
Babcock & Wilcox, Ltd., Montreal.
Elliott Co., Pittsburgh, Pa.
Liberty Mfg. Co., Pittsburg, Pa.
Pilley Packing and Flue Brush Mfg. Co., St. Louis, Mo.

TUBE CUTTERS
Babcock & Wilcox, Ltd., Montreal.
Liberty Mfg. Co., Pittsburg, Pa.

TUBES, BOILER
Babcock & Wilcox, Ltd., Montreal.

TUBE EXPANDERS
Babcock & Wilcox, Ltd., Montreal.
Liberty Mfg. Co., Pittsburg, Pa.

TUBING, FELXIBLE METALLIC
Pennsylvania Flexible Metallic Tubing Co., Cleveland, O.

TUNGSTEN LAMPS
Bawden Machine Co., Toronto.

TURBINE OIL
Kellogg & Co., E. H., New York, N.Y.

TUNGSTEN LAMP (Vacuum and Gas Filled Types
Can. Laco-Phillips Co. of Toronto, Ont

TURBINE WATER WHEELS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Boving Co., Hamilton.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.

TURBINES, STEAM
Belliss & Morcom, Birmingham, Eng.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Coe Co., C. T., 10 Johnson St., Newark, N.J.
Coppus Engr. & Equip. Co., Worcester, Mass.
Escher Wyss & Co., Montreal, Que.
Kerr Turbine Co., Wellsville, N.Y.
Laurie & Lamb, Montreal.
John McDougall Caledonian Iron Works, Montreal.
Sturtevant Co. of Canada, B. F., Galt, Ont.

UNIONS
Canadian Fairbanks-Morse Co., Montreal.
Dart Union Company, Toronto.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.

UNIONS, BALL JOINT, COMBINATION, FLANGED PIPE, GROUND JOINT, MALLEABLE IRON, FLANGE, PIPE, SWING
Jefferson Union Co., Lexington, Mass.
Dart Union Company, Ltd., Toronto, Ont.

VACUUM GOVERNORS
Smart-Turner Machine Co., Ltd., Hamilton.
Canadian Steam Boiler Equipment Co., Toronto.
G. M. Davis Regulator Co., Chicago.
Leitch Co., Arthur S., Toronto, Ont.

VACUUM REGULATING VALVES
Can. Steam Boiler Equipment Co., Toronto, Ont.
Darling Bros., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

VACUUM TRAPS
Can. Morehead Mfg. Co., Woodstock, Ont.
Can. Sirocco Co., Windsor, Ont.
Cole, Ltd., Geo. W., Toronto.
Nashua Mach. Co., Boston, Mass.

VALVE DISCS
Wm. C. Wilson & Co., Toronto.

VALVE LEATHER
Beveridge Paper Co., Ltd., Montreal, Que.
Can. B. K. Morton Co., Toronto, Montreal.
Graton & Knight Mfg. Co., Montreal.

VALVE RESEATING MACHINES
Darling Bros., Montreal.

VALVES
Babcock & Wilcox, Ltd., Montreal.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Can. Steam Boiler Equipment Co., Toronto, Ont.
Frick Co., Waynesboro, Franklin Co., Pa.
G. M. Davis Regulator Co., Chicago.
D'Este Co., Julian, Boston, Mass.
Homestead Valve Mfg. Co., Pittsburg.
Jenkins Bros., Montreal.
Kerr Engine Co., Walkerville, Ont.
Liberty Mfg. Co., Pittsburg, Pa.
Lunkenheimer Co., Cincinnati, O.
Mason Regulator & Engineering Co., Montreal.
Mason Regulator Co., Boston, Mass.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor.
Pratt & Cady, Hartford, Conn.
Watson & McDaniel Co., Philadelphia.
Wm. C. Wilson & Co., Toronto.
York Manufacturing Co., Philadelphia.

VALVES, ACID RESISTING
Homestead Valve Mfg. Co., Pittsburg.
McAvity & Sons, T., St. John, N.B.

VALVES, BACK PRESSURE
Can. Allis-Chalmers, Ltd., Toronto, Ont.

VALVES, BLOW-OFF
Babcock & Wilcox, Ltd., Montreal.
Canadian Fairbanks-Morse Co., Montreal.
Elliott Co., Pittsburg, Pa.
Homestead Valve Mfg. Co., Pittsburg.
Jenkins Bros., Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Watson & McDaniel Co., Philadelphia.

VALVE CHAIN WHEEL
Babbitt Steam Specialty Co., New Bedford, Mass.

VALVES, FOOT
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Smart-Turner Machine Co., Ltd., Hamilton.

VALVES, GATE
Babcock & Wilcox, Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

VALVES, MULTIPORT
Can. Allis-Chalmers, Ltd., Toronto, Ont.

VALVES, NON-RETURN STOP
Canadian Fairbanks-Morse Co., Montreal.

VALVES, REDUCING
D'Este Co., Julian, Boston, Mass.
Leitch Co., Arthur S., Toronto, Ont.
Liberty Mfg. Co., Pittsburg, Pa.
Mason Regulator Co., Boston, Mass.
Jas. Morrison Brass Mfg. Co., Toronto.
Mueller Mfg. Co., H., Sarnia, Ont.
Watson & McDaniel Co., Philadelphia.

VALVES, RELIEF
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
McAvity & Sons, T., St. John, N.B.

VALVES, RADIATOR
Jenkins Bros., Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.

VALVES, POP
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.

VALVES, PUMP
Beveridge Paper Co., Ltd., Montreal, Que.
Canadian Fairbanks-Morse Co., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

VALVES, SAFETY THROTTLE
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Detroit Lubricator Co., Walkerville, Ont.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.

VALVES, VACUUM
Sarco Co., Inc., New York, N.Y.

VAULTS AND VAULT DOORS
Canadian Fairbanks-Morse Co., Montreal.
Goldie & McCulloch Co., Galt.

VENTILATING APPARATUS
Sturtevant Co. of Canada, B. F., Galt, Ont.

VOLTMETERS
Can. H. W. Johns-Manville Co., Toronto, Ont.

WASHERS, FIBRE
Beveridge Paper Co., Ltd., Montreal, Que.

WASHERS, LEATHER
Graton & Knight Mfg. Co., Montreal.

WASTE
Wm. C. Wilson & Co., Toronto.
Can. Steam Boiler Equipment Co., Toronto, Ont.

WATER COLUMNS, GAUGES
Babcock & Wilcox, Ltd., Montreal.
Elliott Co., Pittsburg, Pa.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.
W. J. Wall, Montreal.

WATER HOSE
Can. H. W. Johns-Manville Co., Toronto, Ont.
Liberty Mfg. Co., Pittsburg, Pa.
Pennsylvania Flexible Metallic Tubing Co., Cleveland, O.

WATER LIFTERS
Watson & McDaniel Co., Philadelphia.

WATER MOTORS
Elliott Co., Pittsburg, Pa.

WATER PURIFIERS, SOFTENERS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Laurie & Lamb, Montreal.
Scaife & Sons, Wm. B., Pittsburgh, Pa.

WATER SUPPLY SYSTEMS
Mueller Mfg. Co., H., Sarnia, Ont.

WATER WHEELS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Escher Wyss & Co., Montreal, Que.
MacKinnon, Holmes & Co., Sherbrooke, Que.
John McDougall Caledonian Iron Works, Montreal

WATERWORKS SUPPLIES
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
McAvity & Sons, T., St. John, N.B.

WATTMETERS
Can. H. W. Johns-Manville Co., Toronto, Ont.

WHISTLES, PLAIN OR CHIME
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.

WIRE BRUSHES
Pilley Packing and Flue Brush Mfg. Co., St. Louis, Mo.
Penberthy Injector Co., Windsor, Ont.

WRENCHES
Greene, Tweed & Co., New York.
Trimont Mfg. Co., Roxbury, Mass.
Williams & Co., J. W., Brooklyn, N.Y.

WATER SCAIFE AND WE-FU-GO
PURIFICATION SYSTEMS
SOFTENING & FILTRATION
FOR BOILER FEED AND ALL INDUSTRIAL USES
WM. B. SCAIFE & SONS CO. PITTSBURGH, PA.

Don't buy that New Electrical Apparatus Just Yet

WE can supply you with high-grade apparatus that has been slightly used and discarded through no fault of its own, at an immense saving in cost. For instance, in many cases we take over entire plants simply because of changed conditions such as increased capacity, change of system, etc.

EVERYTHING IS OVERHAULED AND REFINISHED BY US AND **GUARANTEED** AS GOOD AS NEW, BOTH ELECTRICALLY AND MECHANICALLY.

Our catalogs of offerings should be in the hands of every power plant superintendent each time they are gotten out, and it will be worth while for anyone interested in this class of power plant equipment to be on our mailing list to receive all offerings.

Nearly all of the principal power, lighting and street railway plants in the United States are our customers.

WRITE FOR OUR LATEST CATALOG of Power House Equipment, Street Cars, Motors, Hoists, Compressors, etc.

MACGOVERN & COMPANY, Inc.

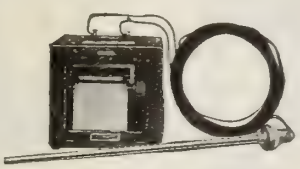
114 Liberty St., New York City

Tycos

TEMPERATURE INSTRUMENTS

Indicating Recording Controlling

Mercurial, Recording and Index Thermometers for all industrial and laboratory applications.
Electric Contact Thermometers.
Temperature, Pressure and Time Regulators.
Mercury Column Vacuum Pressure and U Gauges.
Base Metal, Rare Metal and Radiation Pyrometers.
Fery Radiation Pyrometers.
Hygrometers.
Hydrometers.
Mineral Oil Testing Instruments.
Aneroid Barometers.
Mercurial Barometers.
Recording Barometers.
Pocket Compasses.
Surveying Compasses.
Rain Gauges.
Anemometers.
Air Meters.
Thermographs.
Hand Levels.
Aviation Barometers.
Inclinometers.
Sphygmomanometers.
Fever Thermometers.
Urinary Glassware.
Thermometers of all kinds for home and general use.



Tycos Recording Pyrometer

Tycos Pyrometers are a necessity in every industry involving the application of high temperatures.

Just write for our catalogue describing these efficient *Tycos* aids.

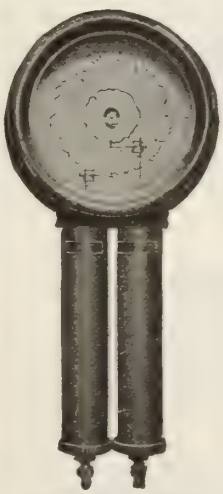
Taylor Instrument Companies
ROCHESTER, N.Y.
201 Royal Bank Bldg., Toronto, Ont.

67

UEHLING WASTE METER

COMBINED

CO_2 AND TEMPERATURE RECORDER



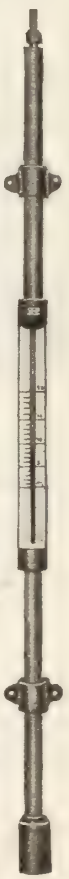
Record of CO_2 and stack temperature on one chart.

Does your fireman know how much fuel he is wasting? Do you know?

The Uehling CO_2 Recorder makes a complete 24 hr. record of your combustion efficiency and the CO_2 indicator at the Boiler Front holds the fireman responsible.

Get more **Steam** per pound of **Coal** and reduce your annual fuel consumption.

Let us know the number and size of your boilers and coal consumed per year, upon receipt of which information we will be glad to send you full particulars.



CO_2 Indicator for Boiler Front

Let us hear from you. We are pioneers in the manufacture of Indicators and Recorders for Power Plant purposes.

Send for our Bulletin No. 110.

Uehling Instrument Company

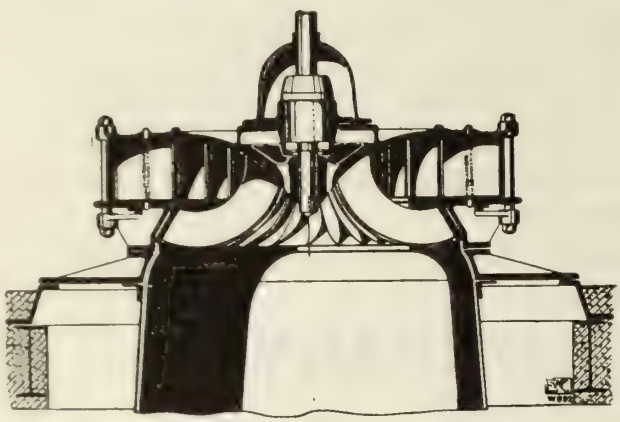
2008 Empire Building **New York City**

If any advertisement interests you, tear it out now and place with letters to be answered.

Escher Wyss & Co. S.A. Zurich (Switzerland)

Montreal Office: 211 Coristine Building

Water Turbines



Governors

Pipelines

Turbopumps

15/18

ADVERTISING INDEX

A

Albany Lubricating Co. 73
Alberger Heater Co. 54
American Steam Gauge & Valve Mfg. Co. 52
American Steam Pump Co..... 8
Anderson Co., V. D. 81
Armstrong Cork & Insulation Co. 11

B

Babbitt Steam Specialty Co.... 62
Babcock & Wilcox 78
Bennis & Co., Ltd., Ed. 81
Boiler Inspection Dept. 77
Boving Hydraulic & Eng. Co. .. 76
Bowser, S. F., & Co., Inc..... 85

C

Can. Allis-Chalmers Co. 9
Can. Assoc. Stationary Engrs.. 83
Can. Bond Hanger & Coupling Co. 73
Can. Detroit Lubricator Co..... 5
Can. Fairbanks-Morse Co. 19
Can. General Electric Co. 9
Can. H. W. Johns-Manville Co. 61
Can. Morehead Mfg. Co. 60
Can. S K F Co..... 55
Can. Steam Boiler Equipment Co. 4
Canuck Supply Co., Ltd. 57
[illegible] Mfg. Co. 59
Cling-Surface Co. 75
Cole Ltd., Geo. W. 47
Coppus Engr. & Equip. Co.... 6
Coventry Chain Co..... 66
Crane Packing Co. 64

D

[illegible] 5
Dart Union Co. 63
Davis Regulator Co. 59
D'Este Co., Julian 70
Direct Separator Co. 51
Dixon Crucible Co., Jos. 47
Dominion Belting Co. 74
Dominion Coal Co. 76
Dunham & Co., C. A. 59
Durabla Mfg. Co..... 52

E

Economy Fuse & Mfg. Co. of Canada 77
Elliott Co. 45
Engineering & Mach. Works of Canada, Ltd. 2
Escher Wyss & Co. 88

F

Federal Engineering Co. 81
Francis & Co., Walter J. 48
Frick Co. 11

G

Galt Foundry Co. .....
Garlock Packing Co. 72
Garth Co. 76
Gates, John W. 48
Goldie & McCulloch Co. 16
Graton & Knight Mfg. Co. 50
Greene, Tweed & Co. 53
Green's Economizer Co..... 68

H

Holmes Metallic Packing Co.... 76
Homestead Valve Mfg. Co..... 70
Hoyt Metal Co. 2

I

Inglis Co., John...Inside back cover

J

Jamison Cold Storage Door Co. 12
Jefferson Union Co. 65
Jeffrey Mfg. Co. .....
Jenkins Bros. 69
Johns-Pratt Co., The 60
Jones Underfeed Stoker Co..... 4
Jordan Bros., Inc. 62

K

Kellogg & Co., E. H. 47
Kerr Engine Co..... 70

L

Ladd Co., The Geo. T. 77
Laurie & Lamb 13
Leitch Co., The Arthur S. 6
Liberty Mfg. Co. 45
Linde Canadian Refrigeration Works Co. 10
Lunkenheimer Co. 66

M

MacGovern & Co. 87
MacKinnon, Holmes & Co..... 48
MacLean's Magazine 56
Magnolia Metal Co. 74
Mason Regulator Co. 6
Mason Regulator & Engr. Co... 7
McAvity & Sons, T. 64
McDougall Caledonian Iron Wks. Co. 14
McGhie, W. C. 76
McLaren Ltd., D. K. 71
Metlskin Co., Inc. 51
Morrison Brass Mfg. Co., Jas. Outside back cover
Morse Chain Co. 75
Mueller Mfg. Co., H. 67
Murphy Iron Works 3

N

National Boiler Seam Protector Co. 76

P

Penberthy Injector Co..Front cover
Pennsylvania Flexible Metallic Tubing Co. 51
Pilley Packing & Flue Brush Mfg. Co. 77
Power Plant Equipment Co. ... 3
Pratt & Cady Co., Inc..... 52

S

Sarco Co., Inc. 46
Scaife & Sons Co., Wm. B..... 86
Schaeffer & Budenberg Mfg. Co. 6
Shell-Bar, Boico Supply, Ltd... 8
Smart-Turner Mach. Co. 77
Starrett, L. S., Co. 78
Steel Mill Packing Co. 60

T

Taylor Instrument Co. 87
Thomson-Gordon, Ltd. 60
Toch Bros. 62
Trimont Manufacturing Co..... 78

U

Uehling Instrument Co. 87
United States Rubber Co..... Inside front cover

V

Vilter Mfg. Co. 10

W

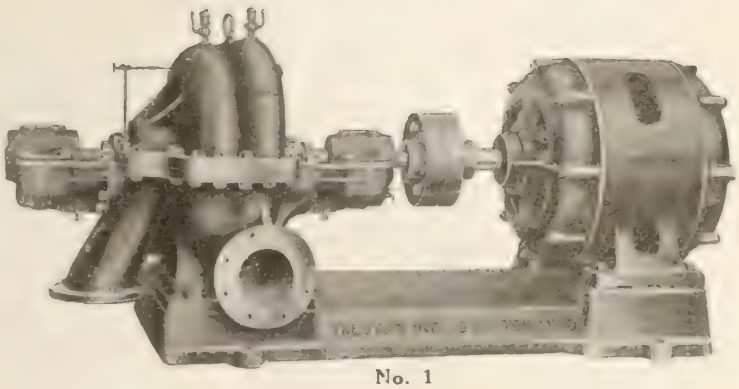
Wall, W. J. 48
Waterous Engine Works Co. .. 1
Watson & McDaniel Co. 76
Wenting, J. H. 77
Williams & Co., J. H. 64
Wilson & Co., Wm. C. 47

Y

York Mfg. Co. 12

Inglis Pumps

INGLIS TURBINE PUMPS set the standard of merit and efficiency. Numerous installations throughout Canada testify daily to their reliable performance under the most severe strains.



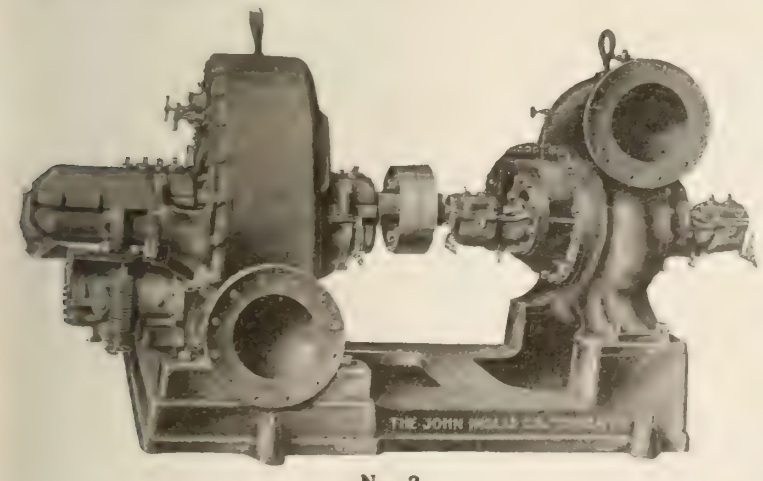
No. 1

Oil ring bearings, hydraulic balance and water-cooled thrust bearings are standard for all "Inglis" Turbine Pumps.

Impellers and passages are highly finished, all working elements being carefully balanced against vibration.

Illustration No. 1 shows Multi-Stage Split Case Turbine Pump for Medium and High Pressures. Direct Connected to electric motor.

Illustration No. 2 shows Double Suction Pump for circulating low or medium leads. Directly connected to steam turbine.



No. 2

WHEN you install an Inglis Pump you may feel certain that you have made a safe choice.

Put your problems up to Inglis Engineers. Their expert advice is yours for the asking.

Write us.

The John Inglis Co. Ltd., 14 Strachan Ave., Toronto

Engineers and Boilermakers

J. W. Anderson, 7 Bank St. Chambers, Ottawa, Representative

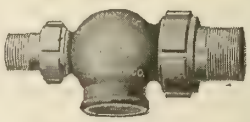
Morrison's

Steam Goods and Specialties

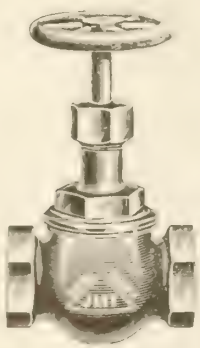
Model C
Safety Valve

TRADE MARK J.M.T. REGISTERED
A GUARANTEE OF QUALITY

Oil Cup

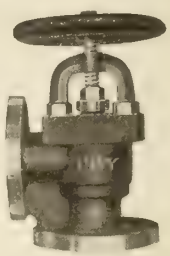


Gem Ejector



J. M. T. Globe
Valve Renewable
Disc

Pressure Gauge



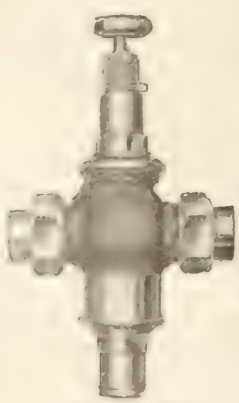
Navy Valve

Approved by the Provincial Boiler Inspection Departments.

Every article thoroughly tested before leaving works.

A few of our lines—

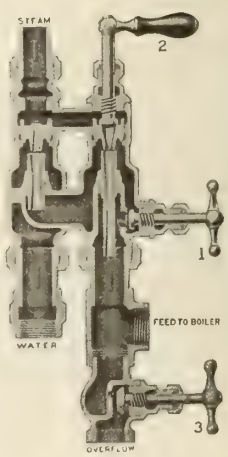
Stop Valves, Check Valves, Gate Valves, Safety Valves, Relief Valves, Reducing Valves, Steam Traps, Injectors, Ejectors, Inspirators, Jet Pumps, Steam Gauges, Vacuum Gauges, Ammonia Gauges, General Boiler Mountings, Gauge Board Outfits, Lubricators, Pipe Fittings, Steam Whistles, Engine Indicators, Pipe Tools, Etc.



J. M. T. Reducing
Valve

James Morrison Brass Mfg. Company

93-97 Adelaide Street West
TORONTO



Genuine
Hancock Inspirator

ANNUAL EQUIPMENT AND C.A.S.E. PRE-CONVENTION NUMBER.

POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power; and to the operation of Refrigerating Machinery.

Published by The MacLean Publishing Company, Limited, 143-153 University Ave., Toronto

MONTREAL: Southam Bldg. LONDON, ENG.: 88 Fleet St., E.C. WINNIPEG: 1207 Union Trust Bldg.

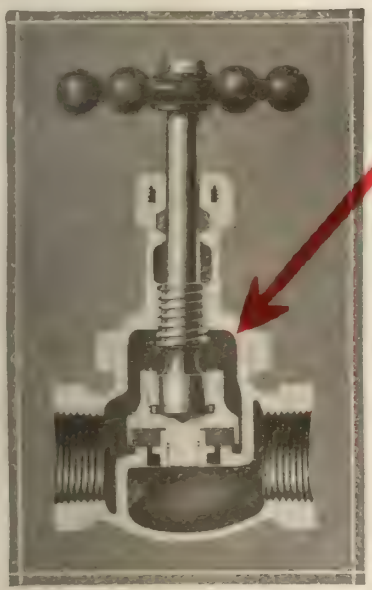
Vol XI—No. 6 Publication Office, Toronto—June, 1918 Published Monthly $1.00 per Year.

PENBERTHY

BRASS VALVES

"THE ALL QUALITY LINE"

Outside Bonnet Construction



Sectional View

The discs used in our valves do not crack or flake under high steam pressures or severe conditions. They give the best service.

They are interchangeable as regards shape, size, etc., with other standard makes of discs on the market.

If your dealer can't supply you write us.

Follow the Arrow

It takes you to the one big improvement in valve construction and found in **all** Penberthy Valves, viz., **Outside Bonnet Construction.** Do you realize what this means to you as regards your personal safety from accidents? There can be

NO SPREADING OF BONNET END

of body when screwing down bonnet tight, causing a loose-fitting and unsafe bonnet.

NO CORROSION OF THREADS

causing the bonnet to freeze to body, because the threads are outside—away from action of steam and water, etc. Therefore there is no straining of valve when taking same apart. For the same reason you can see how easy it is to take the bonnet off without strain or brute force.

This is the Name

COMPODISK

Cast on the body of every genuine Penberthy Valve of this type (with the composition disc), but if you don't insist on the genuine you are liable to get the same old model valve that has never kept up with the present progressive age. When you buy the Penberthy Valve you are going to enjoy real valve comfort. Don't be satisfied with what you have been using, but make up your mind right now to order Penberthy Valves the next time.

Penberthy Valves are made in the same shops by same workmen that make the Penberthy Injector. Doesn't that Guarantee Service and Quality?

Write for Free Valve Catalog

Penberthy Injector Co., Limited, Windsor, Ont.

Unequaled Service Through Co-operative Distribution

One of the principal objects accomplished by the new method of marketing our mechanical goods is the increased co-operation that has been made possible with dealers and jobbers.

The well-known brands of our subsidiary companies—

Revere Rubber Co.
Peerless Rubber Mfg. Co.
Mechanical Rubber Co., Cleveland.
Mechanical Rubber Co., Chicago.
Sawyer Belting Co.
India Rubber Co.
Eureka Fire Hose Mfg. Co.

are now marketed through ONE strong sales organization—
UNITED STATES RUBBER COMPANY, MECHANICAL GOODS DIVISION.

We are now able to offer dealers and jobbers a stronger and more complete line of mechanical goods than ever before offered by any rubber company.

We deeply appreciate the great service rendered by dealers and jobbers to consumers. We feel that in making it possible for consumers to purchase their favorite brands of packing, belting and hose through their own dealer and jobber, we are assisting the consumer as well as the dealer and jobber. Dealers and jobbers everywhere now have an unexampled opportunity to promote the interests of their customers as well as themselves, by taking advantage of the attractive proposition presented in the wide variety of well-known brands assembled in the United States line of mechanical rubber goods. We wish and intend to do everything to extend the numbers of dealers and jobbers, as we realize that this means greater service to consumers.

Dealers and jobbers are enthusiastically co-operating in the new plan, and as merchants they have been quick to grasp the strength of this complete line of mechanical rubber goods, embracing such famous brands as

Rainbow Packing
Honest John Packing
Peerless Spiral Packing
Rainbow Belting
Eureka Fire Hose
Giant Steam Hose
Relio Conveyor Belt
Holdtite Friction Tape
Rainbesto Packing
Buckeye Splicing Tape
Four-Ace Seamless Belting
Paragon Fire Hose
Anaconda Tender Hose
Peerless Air Hose
Kold-Pak Jar Rubbers
Revere Garden Hose
Spring Step Heels
Giant Seamless Belting
Giant Suction Hose
Usudurian Packing

all bearing, in addition to their own well-known trade-mark, the great seal signifying service and quality of the largest rubber manufacturer in the world.

United States Rubber Co.

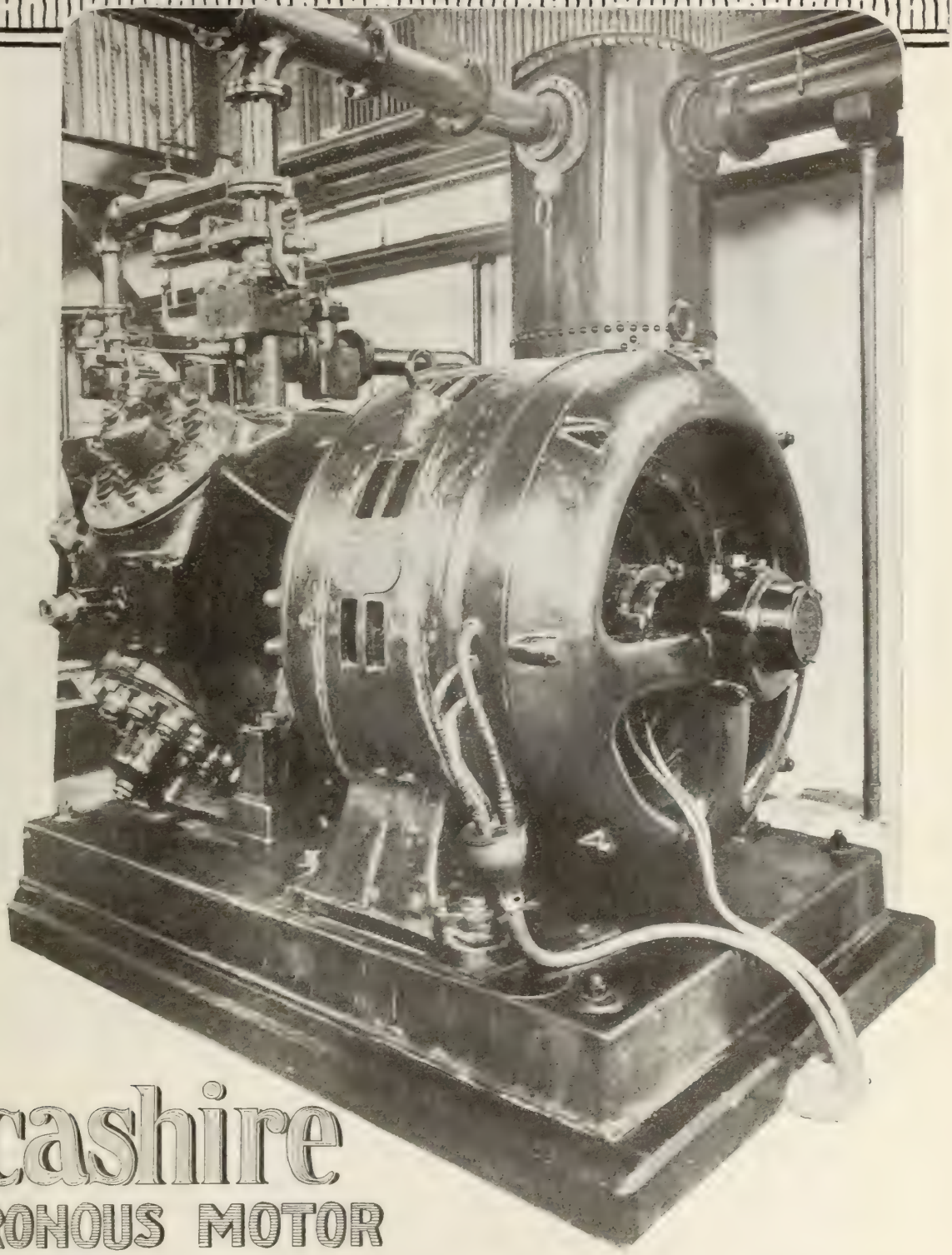
Mechanical Goods Division

NEW YORK

"Lancashire" Ball Bearing Induction Motors are the PIONEER Ball Bearing Motors in Canada.

They have been giving satisfaction and continuous service for the past NINE YEARS.

25 cycle, 550 volt., 3 phase motors carried in stock in Toronto.



Lancashire
SYNCHRONOUS MOTOR

As supplied to the cities of:—

LONDON GUELPH STRATFORD AND OTHERS IN CANADA

ELECTRICAL MACHINERY for all purposes

The Lancashire Dynamo & Motor Co. of Canada Ltd., 107 DUKE ST., Toronto

Steel Plate Work

WE have made a success of building Steel Plate Work by specializing in it.

The recent extensions to our shops have placed us in a better position than ever before to do this work. Our facilities in every department have materially increased—we have the men, the equipment, and the experience to turn out this special work as it should be.

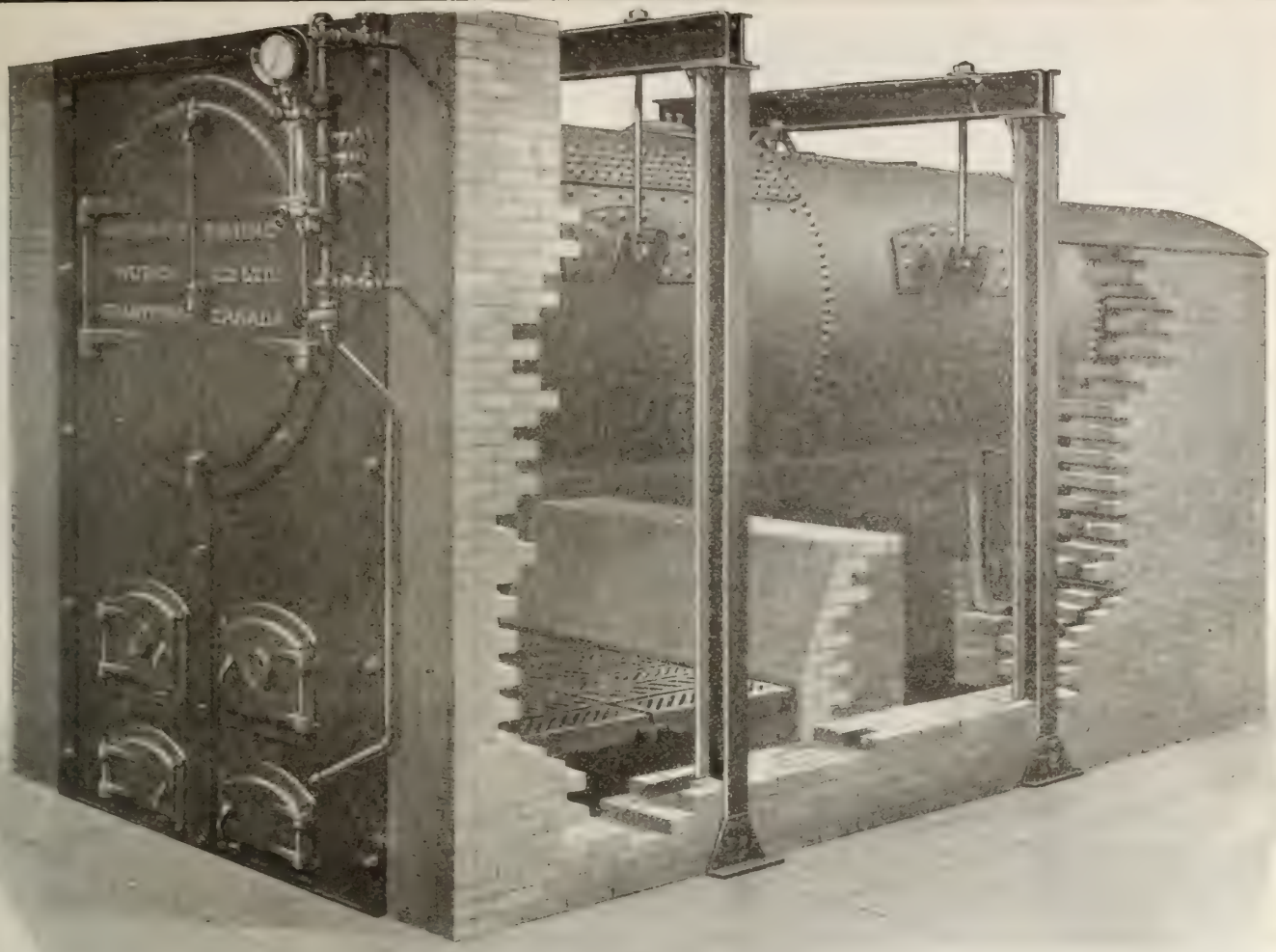
We design and build any size of:—

Conveyors and Elevators
Smoke Breechings
Steel Stacks
Spark Arresters
Steel Buckets
Steel Tanks
Storage Bins
Cookers and Digesters
Steel Gas Mains
Refuse Burners

Before you buy anything along these lines, send us your sketch and let us quote.

Waterous

BRANTFORD, ONTARIO, CANADA



BOILERS

WATEROUS Return Tubular are quick steaming, economical of fuel and absolutely reliable. Power Boilers up to 165 H.P. Heating Boilers in sizes to 72" x 16'---most standard sizes carried in stock. We can supply brick or all-steel settings designed and dimensioned to give best results with whatever fuel you are using.

Boilers in Stock for immediate Shipment

2—48" x 14' Horizontal	5—72" x 18' Horizontal	1—30 H.P. Locomotive
1—54" x 14' "	2—15 H.P. Vertical	3—40 " "
6—60" x 14' "	2—18 " "	3—60 " "

CATALOGUE ON REQUEST

Waterous

BRANTFORD, ONTARIO, CANADA

View Showing Interior of Boiler Department.

Stationary Boilers

Horizontal Tubular
Vertical Tubular
Locomotive Types

To conform with various Provincial codes.

Catalogs gladly furnished to members of the C.A.S.E.

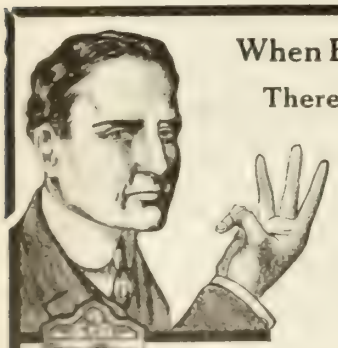
Kindly address nearest office

Engineering & Machine Works of Canada, Limited

Formerly
St. Catharines Works of
The Jenckes Machine Co., Ltd.

Head Office and Works
St. Catharines, Ont.

Sales Offices
710 C.P.R. Building, Toronto
344 St. James Street, Montreal
Hall Machinery Co., Sherbrooke, Que.



When Buying Thermometers
There's Just Three Things to Remember—

First, you must have accuracy and sensitiveness—
Second, durability is absolutely essential—
Third, the thermometer must be suitably constructed for the intended application.

Accuracy, sensitiveness and durability are absolutely guaranteed in

"Crescent" Thermometers

And with nearly seventy years of experience to our credit, we are qualified to properly interpret your needs.

Our Catalog P.H. 200 illustrates and describes "Crescent" Thermometers for every application. Also test thermometers, glass thermometers, etc.

Get a copy of Catalog P.H.-200 to-day.

The Schaeffer & Budenberg Mfg. Co.

Brooklyn, New York

Chicago
Pittsburg
St. Louis
Philadelphia
Los Angeles

Power Plant thermometers for all temperatures not exceeding 1000° F

MASON

Reducing Valves

Pump Regulator
Balanced Valves
Damper Regulators

If you order a Mason you will get absolute satisfaction. This we guarantee you. You simply cannot make a mistake.

Dependable regulation under every possible condition.

Our complete catalog tells you WHY. Let us mail you a copy.

Mason Regulator Company
BOSTON, MASS.

TORONTO REPRESENTATIVES:
The Arthur S. Leitch Co.,
506 Kent Bldg., Toronto.

It takes an expert

to plan and carry out a successful military campaign.

And it takes experts at home to keep the wheels of industry turning at their maximum speed, efficiency and economy.

In the Hoyt Metal Co.'s plant a body of picked men, headed by an expert metal mixer, work intelligently, enthusiastically, energetically, bent on turning out the best metals man can make. Under a perfect, smooth-working system entirely devoid of "red tape" they are giving manufacturing Canada the benefit of years of experience in the alloying of metals. They are putting a quality into Hoyt Metals that can be found in no other alloys.

HOYT METAL CO., TORONTO

New York, N.Y. London, Eng. St. Louis, Mo.

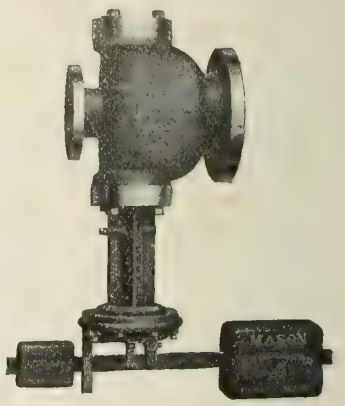
If any advertisement interests you, tear it out now and place with letters to be answered.

MASON'S

Efficiency, Quality and Service

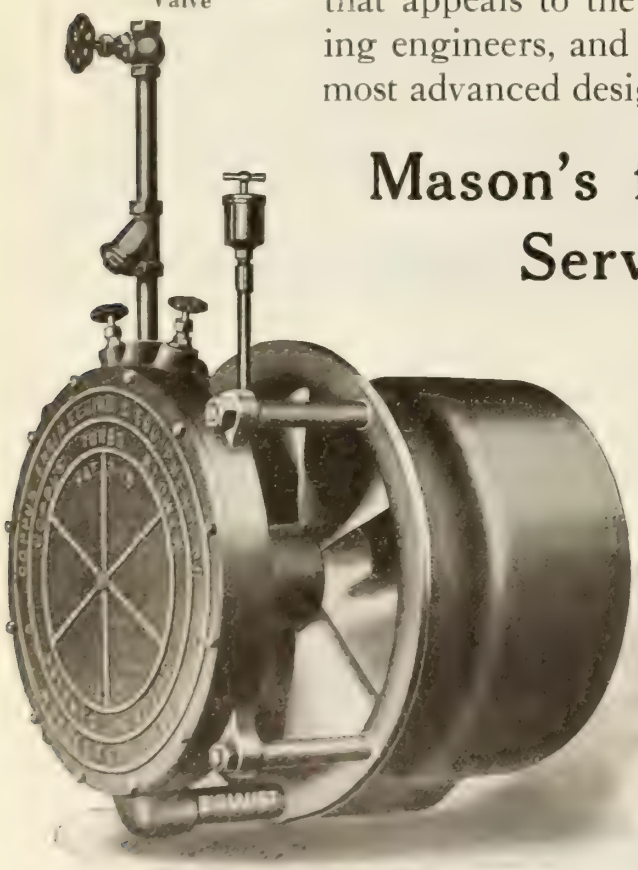
Mason Standard Bronze Reducing Valve

Every good engineer appreciates the importance of perfectly efficient engine room specialties. Mason's line of specialties possesses the quality that appeals to the most discriminating engineers, and they represent the most advanced designs in their line.

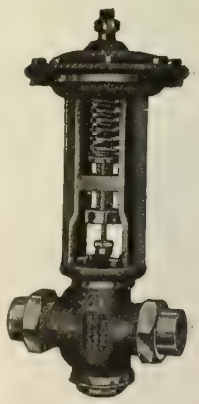


Mason Differential Lever Style Reducing Valve

Mason's for Real Service



Mason's sales engineers know the practical application of Mason's Specialties to actual conditions — they sell from knowledge and experience, not from catalog. When you adopt Mason's equipment you get results.



Mason No. 55 Pump Pressure Regulator

The Mason Regulator & Engineering Co., Limited

Successors to H. L. PEILER & COMPANY

MONTREAL—Office and Factory, 135 Dagenais Street

TORONTO REPRESENTATIVES, The Arthur S. Leitch Co., 506 Kent Building, TORONTO

MASON'S

Made-in-Canada Steam Room Specialties

Mason's Steam Room Specialties include the best known and most reliable lines produced anywhere.

All Made-in-Canada at our finely equipped factory at Montreal. They include:

Mason Reducing Valves (Genuine),
Mason Pump Governors,
Mason Pressure Controllers.

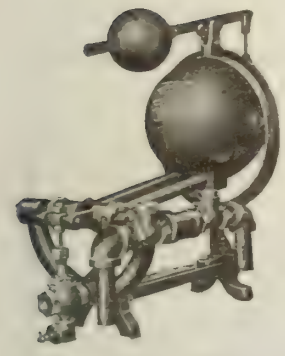
Bundy Steam Traps for every service,
Coppus Turbine-driven Blowers,
Sims Hot Water Generators.

Sims Storage Heaters,
Sims Open Feed Water Heaters.

Bundy Oil Separators,
Ashton Gauges and Safety Valves.

Everlasting Blow-off Valves,
Babbitt Sprocket Rims,
Stratton Steam Separators.

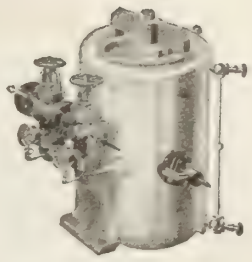
Reilly Multi-coil Feed Water Heaters,
Reilly Evaporators and Distillers,
Reilly Multi-screen Feed Water Filters.



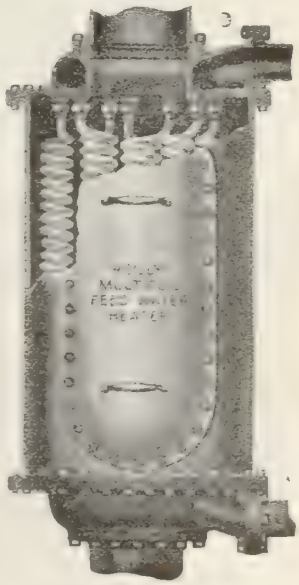
New Bundy Return Trap

Bundy Separating Trap

Bulletins and full information gladly furnished.



Reilly Multi-Screen Feed Water Filter



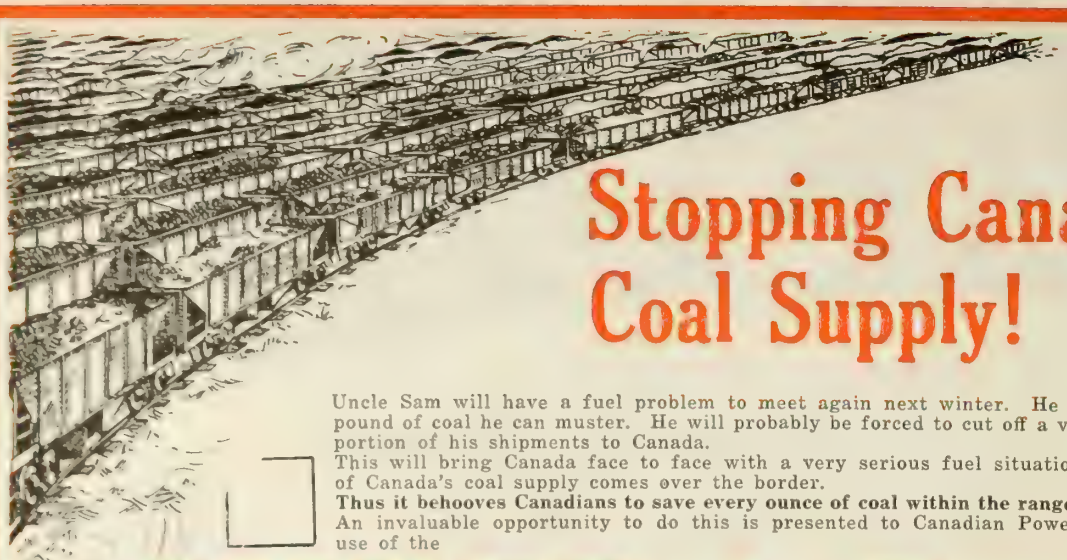
Reilly Multicoil Feed Water Heater

The Mason Regulator & Engineering Co., Limited

Successors to H. L. PEILER & COMPANY

MONTREAL, Office and Factory, 135 DAGENAIS STREET

TORONTO REPRESENTATIVE, The Arthur S. Leitch Co., 506 Kent Building, TORONTO



Stopping Canada's Coal Supply!

Uncle Sam will have a fuel problem to meet again next winter. He will need every pound of coal he can muster. He will probably be forced to cut off a very considerable portion of his shipments to Canada.

This will bring Canada face to face with a very serious fuel situation—for the bulk of Canada's coal supply comes over the border.

Thus it behooves Canadians to save every ounce of coal within the range of possibilities. An invaluable opportunity to do this is presented to Canadian Power Plants by the use of the

COPPUS Turbo Blowers

Coppus Turbo Blowers will burn the poorest coal mined and will keep up steam regardless of poor fuel, poor draft, extreme weather conditions, or heavy demands upon your boilers.

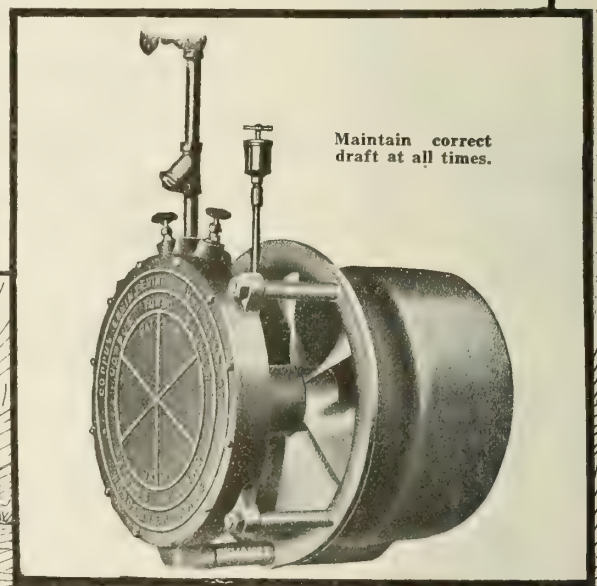
Further, Coppus Turbo Blowers will increase your present steaming capacity to 200%, and in connection with stokers even 300% of normal rating of the boilers without danger of doing injury to the boilers.

Over 1,000,000 H.P. equipped in 5 years. That's the record of Coppus Turbo Blowers. Since the fuel problem has become acute they are in demand everywhere. They are replacing other blowers, too, because of their superior efficiency. Order now and begin saving fuel without any further delay.

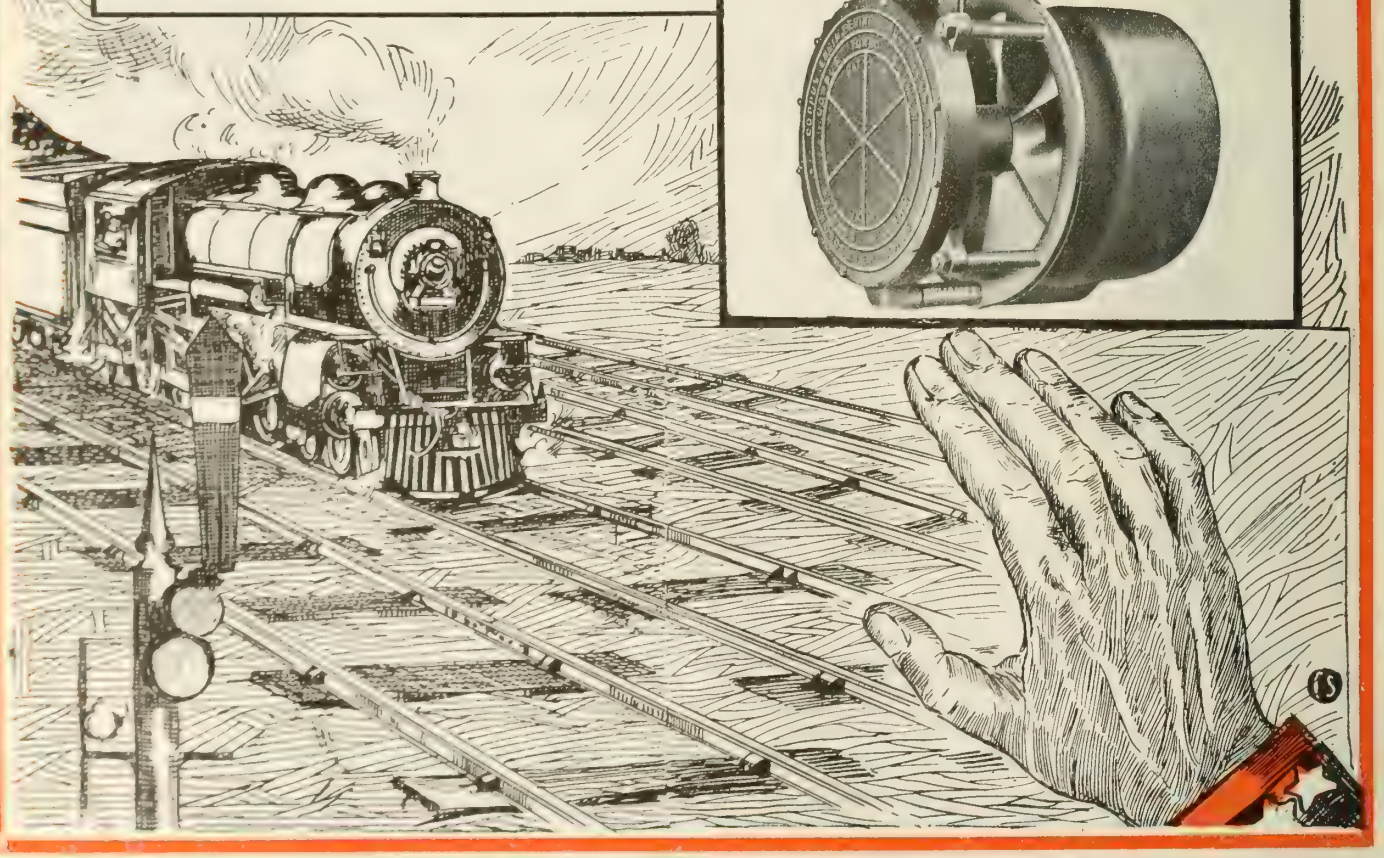
Coppus Engineering & Equipment Co.

167 Union Street, Worceste·, Mass.

CANADIAN AGENTS.—Montreal, Mason Regulator & Engineering Co., 135 Dagenais Street. Toronto, The Arthur S. Leitch Co., 506 Kent Bldg. Winnipeg, Wm. Carter, 817 Union Bank Bldg.



Maintain correct draft at all times.



Problem for Canadian Power Plants!

Present indications are that fuel shortage will constitute an exceedingly serious problem for Canadian power plants throughout the duration of the war.

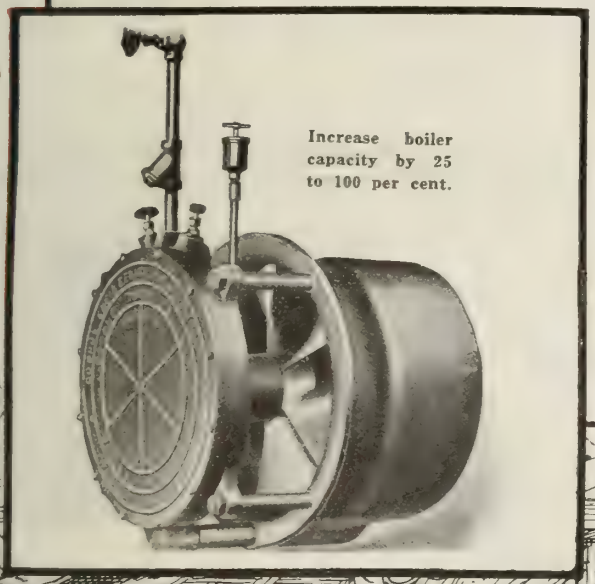
You owe it to your country and you owe it to your own business interests to give this problem your most serious attention. And the time to take action is NOW.

Back up the Fuel Controller in his efforts to ward off a crisis and at the same time save money for yourself by installing

COPPUS Turbo Blowers

Fill the Bill in an Emergency

Overseas shipping and railroads demand the best grade of bituminous coal. They must be supplied equal to their requirements. You may have to burn a low grade of coal as a consequence. But this will not cause you any concern if you have installed **Coppus Turbo Blowers.**



Increase boiler capacity by 25 to 100 per cent.

They enable power plants to make steam with anything in the form of coal—even what looks like black dirt—and at the same time greatly increase boiler capacity.

Because they make combustion conditions instantly adjustable to the coal, no matter what the grade—because the draft is always under CONSTANT CONTROL.

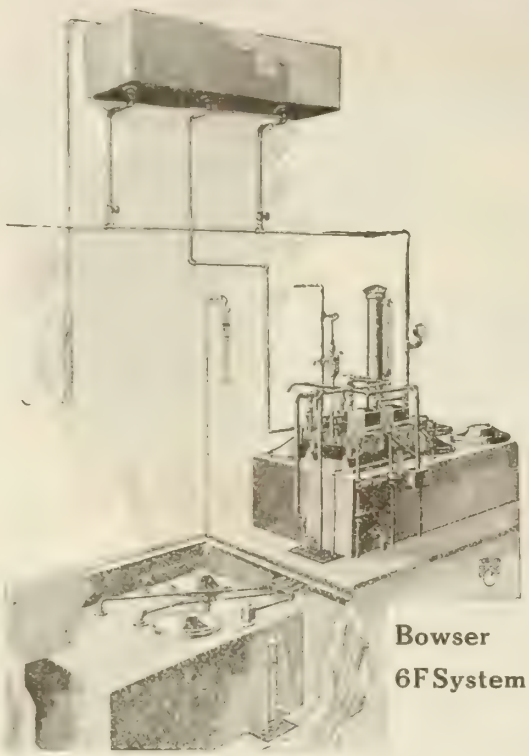
Scientifically correct design; simplicity, ruggedness, power and low steam consumption make COPPUS TURBO BLOWERS constant dividend payers under normal conditions as well as indispensable in emergencies.

Write us and let us show you how easily you can cope with the fuel problem which is bound to confront you for one, two or three years to come. The fact that we are equipping on an average 100,000 B.H.P. per month with Coppus Turbo Blowers is ample proof of our ability to serve you.

Coppus Engineering & Equipment Co.
167 Union Street Worcester, Mass.
CANADIAN AGENTS.—Montreal, Mason Regulator & Engineering Co., 135 Dagenais Street. Toronto, The Arthur S. Leitch Co., 506 Kent Bldg. Winnipeg, Wm. Carter, 817 Union Bank Bldg.

If any advertisement interests you, tear it out now and place with letters to be answered.

MORE POWER—LESS COST



Bowser
6F System

BOWSER
ESTABLISHED 1885

Filtration Systems enable a supply of clean, cool oil to be fed to engine bearings at all times.

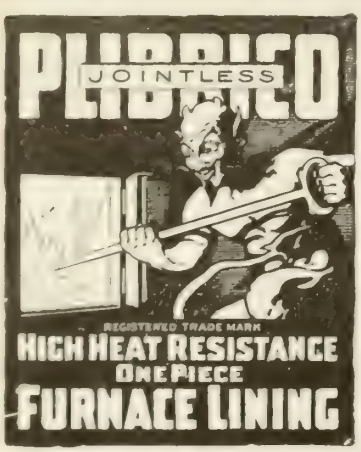
Clean oil, free from dirt and grit, reduces friction, thus releasing power formerly lost. More power with the same amount of fuel and energy means less cost.

The illustration shows the Bowser 6F Filtration System. Especially suited where large quantities of water return with the dirty oil.

Write for Booklet 33.

S. F. Bowser & Co., Inc.

Toronto **Ontario**



If I could line my place with this stuff --I would have it fixed forever.

PLIBRICO JOINTLESS

AND

PLIBRICO-BOND HIGH TEMPERATURE

There are reasons why all up-to-date Plants from Coast to Coast now use the above Modern Materials in place of the old-fashioned Firebricks and Fireclay in Furnace Linings, Woodburners, Dutch Ovens, Smelters, Cupolas, Nosing Furnaces in Ammunition Plants, etc. Your own men can do the work and you are assured of minimum Coal Bills, which is a Patriotic Duty to-day.

ROOFINGS

Roofings—Our Stormproof, Stormking and Stormtight qualities will solve all your troubles. The first two are rubber, and the last is in liquid and plastic. Repairs all roofs and guaranteed ten years.

LAPIDOLITH
TRADE MARK

The oldest and most satisfactory Concrete Hardener—makes Concrete Floors and Walls permanently Dustproof, Wearproof, and Waterproof; also as smooth as a Hardwood Floor. Will be pleased to give you further particulars regarding these guaranteed materials and also our BOICO Boiler Compound and SHELL BAR GRATES which will enable you to burn Slack Coal.

MILL SUPPLY DEPARTMENT

Beveridge Paper Co., Ltd., - Montreal, P.Q.

Stocks also at St. John, N.B., and Toronto, Ont. N. J. Dinnen & Co., Winnipeg

GARLOCK PACKINGS

"SPARE THE ROD"

DUST and grit are as injurious to piston rods as inferior and poorly lubricated packing. All styles of Garlock Ring Packing are enclosed in press-board tubes and are packed in cartons that are practically dust-proof, which not only prevents accumulation of dirt and grit on the packing but likewise prevents drying out of the lubrication.

ON the blank lines of the label attached to the end of each box of Garlock Packing are entered the name of the rod for which the packing is intended and the order numbers, section number and style number of the packing, which enable a customer to reorder a box of packing without remeasuring the rod and without likelihood of making mistakes in specifications.

Our packings are billed at net weights; the weights of boxes and tubes are not included.

THE GARLOCK PACKING COMPANY

HAMILTON - ONTARIO

Branches:

Montreal, Quebec - - - 409 Shaughnessy Building
Toronto, Ontario - - 404 Continental Life Building
Winnipeg, Manitoba - - - - - Galt Building

At the C.A.S.E. Convention

to be held at London, Ontario, June 25, 26 and 27th, we are showing the following lines:

Webster Sylphon Traps
Webster No. 7 Trap.
Dexter Reseating Machines.
Reliance Marine Reducing Valve.
Water Seal Trap.
Water Systems (Hydro Pneumatic).
Modulation Valves.
Pressure Reducing Valves.
Clark Flexible Coupling.
Feed Water Filters.
Pumps.

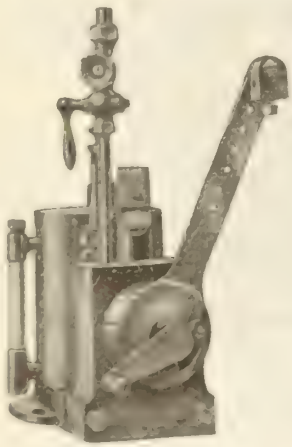
Ask to see these machines and devices, find out their good points, then you will realize why our product is so much in demand.

We are going to do **our** best to make the Convention a success. Try and do **your** best.

Darling Brothers Limited 120 Prince Street Montreal

Pumps for any Service. Webster System of Heating. Steam Appliances. Elevators.

When an Engineer says—



Clutch Drive Pattern

"I HAVE a Rochester Lubricator in my plant that has been running steadily for 12 years," you may rest assured that it will pay you to replace your old lubricator with a Rochester.

One Rochester will prove it. Give it a trial on your engine. Specify it when you buy a new engine, air compressor or pump. Remember all oil is utilized, which eliminates waste, and there is positive lubrication.

THE

ROCHESTER LUBRICATOR

Manufactured by

Greene, Tweed & Co., New York

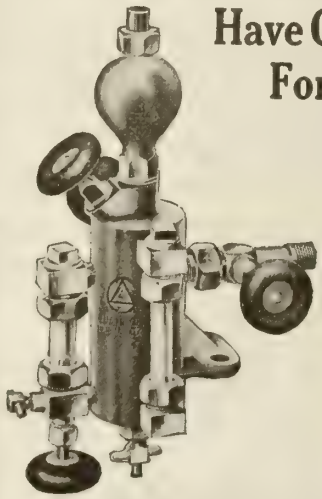
Sole Agents for Canada

Darling Brothers, Limited

120 Prince Street, Montreal

Detroit Lubricators

Have Given Satisfaction For Forty Years.



Built in a sufficient variety of styles to lubricate properly every type of steam engine, pump, gas engine, air compressor, etc.

Send to-day for catalog L 1. The information on lubricating devices contained in it will be valuable to you.

THEIR efficiency holds over half the world's trade.

Makers of Stewart Carburetors.

CANADIAN DETROIT LUBRICATOR COMPANY, LTD.

WALKERVILLE, ONT.

JONES

Underfeed Automatic STOKERS

THERE IS NO WASTE with a Jones Underfeed Stoker in action—everything that should be burned to generate steam is consumed. An immediate and permanent result that comes from the installation is a SAVING OF FROM 15 to 25%.

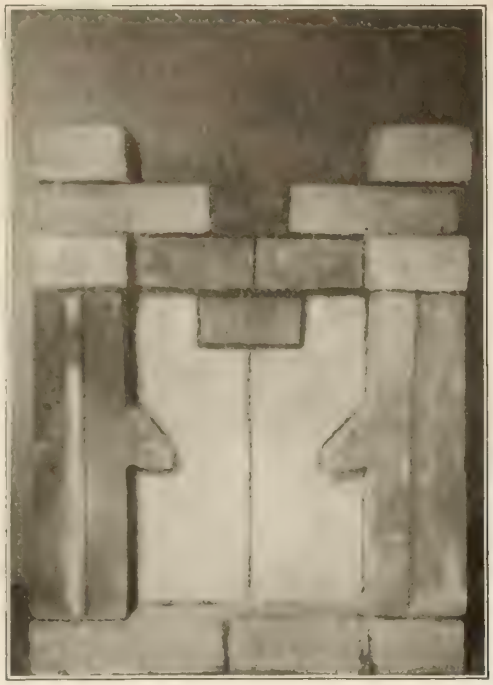
Jones Stokers maintain a constant steam pressure, due to the automatic control of air supply and coal feed, take care of large overloads—and there are many other advantages in using them.

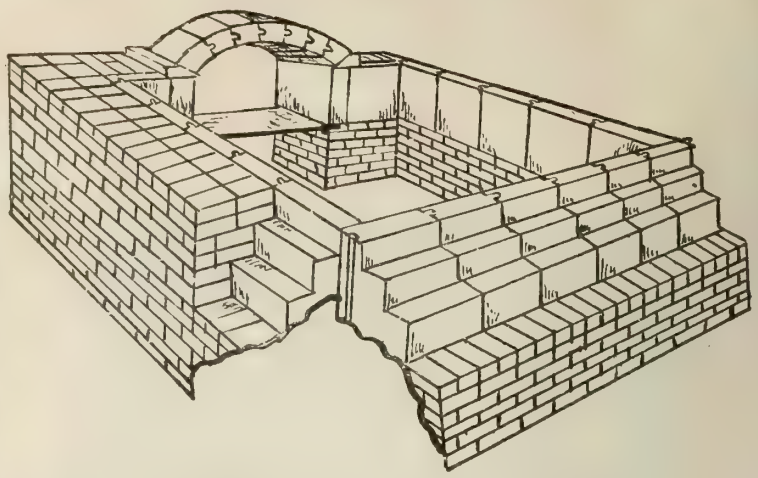
Give us your name and address and we'll gladly send you full particulars.

Jones Underfeed Stoker Co., Limited

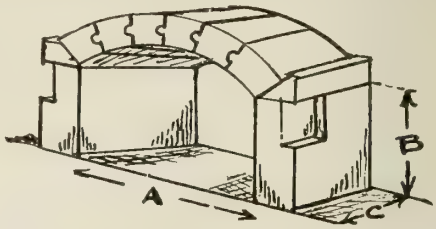
37-41 Britain St., TORONTO

Jones Underfeed Stoker Installation in the C.P.R. Passenger Terminal, Quebec





GATES BOILER FURNACE LINING (Pat. 1916)
When ordering give dimensions of Firebox and Doors



GATES BOILER DOOR ARCH AND JAMBS
When ordering give above dimensions

Gates Patent Furnace Linings are the simplest and most durable linings made. Their use materially reduces the number of joints in the furnace walls, clinkers do not readily form on their smooth and even surfaces, and the tongued and grooved joints prevent air leaks, thus the linings not only last longer, but tend to promote better combustion. The material used is very hard and refractory; the softening point is 1,700 degrees Centigrade. These qualities are essential to a good boiler setting. These furnace side wall blocks, when fused out, can be replaced without disturbing the adjoining brickwork by any handy man.

First-grade Firebrick, Fireclay, High Temperature Cements, etc., carried in stock.

Quotations given on all kinds of special shaped fireclay goods.

Write to-day for catalogue and full particulars of this lining. Information will be gladly furnished on request.

JOHN W. GATES

382 St. James St. Montreal, Que.

Are Real Coal Savers

BECAUSE:---

THEY burn cheap fuel—and less of it.

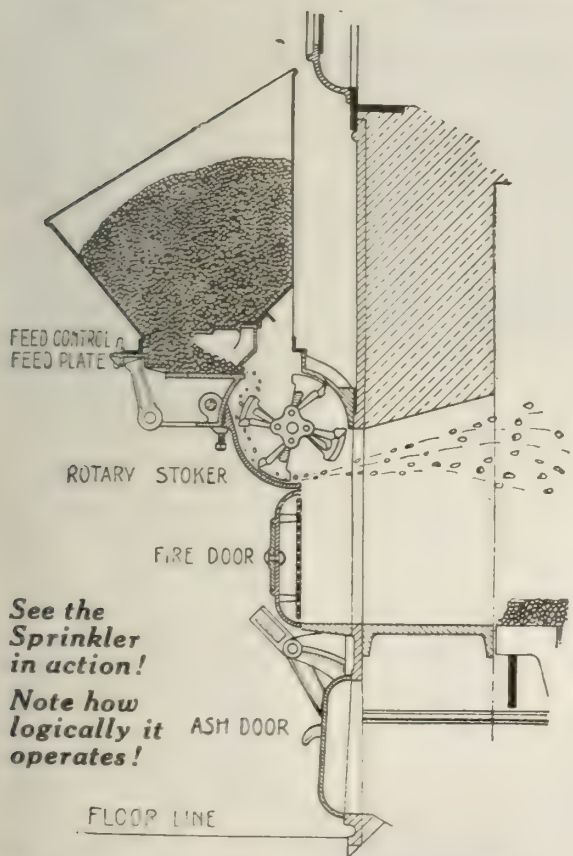
" give complete and smokeless combustion.

" feed the fuel to the furnace with the doors shut.

" do not require skilled firemen.

" maintain a brilliantly hot fire.

" are simple, strong and carefully made.



See the Sprinkler in action!

Note how logically it operates!

The Galt Sprinkler Stoker automatically feeds and uniformly spreads the fuel to the furnace in a light continuous stream and gives a perfectly level fire, 3 to 4 inches thick.

Send for one of our Combustion Engineers to look over your plant. No obligation.

Have you our Stoker Catalogue?

Galt Foundry Co., Limited - Galt, Ont.

Boiler Scale Costs More than Boico

Think of all you pay for it—Boiler scale. In the course of a year you pay tons of coal, and all the time it acts as a check to power efficiency. Like corroding rust, it slowly but nevertheless surely shortens the life of your boiler.

The cost of Boico is trivial compared with all you pay for scale. For Boico positively removes boiler scale and absolutely prevents further formation. It saves fuel, oil and packing. It will not carry over in the steam; it will not cause foaming or priming, and it is guaranteed not to injure packing or valves in the slightest. **Write for free trial.**

Anti-Clinker Shell Bar Grates

insure more heat from much less coal. Built on a scientific air-draft principle, fully 50% of the total surface air space, they provide ample air to command perfect combustion, adding as much as 25% more heat to the fuel gases and so preventing clinker formation. Moreover, Anti-Clinker Shell Bar Grates cannot twist or warp, and they're easily cleaned.

Copper Asbestos Boiler Gaskets

are made of copper, with pure asbestos cord-filled corrugations. They put a stop to leaks in pipe lines, for they never blow-out and never stick.

Tip-It Patent Welding Process

gives you tools whose shanks are carbon and whose cutting tips are high-speed steel. A money-saver!

Get in touch with us to-day!

Shell-Bar Boico Supply, Limited

376 Dufferin St., Toronto, Canada

Milton & Prentiss

MACHINERY BROKERS and ENGINEERS

New and Second-Hand Machinery (Steam and Electric)
PUMPS, METERS, TRANSFORMERS.

Agents for:
SCHAEFFER & BUDENBERG PRESSURE GAUGES, RECORDING GAUGES, INDUSTRIAL RECORDING THERMOMETERS.
STEAM JET ASH CONVEYOR
FEDERAL METALLIC PACKING

Machine Work, Welding, Repairs,
Millwrights; Moving and Erecting Machinery.

Head Office:
1504 Traders Bank Building

Shop:
Interurban Engineering Co., Limited
96 Vine Ave., West Toronto

Starrett Speed Indicator
The Chief's Friend
The Starrett Speed Indicator is a handy little tool for an engineer to have in his pocket. It is described in Catalog No. 21CD, which shows 2100 tools of acknowledged accuracy.
The L. S. Starrett Co.
The World's Greatest Toolmakers
Manufacturers of Hack Saws unexcelled
ATHOL, MASS.
New York, London
Chicago
42-791
STARRETT TOOLS

A Good Hide is the beginning of a Good Belt—and the Genuine British Oak Tanning process is the completion

D. K. McLAREN'S
Leather Building

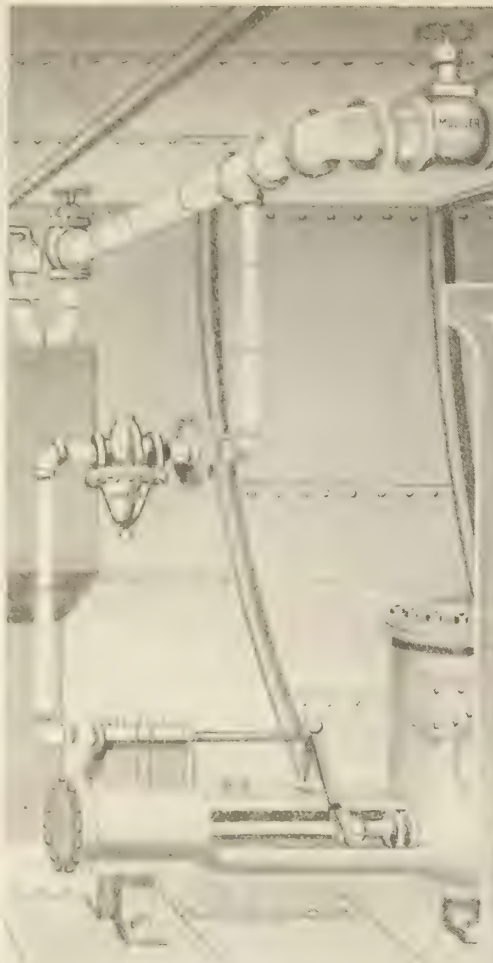
Represents Flawless Backs of the hides of the choicest steers tanned by the genuine British-Oak process; the best known for preparing belts for hard service. Every bit of the hide's natural strength is preserved. Minimum stretch, minimum slippage and fewer breaks are the results you can expect.

TRADE MARK

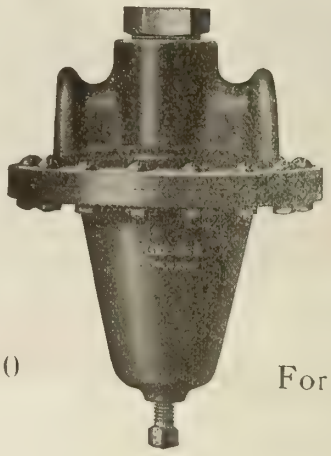
D·K·McLAREN LIMITED

Head Office and Factory: 351 St. James St., Montreal, P.Q.

Toronto, Ont.	St. John, N.B.	Vancouver, B.C.
194 King St. West.	90 Germain St.	849 Beatty St.



MUELLER



E5010 For Water

Reducing and Regulating Valves

Before you install your valve, be absolutely sure on these three points.

1. The right kind of valve is the one that is adapted to your particular service. No one type will answer all purposes. Different service and at times different conditions in the same kind of service necessitates different types of valves.

2. The right size of valve is the size that will make the proper reduction and regulation and has a wide enough seat opening to prevent obstruction and cutting out of the seat. *A general fault is using a valve that is too large.* Ordinarily they should be smaller than the pipe to which they are attached.

3. Proper assembling means that valves should have working parts suitable to service, and diaphragms and springs suitable to pressure range.

Don't guess. Consult us. When valves are installed under MUELLER supervision, we fully warrant them to perform the service for which we recommend them.

We make valves for water, steam, gas, air, oil and ammonia. There is a stock valve in our catalog that will meet your needs. If you have a specially intricate problem to solve, our experts are at your command.

H. MUELLER MFG. CO., LIMITED

SARNIA, CANADA

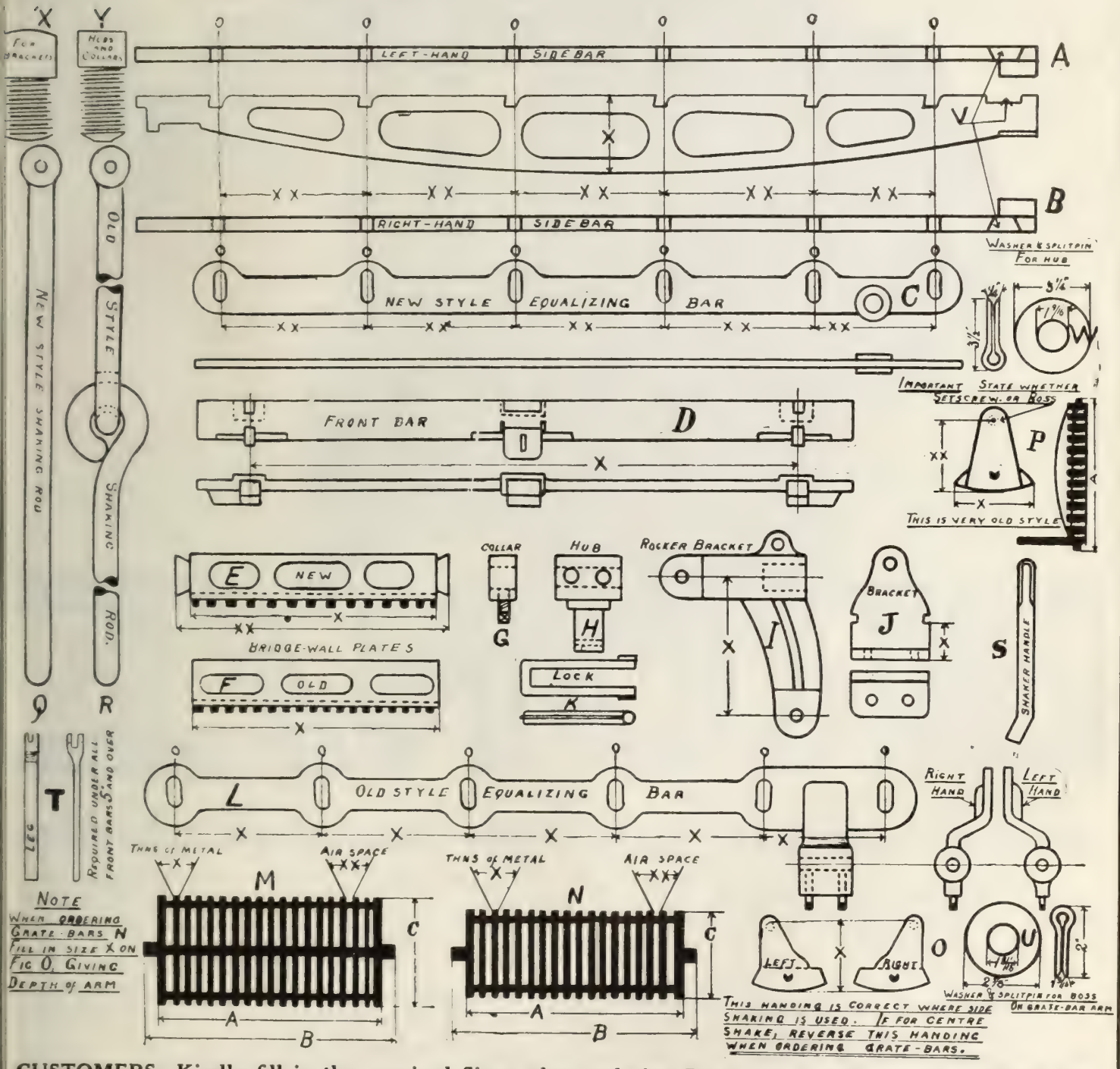
MUELLER

Mount this Chart of "Cyclone" Grate Bar Parts

On Cardboard

You should find this chart helpful when ordering piece parts of our famous "Cyclone" Shaking and Dumping Grates. Keep it handy.

Engineers and plant owners unacquainted with the "Cyclone" Grate and the service we give, **write us to-day.**



CUSTOMERS: Kindly fill in the required Sizes when ordering Parts and it will greatly facilitate the dispatch of same. When ordering Parts for grates N, which is the old style 8" centres, and all sizes under, kindly order as far ahead of date required as possible, as we do not carry large stock of 8" centres and under.

The Canadian Steam Boiler Equipment Co., Ltd.

Sole Makers for Canada

20 McGee Street Phone G. 3660 Toronto, Ontario

DART
Trade Mark

BRONZE

Meets Bronze at the Joint

Couple up your pipe lines with Dart Unions and be forever free from leaking connections.

Dart Union Pipe Couplings stay tight because the Bronze faces will not rust or corrode, and the heavy iron parts will not stretch or pull apart.

This means no deterioration

Dart Unions are easy to use because of the Ball-shaped Joint which enables you to connect pipes quickly, whether pipes are in or out of alignment.

No upkeep cost. No replacement cost. No loss from leaks.

Order from your jobber.

Made in Canada by
DART UNION COMPANY, LIMITED
TORONTO, CANADA

DART UNION PIPE COUPLINGS STAY TIGHT

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

"VULCABESTON" RED FIBRE SHEET PACKING

ENDURANCE

"VULCABESTON" RED FIBRE SHEET PACKING

The final test of the value of any packing is **endurance—how long it keeps the joint tight.**

Every blow-out, every leaky joint, means trouble and expense, and their number largely depends upon the packing you use. You can save these losses by using

VULCABESTON

Red Fibre Sheet Packing

VULCABESTON Red Fibre Sheet Packing will make joints that will last under any and all conditions: even under conditions fatal to other packings.

VULCABESTON Red Fibre Sheet Packing is not a one-track packing. It is universal in its application, and can be used with equal advantage for steam (wet, dry or superheated) water, oil, gas, ammonia—anywhere or for any service.

VULCABESTON Red Fibre Sheet Packing will stand extreme heat without baking or vulcanizing; is impervious to moisture, cuts easily and seats perfectly—and it always makes a tight joint that stays tight. We claim that for all-around service, Vulcabeston is without a peer. Try it, and find out whether we're right or not! You surely cannot afford to neglect a packing that offers the unusual advantages that Vulcabeston does.

BUY FROM OUR DEALER NEAREST YOU OR ASK US

Atlanta, Ga.,
Clayton S. Berry

Baltimore, Md.,
Carey Mach. & Supply Co.

Birmingham, Ala.,
All Supply Dealers

Boston, Mass.,
Eagle Oil & Supply Co.

Buffalo, N.Y.,
All Supply Dealers.

Charlotte, N.C.
Textile Mill Supply Co.

Chattanooga, Tenn.,
All Supply Dealers.

Chicago, Ill.,
Seehausen, Wehrs & Co.

Cincinnati, Ohio,
Vulcan Supply Co.

Cohoes, N.Y.,
Sweet & Doyle.

Columbus, Ohio,
Columbus Mill & Mine Supply Co.

Cleveland, Ohio,
Steam Equipment Mfg. Co.

Dayton, Ohio,
All Supply Dealers

Denver, Colorado,
Mountain States Rubber Co.

Detroit, Michigan,
Kenneth Anderson Co.

Duluth, Minn.,
Marshall-Wells Hdwe. Co.

El Paso, Texas,
All Supply Dealers.

Erie, Penn.,
H. P. Weller Supply Co.

Evansville, Ind.,
Laib Co.

Hartford, Conn.,
Hartford Mill Supply Co.

Holyoke, Mass.,
Holyoke Valve & Hydrant Co.

Houston, Texas,
Houston Mill Supply Co.

Indianapolis, Ind.,
Hoover Equipment Co.

Jacksonville, Fla.,
All Supply Dealers

Kansas City, Mo.,
All Supply Dealers

Little Rock, Ark.,
Central Supply Co.

Los Angeles, Cal.,
Warren & Bailey Co.

Louisville, Ky.,
Laib Co.

Macon, Ga.,
Mallary Mill Supply Co.

Memphis, Tenn.,
Reed & Duecker

Milwaukee, Wis.,
Newton-Johnson, Sales Engrs., Inc.

Minneapolis, Minn.,
All Supply Dealers

Mobile, Ala.,
All Supply Dealers

New Orleans, La.,
Dixie Mill Supply Co.

New York, N.Y.,
Pitts & Kitts Mfg. & Supply Co.

Norfolk, Va.,
E. V. White & Co.

Omaha, Nebr.,
H. M. Orschel & Co.

Philadelphia, Pa.,
Pitts & Kitts Mfg. & Sup. Co.

Pittsburgh, Pa.,
Steam Equipment Mfg. Co.

Portland, Ore.,
Marshall-Wells Hdwe. Co.

Rochester, N.Y.,
Haverstick & Co.

Salt Lake City, Utah,
Mt. States Rubber Co.

San Francisco, Cal.,
Gutta Percha & Rubber Mfg Co.

Savannah, Ga.,
All Supply Dealers

Seattle, Washington,
Brinkley Supply Co.

St. Louis, Mo.,
Donovan Iron & Supply Co.

St. Paul, Minn.,
Robinson, Carey & Sands Co.

Tampa, Fla.,
All Supply Dealers

Toledo, Ohio,
The Hardy & Discharger Co.

Troy, New York,
All Supply Dealers

Tulsa, Okla.,
Frick-Reid Supply Co.

Utica, N.Y.,
Chas. Millar & Son Co.

Brisbane, Queensland, Australia,
Phillip Frankel & Co.

Havana, Cuba,
Machin & Wall

Montreal, Que., Can.,
Ross & Greig

San Juan, Porto Rico,
Lucas Blanco & Co., Agents for Porto Rico, Virgin Islands, Dominican Republic, Republic of Haiti.

Toronto, Ont., Can.,
James Morrison Brass Mfg. Co., Ltd.

Vancouver, B.C., Can.,
Fleck Bros., Ltd.

Winnipeg, Manitoba, Can.,
Crane Co.

The Johns-Pratt Company, Hartford, Conn., U.S.A.

J-P J-P

If any advertisement interests you, tear it out now and place with letters to be answered.

This book should be in the hands of every pump user A postal will bring your copy promptly

MARSH and AMERICAN

Steam and Power Driven Pumps and Air Compressors

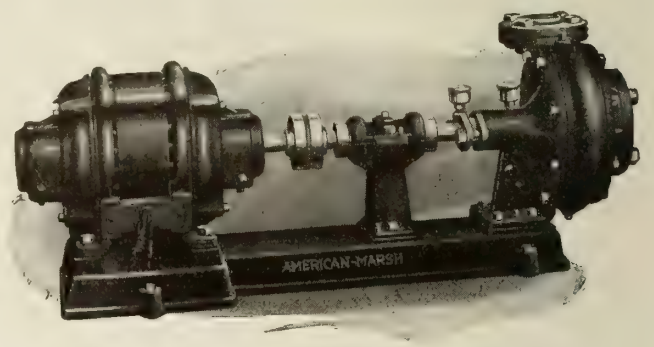
Marsh and American Pumps are especially adapted for long, hard service because they are *extra heavy* in design and of *extremely rigid construction.* Every unit is built amply strong to withstand 24-hour-a-day service and to stand up under any unforeseen strain which may be placed upon it. Piston rods on the steam pumps are extra large and made of solid bronze. The water ends are equipped with heavy cast bronze removable bushings.

This superior construction not only insures continuous and satisfactory operation, but practically ***eliminates expensive shut-downs.*** Marsh and American Pumps are the product of over 25 years' experience in the design and construction of high grade pumping machinery. Over 135,000 in actual service throughout the world.

The AMERICAN-MARSH LINE OF CENTRIFUGAL PUMPS is composed of both single and double suction types which are designed for heads up to 125 feet. They are equipped with wide ring oiled bearings and the single suction type has overhanging casing enabling the discharge to be taken at any angle desired.

CANADIAN AGENTS

A. R. Williams Machinery Co., Toronto.
Williams & Wilson, Montreal.
London Engine Supplies Co., London, Ont.
Stuart Machinery Co., Winnipeg.
Mechanics' Supply Co., Quebec, Que.
Gorman, Clancy & Grindley, Limited, Edmonton and Calgary.
Taylor Engineering Co., Ltd., Vancouver, B.C.



American-Marsh Centrifugal Pump.

American Steam Pump Company

Battle Creek, Mich.

Water Wheels and Hydraulic Power Plant Equipment

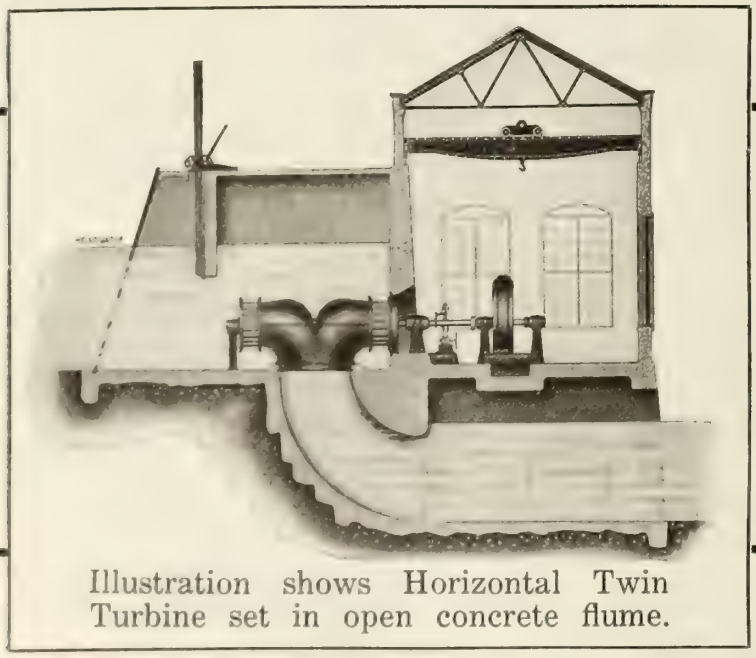


Illustration shows Horizontal Twin Turbine set in open concrete flume.

WE manufacture water-wheels, trash racks, head gate hoists, stop-log winches and steel plate feeder pipes.

It will pay you to consult us when in need of the above lines—and we will be pleased to receive your inquiries.

Engineers and Manufacturers

William Hamilton Co., Limited, Peterboro, Ont.

JOHNS-MANVILLE SERVICE
COVERS THE CONTINENT

JOHNS-MANVILLE PACKINGS

Designed by Engineers for Engineers

THE further from the boiler your leaks occur, the more they cost you at the coal pile. Power saved in steam means more than power saved in coal.

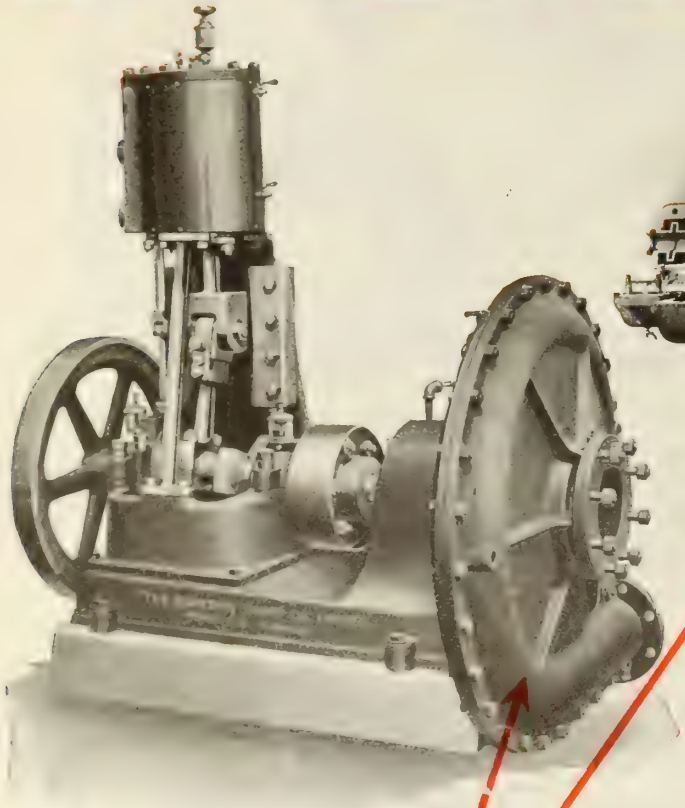
So your rod friction in pump, compressor or engine becomes a costly loss. The same holds true of flange losses or piston leaks. All of which proves the importance of careful packing.

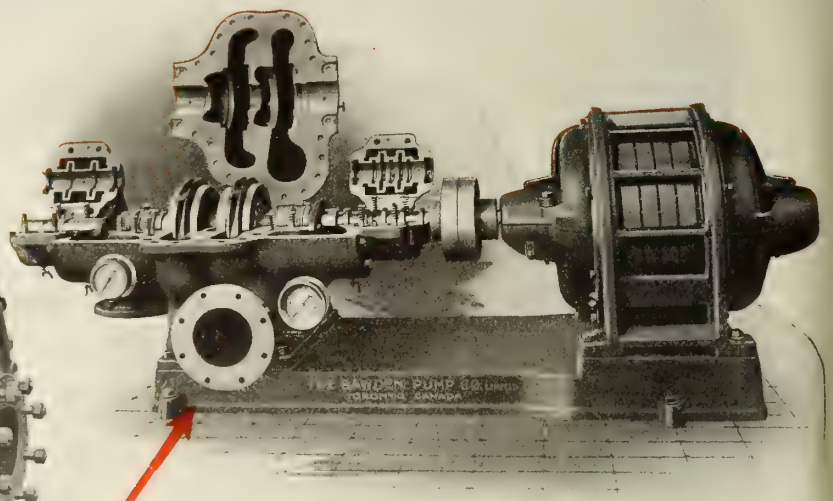
It is for this reason that Johns-Manville has taken the subject of packing seriously, put it on an engineering design basis and built each type to pass the most severe laboratory and service tests. It is years of this kind of work that has finally developed a standard line of packing—each one of which is backed by a logical engineering reason.

Any one packing is unique in its field—the list as a whole constitutes an important contribution to power plant economy.

THE CANADIAN H. W. JOHNS-MANVILLE CO., LTD.
Montreal Toronto Vancouver Winnipeg Hamilton
London Ottawa

BAWDEN PUMPS



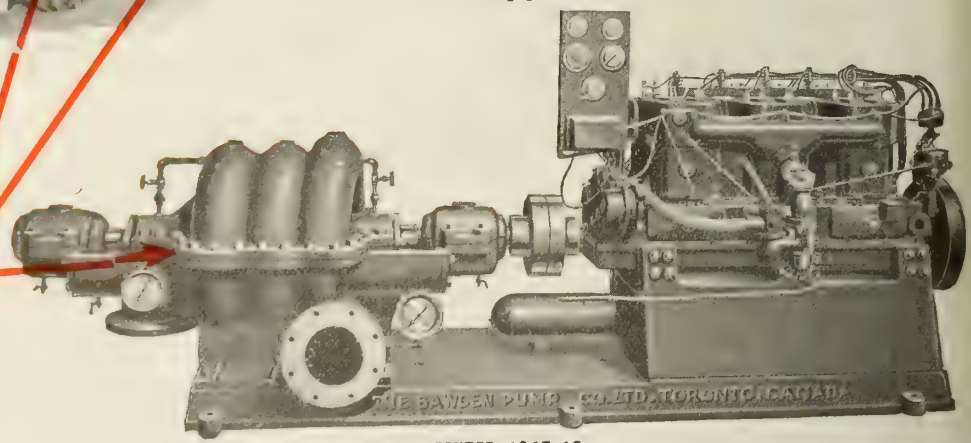


PATENTED 1917-18

Does not the accessibility of our Pumps appeal to you

PATENTED 1917-18

INSTALL PUMPS
WITH
FLOATING SHAFTS
THE
LAST WORD
IN
HYDRAULIC BALANCE

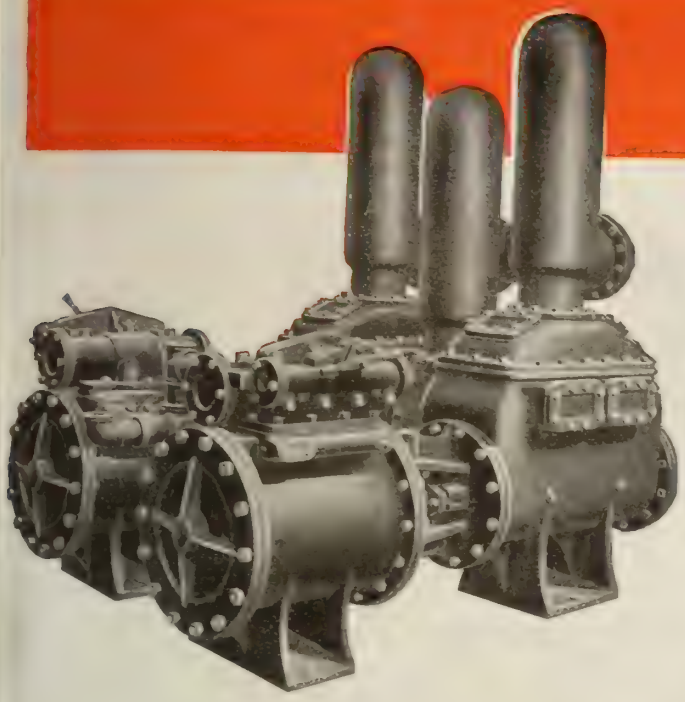


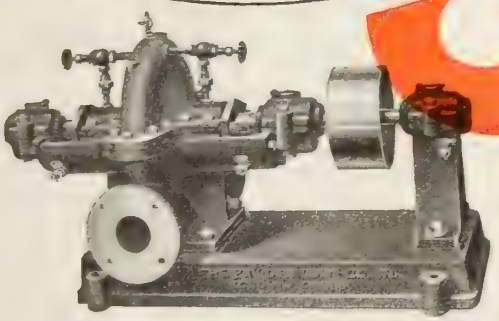
PATENTED 1917-18
Emergency Fire Pump. Always Ready when the Call Comes

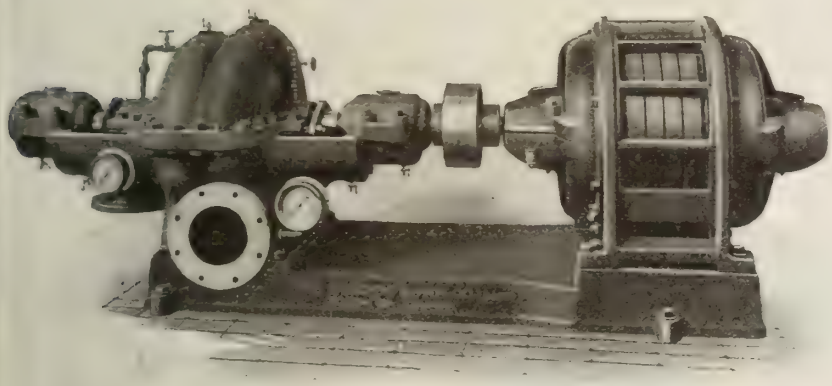
Parliament Buildings, Ottawa, are Equipped Throughout with Bawden Pumps

THE BAWDEN PUMP CO., LIMITED, STERLING ROAD, TORONTO

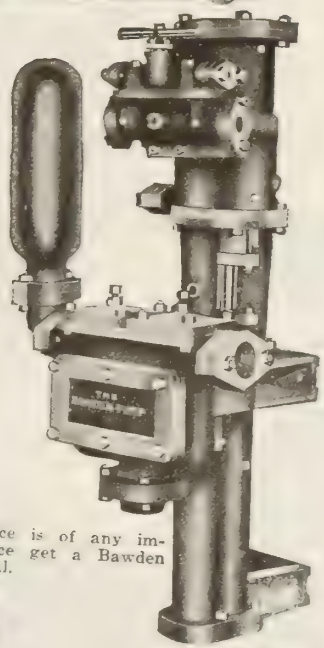
BAWDEN NEVER SHORT STROKE PUMPS

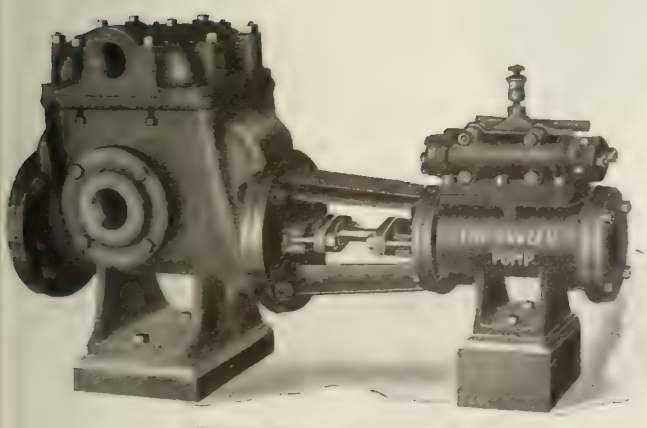




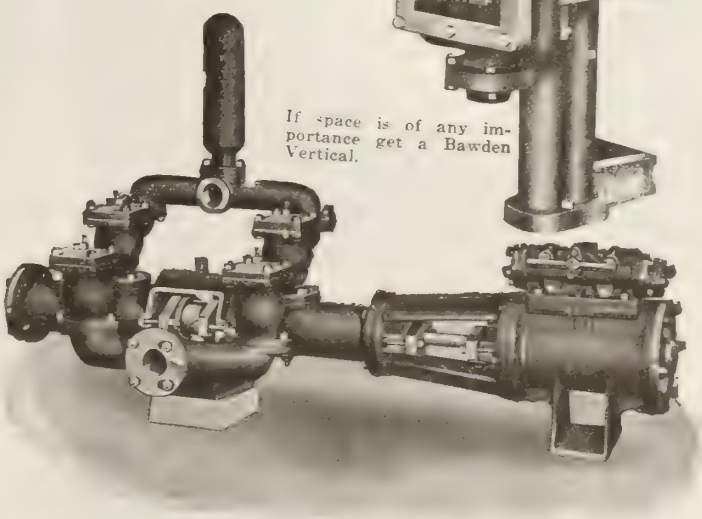


PATENTED 1917-18





Bawden Patented Vacuum Pump.



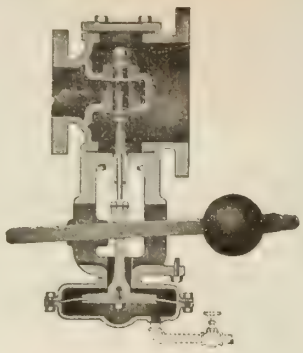
If space is of any importance get a Bawden Vertical.

Save Coal by using Compound Steam Pumps

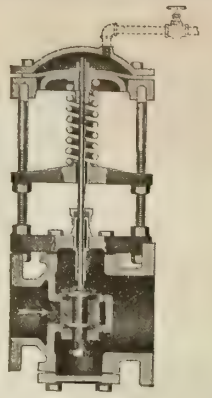
THE BAWDEN PUMP CO., LIMITED, STERLING ROAD, TORONTO

If any advertisement interests you, tear it out now and place with letters to be answered.

Kieley Rockaway
Single Seated



Kieley Special, '98.



Kieley Rockaway
Double Seated

YOU WOULD NOT EXPECT

a centrifugal pump to fulfill the duties of a centrifugal fan. Neither should you expect one type of reducing valve to operate efficiently on every service.

Let us know your requirements and we will furnish a Kieley & Mueller Pressure Regulating Valve that will fulfill them no matter how exacting they may be.

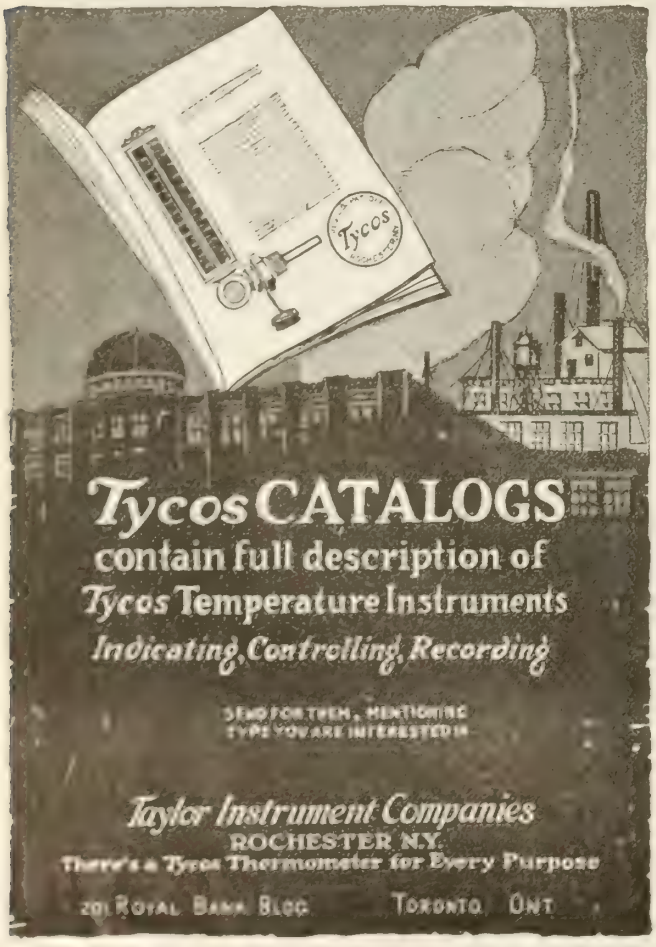
KIELEY STEAM SPECIALTIES

that have stood the test of time

BACK PRESSURE VALVES	EXHAUST HEADS	DAMPER REGULATORS
PUMP GOVERNORS	STEAM TRAPS	REGULATING VALVES
SEPARATORS	FLOAT VALVES	STOP AND CHECK VALVES

THE ARTHUR S. LEITCH COMPANY

505-6 Kent Bldg., Toronto



UEHLING WASTE METER

COMBINED

CO_2 AND TEMPERATURE RECORDER

Record of CO_2 and stack temperature on one chart.

Does your fireman know how much fuel he is wasting? Do you know?

The **Uehling CO_2 Recorder** makes a complete 24 hr. record of your combustion efficiency and the **CO2 indicator at the Boiler Front** holds the fireman responsible.

Get more **Steam** per pound of **Coal** and reduce your annual fuel consumption.

CO2 Indicator for Boiler Front

Let us know the number and size of your boilers and coal consumed per year, upon receipt of which information we will be glad to send you full particulars.

Let us hear from you. We are pioneers in the manufacture of Indicators and Recorders for Power Plant purposes.

Send for our Bulletin No. 110.

Uehling Instrument Company

2008 Empire Building **New York City**

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

"How Can I Reduce My Fuel Costs?"

UPSTAIRS the building Owner or Superintendent is asking that question as he figures up his fuel bills. With coal so high and scarce and the necessity for laying in next winter's supply staring him in the face, no wonder he's worried. He's up against it for fair.

Here's a big chance for the stationary engineer to put a smile where there's a worried look and a frown. How glad the Superintendent would be to know about The Dunham Radiator Trap — the big coal saver—The Guardian of the Coal Pile.

Many, many buildings are now being equipped with Dunham Radiator Traps. Wherever this is done a big saving in coal is effected. This is because The Dunham Radiator Trap prevents any waste of steam. Every ounce of coal—every latent bit of energy in the fuel is utilized to produce heat. No steam is lost through leaking air valves or fighting imprisoned air in the radiators.

It's up to you to cut down those fuel bills for the Superintendent. The Dunham Radiator Trap offers you this big opportunity. Go upstairs and talk to the Superintendent while he's wondering how to get more heat at less cost.

The quicker the building is equipped with Dunham Radiator Traps the sooner will the fuel bills begin to drop and a smile of satisfaction settle down on the face of the owner or manager of the building.

The DUNHAM HEATING SERVICE

C. A. DUNHAM COMPANY, LIMITED

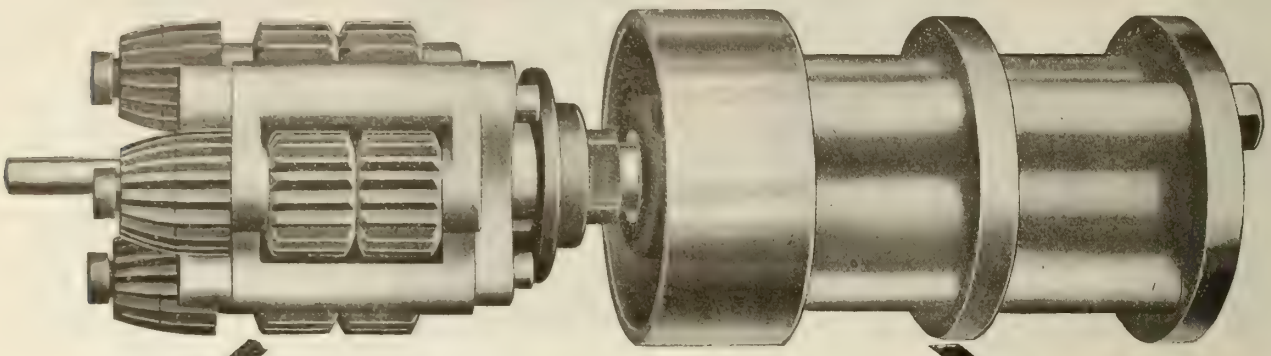
Toronto, Canada

Branch Offices: Halifax Montreal Ottawa Winnipeg Vancouver Calgary

If any advertisement interests you, tear it out now and place with letters to be answered.

CLEAN YOUR BOILER TUBES

IN LESS TIME, WITH LESS POWER



You can remove all of the scale and keep the tube surfaces clean and polished by frequent use of

ROTO

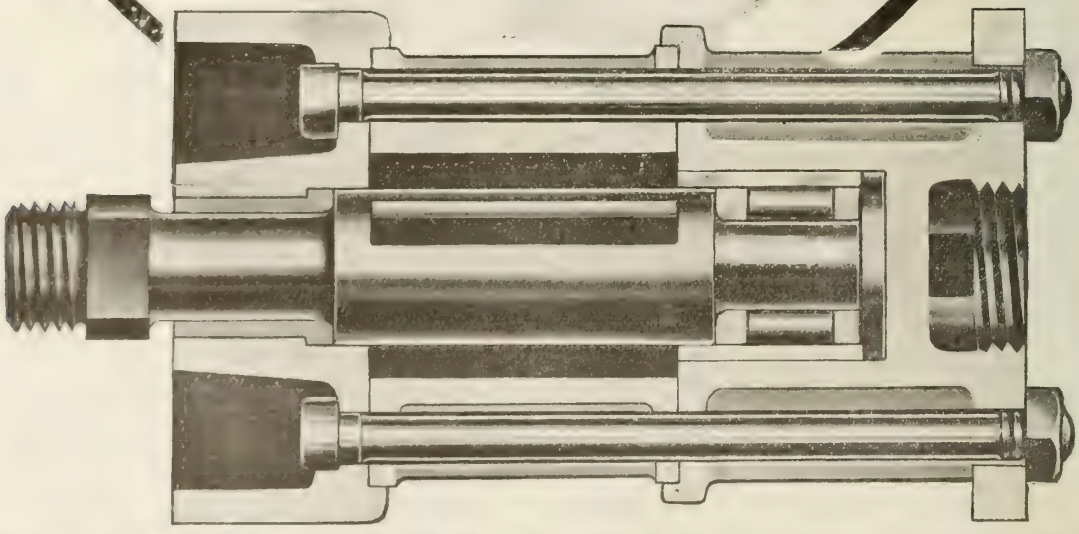
TUBE CLEANERS

Unrivaled in speed and durability. By far the cheapest cleaners because of their high efficiency. They combine the most powerful, reliable and durable motors with the most effective scale-removing tools.

Hardened Steel Armor Rings thoroughly protect the motor. The hard steel rings keep it straight, round, up to size and a correct fit for the boiler tube even after long use. Roto motors cannot pass over scale or get wedged and stuck in the boiler tube. They positively eliminate the usual trouble of wearing oval, taper or undersize.

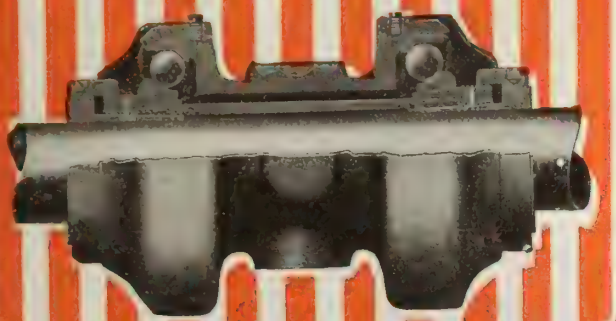
Roto Tube Cleaners include air, steam and water driven, cleaners for all kinds of straight and curved tubes of iron, steel, cast iron, copper, brass, etc., in boilers, fuel economizers, heaters, condensers, evaporators, etc.

Write for Catalogues now.



THE ROTO COMPANY, HARTFORD, CONN.

CHAPMAN
DOUBLE BALL BEARINGS



IF YOU ARE IN NEED OF MORE POWER, Chapman Double Ball-Bearings will give you 15% to 30% more without adding to your power plant.

SAVE

75% Shaft Friction

95% Lubrication

100% Re-babbitting

Wear and Tear on Belting

Danger of Fire from Hot Boxes

Adopted by Canadian and United States Governments. Fit any adjustable hanger.

Write us for details.

The Chapman Double Ball Bearing Company

OF CANADA, LIMITED 339-351 Sorauren Ave. TORONTO, CANADA

TRANSMISSION BALL BEARING CO., Inc., 1050 Military Rd., Buffalo, N.Y.

Drip-pan Collected Oil Comes from this

Anderson Pressure Filter

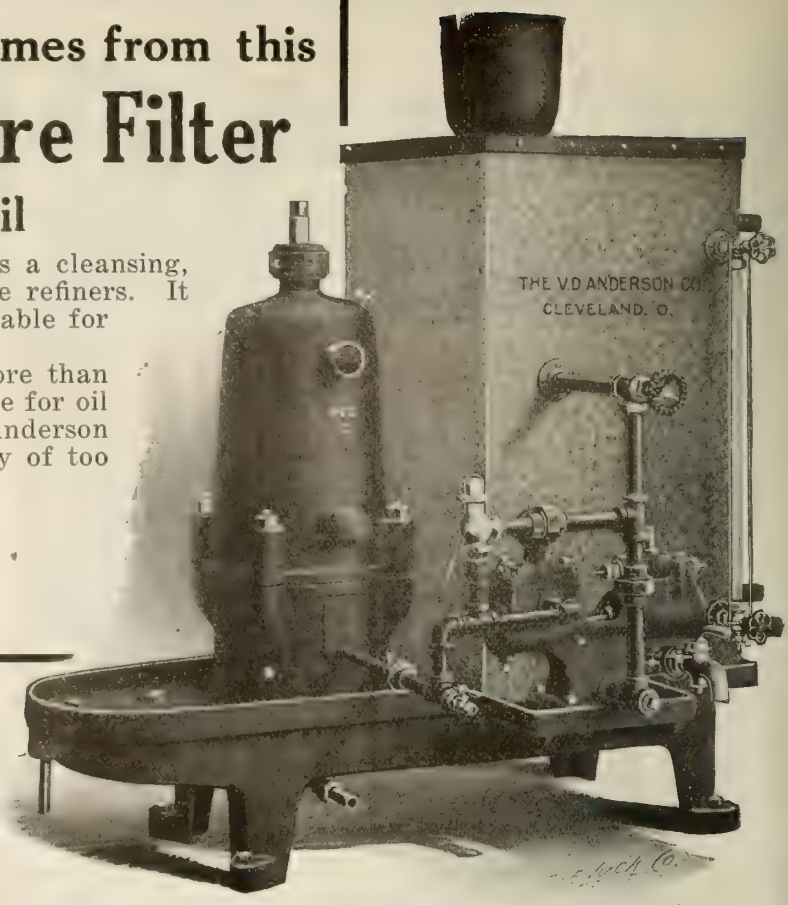
Clean and Pure as New Oil

In this Anderson Filter used oil undergoes a cleansing, purifying treatment identically that of the refiners. It comes from the Filter clean and pure, suitable for use on the finest bearings.

Without the Anderson Pressure Filter, more than half the oil you buy is wasted; your expense for oil is double what it should be. With the Anderson Filter there is no waste. It is an economy of too great importance for you to overlook.

Write now for catalog.

The V. D. Anderson Co.
West 96th St., Cleveland, Ohio



The Wrench of 25% Greater Efficiency

TRIMO PIPE WRENCH

Two new features have been recently added to the Trimo Pipe Wrench, namely Nut-Guards, in all sizes, and unbreakable steel frames, in leading sizes.

The Nut-Guards prevent the accidental rotation of the nut while in use.

These improvements add 25% to the usefulness of the tool.

The Trimo Pipe Wrench is made with wood handles in 4 sizes, 6-in., 8-in., 10-in., 14-in. and in steel handles in all sizes, 6-in. to 48-in. inclusive.

All Trimo Pipe Wrench parts are interchangeable.

The inserted jaw in the handle can be readily replaced when worn, thus adding to the life of the tool.

Nut with Nut-Guards

Inquiries from Importers and Dealers Solicited. Send for Catalogue No. 55.

TRIMONT MANUFACTURING CO.

Cable Address: Trimwrench
Code: Western Union

Roxbury (Boston) Mass., U.S.A.

Having Commutator Troubles?

The Jordan Commutator Truing Device will true your commutators without a shut-down.

Jordan Bros., Inc.
82 Beekman St. New York City, N.Y.

Canadian Representative:
CANADA SALES CO., 183 Church Street, Toronto, Canada

HOT PROCESS WATER SOFTENER FOR STEAM BOILER PLANTS

A Cochrane Softener Installat on at a large chemical works

Economic Benefits

1. **Fuel is saved by reason of heating the boiler feed water with** exhaust steam to 210° Fahr. or higher (depending upon the back pressure carried), 1% being saved for each 11 degrees rise in temperature, that is, 10 to 15% altogether.

2. **Due to pre-heating the water, the steaming capacity of the boiler is increased** in the same proportion that fuel is saved, and by a further amout due to clean heating surfaces.

3. **Due to lessened tendency to foaming, the forcing or driving capacity of the boilers is increased.**

4. **The boilers and piping are protected against corrosion.**

5. **Tube renewals, rolling in of leaky tubes, re-calking of seams, patching of plates, etc., are eliminated or greatly reduced.**

6. **Boiler explosions due to burned or corroded plates are eliminated, and the life of the boiler is in any case greatly increased.**

7. **The cost of carrying spare boilers for use while others are being cleaned or to carry overloads** can often be avoided by maintaining all the boilers clean and ready for service.

8. **Economies result from utilizing cheap sources of water supply,** such as wells or creeks, eliminating the cost of city water or the cost of pumping water long distances.

The Sorge-Cochrane Hot Process Softener for treating boiler feed water represents a radical improvement and embodies the latest developments in the art of softening water. It differs from other systems in that the chemical reagents required for the transformation of the scale-forming and corrosive substances are added to the water while it is hot, that is, after it has been heated to boiling point by spraying through an open steam bath.

See Bulletin 682

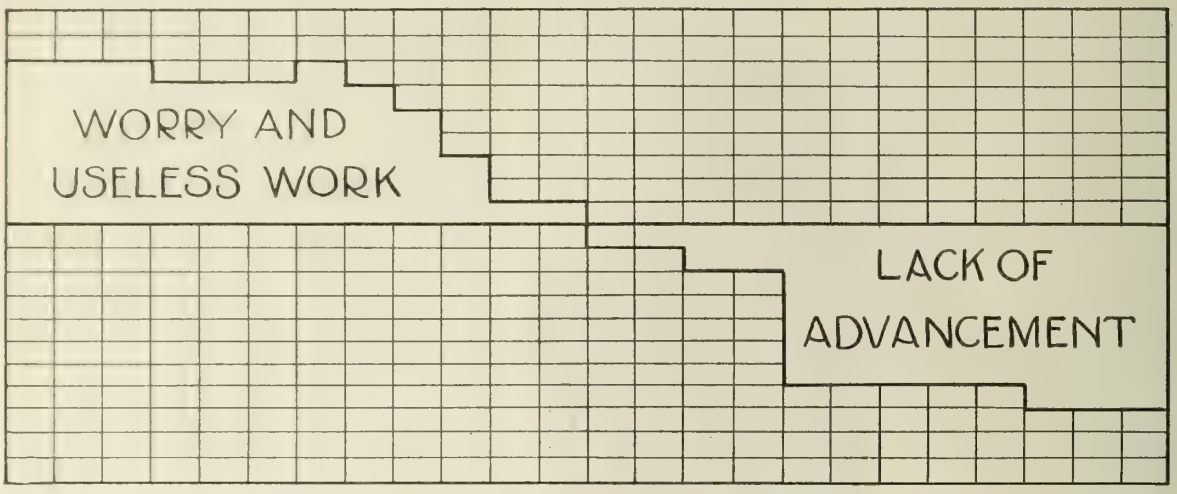
Head Office: Toronto. Sales Offices: Montreal, Halifax, Sydney, Ottawa, Cobalt, South Porcupine, London, Winnipeg, Calgary, Edmonton, Nelson and Vancouver.

CANADIAN ALLIS-CHALMERS LIMITED

Power Plant Equipment, Mining, Crushing, Hydraulic and Milling Machinery, Contractors' Plant and Architectural Bronze and Iron Work.

If any advertisement interests you, tear it out now and place with letters to be answered.

Let the C.A.S.E. Smooth Out Your Load Curve



Remove The Peaks of Worry And Unproductive Labor And Build Up The Valleys By Working For Your Advancement

A man who is thoroughly grounded in the practice of his profession, who is free from personal worry and trouble, overcomes the many difficulties besetting the path of the operating engineer with little labor and in a manner ensuring his advancement.

The successful man owes his success to a wise appreciation of the advantages and mutual help offered by association with those in the same field of endeavor. To join an association having for its objectives the welfare of the engineer in things mental and material, his advancement in knowledge and skill, his protection by provision for sickness and distress is to take advantage of an opportunity indispensable to all who hope to better themselves.

If you are interested in such an organization and live where less than fifteen engineers are located, send for a copy of our constitution and application blanks for admission to nearest branch lodge. If there are more than fifteen engineers in your community, get together and send for particulars regarding formation of a branch lodge.

J. H. HALE, General Secretary,

Canadian Association of Stationary Engineers

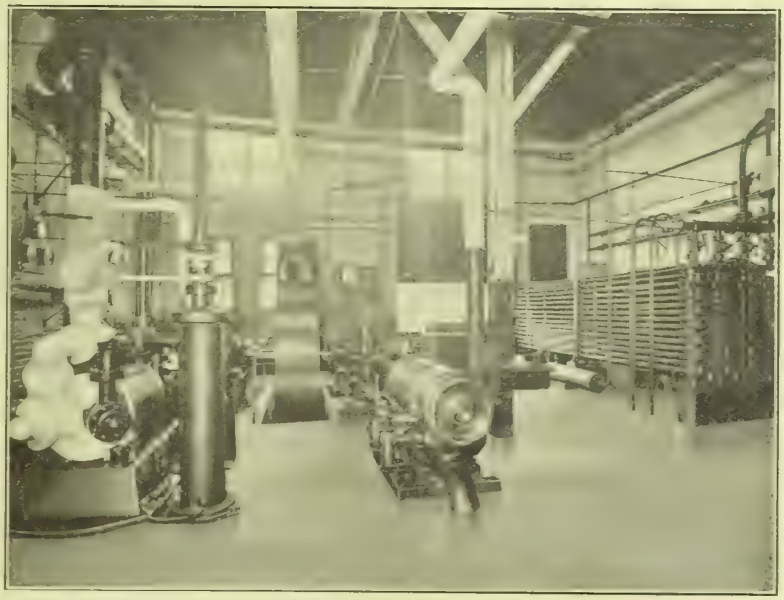
230 Caroline Street Hamilton, Ont.

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

"LINDE"

REFRIGERATING MACHINERY

A careful investigation into the vital features and a thorough comparison of efficiency will prove the value of the "Linde" Refrigeration Machinery.

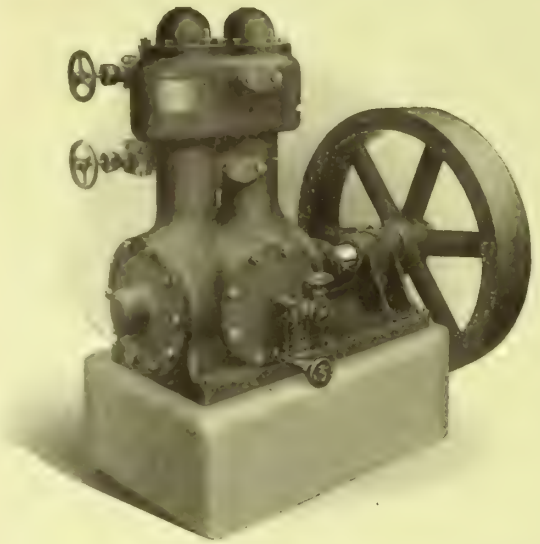


The Linde Canadian Refrigeration Co., Limited

37 St. Peter Street, Montreal

Established and Manufacturing in Canada since 1896

KEEPING UP QUALITY



Circumstances over which we had no control made it necessary to increase our prices, but our 20-year-old policy will not permit us to lower our standard of quality, or in any way abuse the confidence which our many customers have in YORK PRODUCTS.

During the past 20 years we have constantly sought ways and means to improve the quality of our Ice-Making and Refrigerating Machinery. This policy has been pursued up to the present time, and will be continued in the future. This is our guarantee to the trade.

Safeguard your interests by adopting YORK QUALITY.

YORK MANUFACTURING COMPANY

(Ice-Making and Refrigerating Machinery Exclusively)

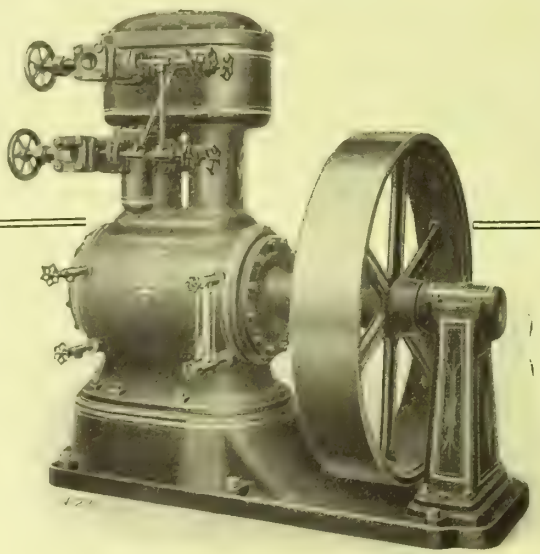
YORK, PA.

For information and prices write to the

CANADIAN ICE MACHINE COMPANY

WINNIPEG, 85 Lombard St. TORONTO, 82 Chestnut St. MONTREAL, 626 Coristine Bldg.

Economy
Efficiency



Durability
Simplicity

FRICK

Machines are a WAR Economy—they save fuel, labor, ammonia and repair costs.

FRICK

Machines are THE Leaders in the Refrigerating and Ice-making industry — continually so since 1882.

Install FRICK Machines

and the savings effected by their economic and efficient operation will materially assist you to pay for those Liberty Bonds which your **Patriotism** and **Love** for the **Boys Over There** prompted you to buy.

Ask for a copy of our list of users covering 48 pages of satisfied customers—also your copy of "Ice and Frost."

Frick Company
WAYNESBORO, PA. U.S.A.
ICE MACHINERY SUPERIOR SINCE 1882

Canadian Representatives:

FRICK ICE & REFRIGERATING COMPANY

Montreal, Canada

There is a FRICK Machine for every refrigerating purpose—all types—Vertical — Horizontal — Absorption.

The VILTER MANUFACTURING CO.

Manufacturers of

ICE MAKING and REFRIGERATING MACHINERY, CORLISS and POPPET VALVE ENGINES, ETC.

242 Beecher Street, Milwaukee, Wisconsin, U. S. A.

Branch Offices:

New York, N.Y.	Philadelphia, Pa.
Pittsburgh, Pa.	Chicago, Ill.
St. Louis, Mo.	Kansas City, Mo.
Houston, Texas.	Los Angeles, Cal.
Salt Lake City, Utah.	Seattle, Wash.
Wellington, New Zealand.	

Products

Vilter Rolling Mill and Girder Corliss Engines, Poppet Valve Engines, Ice Making and Refrigerating Machinery. Machinery for Breweries and Bottlers, Special Machinery.

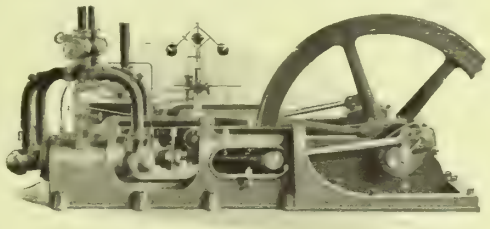
Vilter Improved Poppet Valve Steam Engine

Vilter Poppet Valve Engines effect real power plant economy. We know our statement will be attested to by owners and operating engineers of the plants where Vilter Poppet Valve Engines have been installed. Your request for proof need entail no obligations to purchase.

Vilter Tandem Poppet Valve Engine, direct connected to a Vilter Ammonia Compressor.

Vilter Rolling Mill Type Ammonia Compressor

The Rolling Mill Type Compressor is built along very heavy lines and for all conditions of service. It is used only with slight modifications in all sizes of compressors. The general design is very pleasing to the eye, the machine making an artistic asset to any engine-room. Its very appearance gives assurance and proof of its strength and reliability. This type is built in sizes from 6 Tons to 25 Tons daily refrigerating capacity.



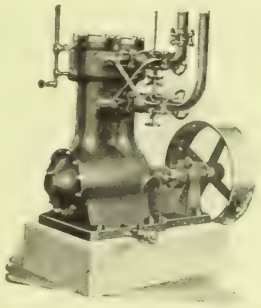
Rolling Mill Type Compressor.

Vilter Duplex Heavy Duty Ammonia Compressors

A Duplex steam-driven unit, with horizontal double-acting ammonia compressors and direct connected to Cross Compound Corliss Engine. Compressor equipped with multiple valve heads, giving maximum area. Stuffing box of the double-packed type, with oil seal and pressure release. The duplex type is built in sizes from 125 to 750 tons.

Small Vertical Twin Cylinder Ammonia Compressor

A small, single-acting compressor, especially designed for users of comparatively small quantities of refrigeration. It is reasonable in first cost. Economical to operate. Simple in construction. Needs very little attention. Is always ready for service. Built in sizes from 1 ton to 20 tons daily refrigerating capacity.



Vertical Twin Cylinder Refrigerating Machine.

Vilter Rolling Mill Type Corliss Engine

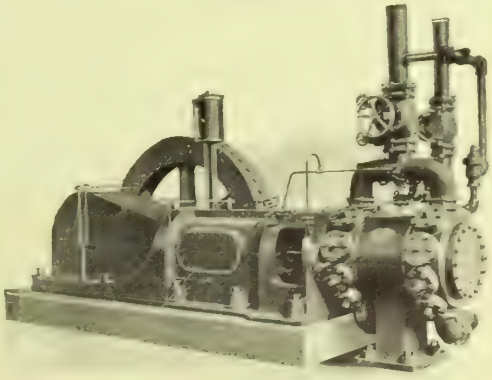
The Rolling Mill type Corliss Engine is of exceptionally massive construction throughout, and is adapted to any class of service from the steady belted load to the direct connected electrical service, in which the engine is subjected to heavy and extremely variable loads. It is built for high steam pressures and high rotative speeds, and may be used with superheated steam up to 100° F. superheat.

Vilter Girder Frame Corliss Engine

is exceedingly strong and rigid, and is designed to take shocks and overloads without possibility of misalignment. Made in 26 sizes, from 25 h.p. up.

Vilter High Speed Ammonia Compressor

Vilter horizontal high speed ammonia compressors are simple in design; rugged in appearance, and in the character of service they give. They are specially designed for direct connection to the newest types of high-speed prime movers, and particularly adapted for direct connection to synchronous motors, a method of drive which is proving so highly economical and efficient.



Horizontal High Speed Ammonia Compressor.

LITERATURE: Bulletins, catalogues and full data regarding our product mailed on request.

An Ice Storage Made This Possible

A 5,000-ton ice storage thoroughly insulated with Nonpareil Corkboard City Ice Company, Lexington, Ky.

If you can sell more ice than you can produce during the summer months, why not avail yourself of the fund of information, relative to the economic advantage of ice storages which we have collected in the course of fifteen years in the insulation business. All of these data are at your command.

Due to the seasonable demand for ice, the City Ice Company, Lexington, Ky., prior to 1912, worked at full capacity during the summer months, but had little or no load during the slack season. As a result, in 1911, their output was only 43.9% of their yearly capacity, and the manufacturing cost averaged $2.50 per ton.

To relieve this condition, in 1912 they installed some new equipment, and an 1800-ton ice storage house, thoroughly insulated with Nonpareil Corkboard Insulation. By filling this storage house in the off-season, their output was increased to 63.9% of their yearly capacity, and the manufacturing cost was reduced to 42 cents per ton.

But this increased production did not take care of the market and in 1914 the storage capacity was enlarged to 5,000 tons. Now the City Ice Company operate under a nearly constant load the year 'round. The efficiency of the employees has increased materially because of constant employment. And in 1915 the Company manufactured and sold 91.3% and 91.2% respectively, of the total yearly capacity.

Armstrong Cork and Insulation Company, Limited 11 Church St., Toronto, Ontario, Canada 505 McGill Bldg., Montreal, Quebec, Canada

Also manufacturers of Nonpareil Cork Covering for brine, ammonia and ice water lines; Nonpareil Insulating Brick for boiler settings, etc.; Circle A Cork Brick for cold storage room floors; Nonpareil High Pressure Covering for steam lines; Nonpareil Cork Machinery Isolation for deadening the noises of machines; and Linotile for floors in offices, residences, etc.

NONPAREIL CORKBOARD INSULATION

For Ice Storage and Cold Storage Rooms

Electric Power Plant For Sale

IT IS COMPOSED OF THE FOLLOWING:

2—13 x 14 Robb & Armstrong S.C. Engines.

2—4 in. Robb Steam Separators.

2—Allis-Chalmers 75 Kw., 275 R.P.M., 240 volt type 1 Generators, and one Switch Board.

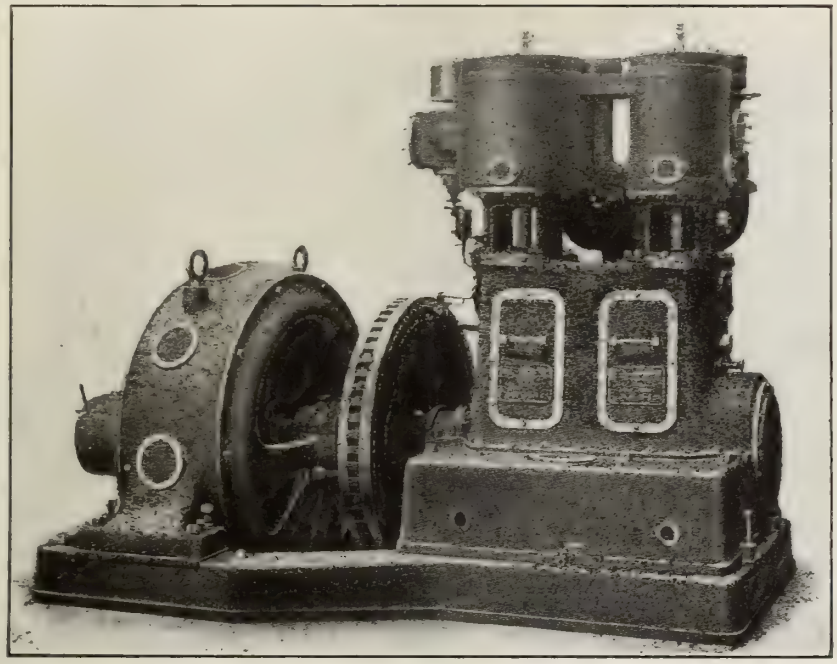
This plant is practically in as good shape as when it was installed. Open for inspection by giving us two days' notice.

LEWIS BROS., LIMITED

20 Bleury Street - - MONTREAL

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

BELLISS & MORCOM, LTD.
Engines and Air Compressors



Belliss & Morcom Motor-Driven Air Compressor.

Belliss Steam Engines, Steam Turbines, Diesel Engines,
Air Compressors, Condensing Plants

Heenan Refuse Destructors, Air Coolers, Water Coolers,
Oil Coolers, Dynamometers

Paterson Water Softening Plants and Filters

Centrifugal Pumps

We can make good delivery for War Service.

LAURIE & LAMB

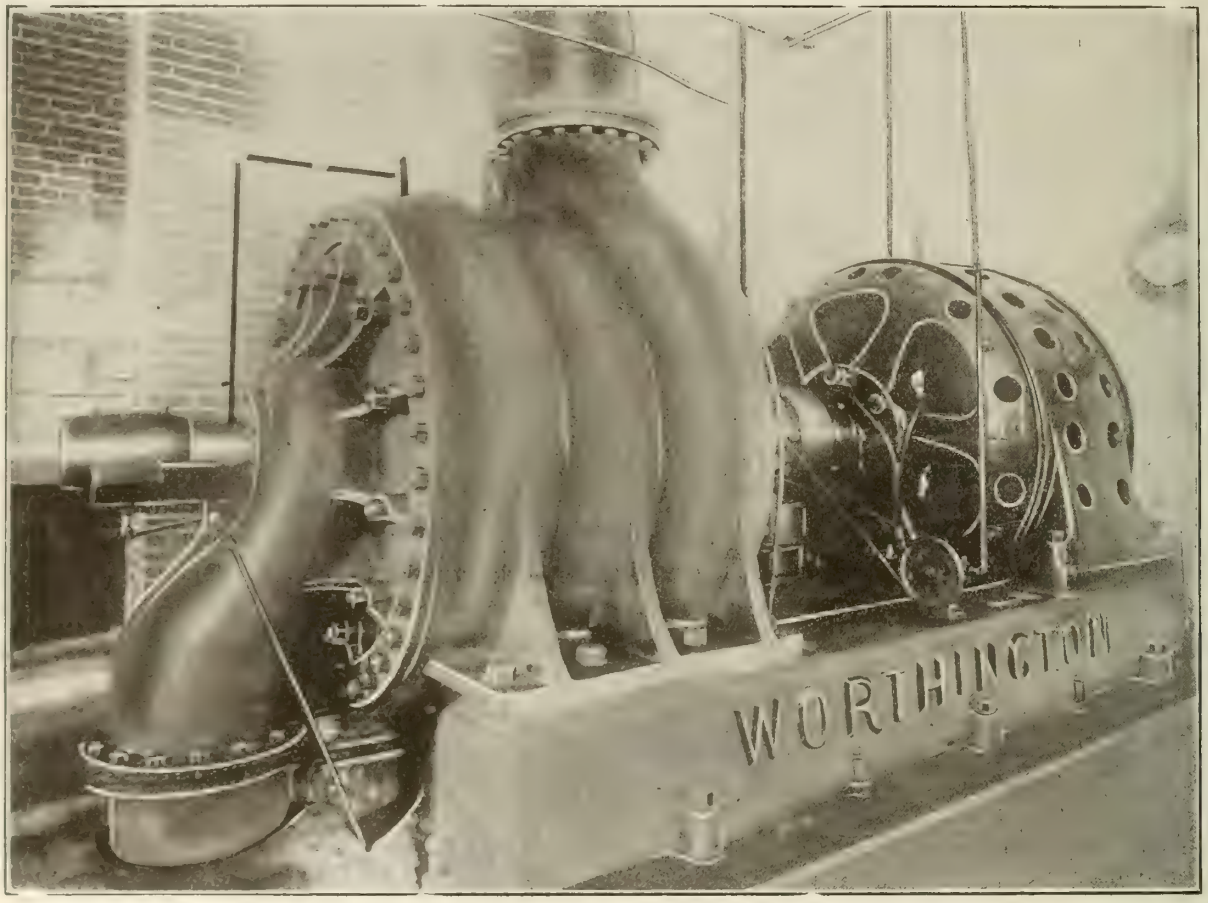
Engineers

211 Board of Trade Bldg. - - MONTREAL

THE JOHN McDOUGALL CALEDONIAN IRON WORKS CO., Limited

Manufacturers of Boilers, Castings, Condensers, Elevators, Engines, Filters, Forgings, Hydraulic Machinery, Pumps — centrifugal and reciprocating, Steam Turbines, Tanks, Water Wheels, Water Works Plants

Works: Seigneurs and William Streets, MONTREAL



5,000,000 gallons daily—Montreal Water Works—Driven by 400 H.P. Induction Motor.

Our Engineers have spent many years developing Centrifugal Pumps and we are now able to offer you perfected designs in any size pump from inch and a half and up for any service you may desire, and to be driven either with motor, engine or belt.

Write us for Engineering information, or prices, any time.

Sole Canadian Agents for H. R. Worthington Co.

Keeping in Stock at Montreal a large assortment of their Boiler, Feed and General Service Pumps

The Publisher's Page

TORONTO JUNE, 1918

An Idea or Two for Engineers

John Hale says
If Canadian engineers
Would use the pages
Of POWER HOUSE
To exchange their ideas
They would not only benefit others
But they would help
Themselves.

* * *

You have a dollar,
I have a dollar
And we swap,
You have my dollar and I have yours
We are no better off.
But if you have an idea
And I have an idea and we swap,
We each have two instead of one.

* * *

You have an engineering idea,
We have an engineering paper.
You send us your idea and
We publish it.

You're extending a helping hand
To some poor chap
Who may be up against it—
Stuck for want of your idea.

* * *

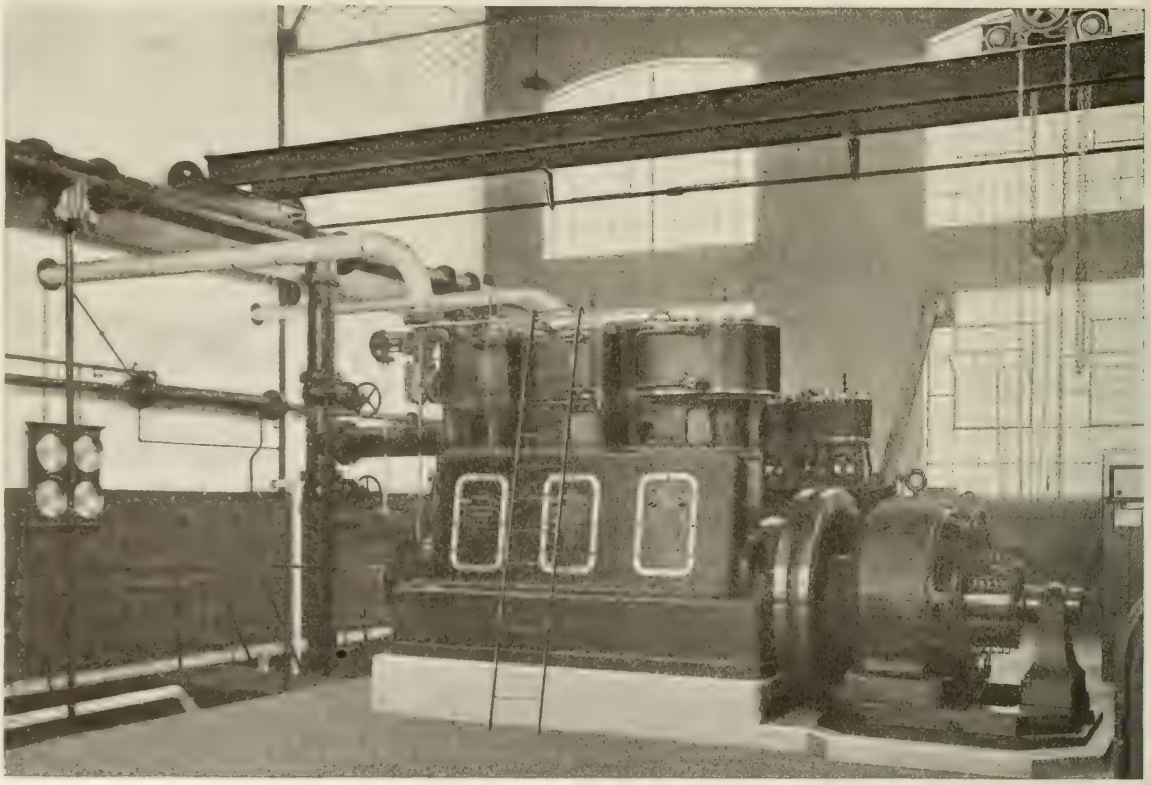
We'll pay you for your idea
And if other engineers follow your
Example, you're going to get a lot
Of good ideas yourself.
The whole business of engineering
Will have fewer thorns
And more roses
And rises.

* * *

You're going through life
Just once
And we have an idea
That if you use your ideas
To help others in this world
You'll be happy in the next,
Which seems to us
Well worth considering.

POWER EQUIPMENT

Built to Meet Your Own Requirements



A corner in the Engine Room of our New Power Plant recently erected at our Main South Works. Equipped with G. & McC. Co. Three-Cylinder Compound and Two-Cylinder Compound Vertical Forced Lubrication Steam Engines.

G. & McC. CO. ENGINES and BOILERS

will provide your plant with

A Continuous and Economical Service

WE BUILD

Horizontal and Vertical Steam Engines; Steam Turbines; Return Tubular and Water Tube Boilers; Heaters; Tanks; Pumps and Condensers; Transmission Machinery; Safes, Vaults and Vault Doors.

The advice of our Engineering Experts, our Catalogues, Specifications, Photographs, etc., will be cheerfully supplied to interested parties.

The GOLDIE & McCULLOCH CO., Limited

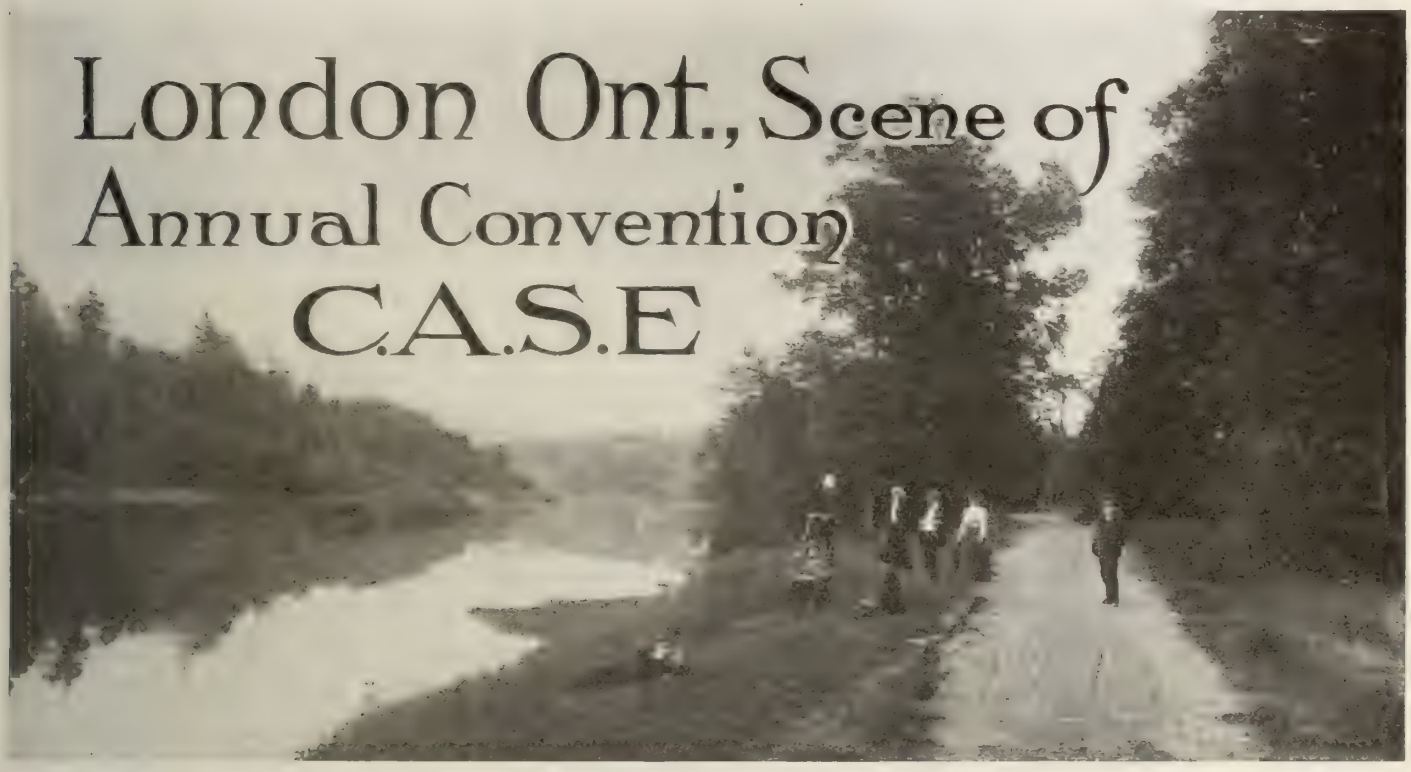
Head Office and Works: GALT, Ontario, Canada

TORONTO OFFICE:	WESTERN BRANCH:	QUEBEC AGENTS:	BRITISH COLUMBIA AGENTS:
Suite 1101-2, Traders Bank Bldg.	248 McDermott Ave., Winnipeg, Man.	Ross & Greig, 412 St. James St. Montreal, Que.	Robt. Hamilton & Co., Vancouver, B.C.

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

POWER HOUSE

London Ont., Scene of Annual Convention C.A.S.E



ON THE BANKS OF THE THAMES RIVER. SPRINGBANK PUMPING STATION IN THE MIDDLE BACKGROUND.

THE Canadian Association of Stationary Engineers has selected a good centre for its 1918 convention. London has seen many conventions, and it will see others. Especially at this time of year, when the great outdoors bids strongly for one's time. London has charms that few places can boast. Parks in abundance, wide streets lined with great shade trees, well-kept homes and grounds, a quick run on the electrics to Port Stanley. In fact, there is just enough outdoor attraction to provide relaxation and pleasure for the delegates, and not enough to make the convention and its purposes of secondary consideration.

London itelf has an interesting history and an historic name. It is a splendid distributing centre, surrounded by a good agricultural and mixed farming district. It is not, and never has been, a boom town. London's growth has been gradual but sure; but London can stand hard times, and perhaps after all that's the acid test of real stability. People who live in London like the place—those who leave carry with them pleasant memories of happy days and worth-while friendships. Yes. it's a good sample of the best that Canada has to offer in the way of the city that has not attained to metropolitan size. It retains the desirable traits of the large town and at the same time takes in every advantage of the larger centres.

The History of London

It will no doubt be of interest to readers of POWER HOUSE, and especially those who attend the Stationary Engineers' Convention, to read of London's early history, its development and growth, and the particular traits that have steadily brought it to the front, and enabled it to keep pace with the development of other places in Ontario and the Dominion.

Should a person desire to do so, it is quite possible to start the picture of London's early history in the woods.

Ninety Years Ago

Ninety years ago "The Forks," as the site of the city was then known (owing to the junction at that point of the north and south branches of the River Thames), was one vast wilderness, the haunt of the bear and the wolf, and the hunting ground of the red man. As far back as 1792, Governor Simcoe had visited the spot—which has been described as "a beautiful situation formed by a bend of the river, a grove of hemlock and pine, and a large creek"—and was so charmed with it that he announced his intention of making it the capital of the new colony of Upper Canada.

It was not, however, until the year 1826 that the site of the future city was surveyed, the first clearance in the woods made, and the first log house built. By the following year the population had grown to 133 persons, and London having meanwhile been chosen as the judicial headquarters of the district, added importance was given the place by the erection of a court-house, which was at that time the most imposing structure to be seen within a hundred miles or more.

In 1838 the place was created a municipality, and two years later, with a population of 2,000 was made a village. In 1845, the population being then 3,500, London suffered a serious setback in being visited by what has since been known as "the great fire," which destroyed a large number of its best buildings. But it rapidly recovered from the effects of the conflagration, for three years later we find it incorporated as a town, with a population of 4,668. That year (1848) also saw the establishment of public schools in London; and it might be remarked, in passing, that in no particular has London kept better pace with other Canadian cities than in the matter of education. The first decennial census, published in 1852, showed the population to have jumped to over 7,000, and two years later a population of 10,060 brought incorporation as a city.

WESTERN UNIVERSITY, A NOTED CENTRE OF LEARNING IN WESTERN ONTARIO.

Growth of Population

It will be seen there was little of the "boom" or the leaps-and-bounds about London's growth; rather it was of the steady, substantial and come-to-stay character. Such, indeed, has also been the growth of population from the time of incorporation up to the present; it has been increased every year, not one instance of decline being recorded. Official figures obtainable give an idea of the steady rise of population during the past fifty-seven years: 1860, 11,200; 1864, 11,555; 1871, 15,826; 1877, 19,100; 1881, 19,725; 1885, 26,075; 1890, 30,075; 1891, 31,977; 1898, 38,224; 1906, 44,704, while the latest figures credit London with 60,000 people.

All this time populous suburbs had been growing to the east, south and west of the city. It was felt that it would be to the interest of all concerned if these outlying sections, two of which had been formed into independent municipalities, were brought into and made to form part of the city. Accordingly, steps were taken to bring this about, the result being the annexation of London East in 1885, of London South in 1890, and London West in 1898.

As a Railway Centre

While a great deal of agitation and misionary work had been done all over Ontario regarding the Hydro radial plans, it remained for London to be the centre at which the first railway, converted from steam power to electric, would open for traffic. It was a gala day for London and for the Hydro group in Ontario when the opening excursion left that city for Port Stanley over the best-built and equipped electric road there is in the country. Delegates were present from all sections of the province, and engineers were there from many points to see what manner of thing this Hydro radial line was. It gave to all a good idea of the goal toward which the Hydro policy was driving.

London is a good railway centre. It was in October, 1853—nearly fifty-four years ago—that the first train on the Great Western Railway arrived in London from the east, which road shortly afterwards was continued through to Detroit. Up to that time all transportation to neighboring towns and to the lakes was by horse and wagon, so that the advent of the "iron horse" was an event of no mean importance. This had the effect of spurring on the enterprising Londoners of that day in the construction of a railway to Port Stanley, lying on the shores of Lake Erie, twenty-three miles distant, and the year 1856 saw the compleltion of that road.

In the year following the city was connected with the G. T. R. main line by the completion of a spur from St. Mary's. The London, Huron & Bruce was the next railway enterprise undertaken by the citizens, and as it would open up direct communication with the thriving towns to the north of the city, the Great Western Railway Company were easily induced to take over the construction of the line, the result being its completion in 1870. With the subsequent absorption of the G.W.R. by the G.T.R., all these lines passed under one management. The construction of the Canada Southern Railway from Niagara Falls to Detroit, and of the Air Line from the Falls to Glencoe, there connecting with the Grand Trunk's line to Detroit, was a matter of no little importance to London. The subsequent construction of the Lake Erie & Detroit River Railway, now part of the Pere Marquette system, gave London still another outlet. The construction some years ago of the branch of the Canadian Pacific Railway through London to Detroit placed the city in direct connection with the great transcontinental road, and thus completed a network of railways in Western Ontario, of which London is the centre.

The first Hydro trunk line, votes for which had been passed by the municipalities concerned, will be Toronto to London, by way of Guelph and Stratford.

ONE OF THE MANY BEAUTIFUL STREETS FOR WHICH LONDON IS FAMOUS.

Its Development

Tables of figures are often dry reading matter. They lack snap and are usually associated with blue books and other documents that are referred to from pressure rather than preference or desire. But figures often tell a pretty good story. For instance if a man tells you he's worth a million to-day, and you knew he had nothing two weeks ago, the figures would suggest quite a story. Well, it's the same regarding London's figures about growth and development. Post office revenue, for instance, is a pretty fair index. The figures for London show:—

1910	$145,250
1911	155,097
1912	170,620
1913	181,185
1914	202,986
1915	221,911
1916	298,917

Customs Receipts

Customs receipts also give a very accurate idea of the power of the people to buy. London's figures are:—

1908	$ 783,208
1911	1,017,503
1914	1,088,078
1915	1,100,711
1916	1,569,311

Bank Clearings

1903	$ 42,848,577
1906	58,063,826
1909	62,093,337
1912	84,525,961
1914	86,024,236
1915	89,774,787
1917	100,900,560

Building Permits

As a general thing there has been very little building going on since the start of the war. Material has been high, labor has been scarce, and the pressing needs of national finance have had first call on the money in the hands of the people. But London has done well even in the war years. The development in recent years is shown by the following:—

1910	$ 805,094
1911	1,036,989
1912	1,136,108
1913	1,789,920
1914	1,837,735
1915	1,207,630
1916	926,125
1917 (11 mon.)	833,210

Since the war started in August of 1914 London has erected almost a thousand dwellings at a cost of well on to two million dollars.

Over 30 factories and warehouses, or additions at a cost of well over half a million.

Over 40 stores, office buildings or places of amusement, costing over half a million.

The building of schools has also been keeping pace with the needs of the population, eight of these erected in recent years costing $460,000.

INTERSECTION OF DUNDAS AND RICHMOND STREETS. LONDON'S THOROUGHFARES ARE COSMOPOLITAN IN THEIR VARIETY.

As a Labor Centre

London is justly celebrated for the quantity and quality of its labor. A large percentage—estimated at 80 per cent.—of the industrial workers own their homes, a fact which indicates agreeable living conditions. Serious labor troubles are practically unknown, and the variety

VIEW IN SPRINGBANK PARK. PROFUSE FOLIAGE AND FLOWERS MAKE THE CITY'S SURROUNDINGS IDEAL.

of occupations which the established factories afford provides a supply of skilled labor of almost every kind. London's factories, covering some 75 distinct lines of manufacture, number over 250, and employ in the aggregate upwards of 12,000 people. Among the leading industries are over a dozen firms engaged in the manufacture of cigars. Montreal alone exceeds London's cigar output.

Here also is the largest stove works in the British Empire, the McClary Mfg. Co., employing 1,500 men. It has two of the Dominion's largest biscuit and candy factories; and is an important brass-working and boot and shoe centre. Other lines represented by numerous firms are: Iron working, carriages, garments, cardboard and wooden boxes, and furniture. London also makes engines, boilers, threshing machines, tractors, cement and concrete products, jewelry, brushes, overalls, cereal products, gas metres, handles, corsets, harness, pork products, show cases, ladders, electric irons, art glass, scales, barrels, hosiery, mattresses, pumps, ale and porter, elevators, soaps, bolts and nuts, bricks, etc.

Manufacturing output, as shown by the last Government census, increased from $8,122,185 to $16,273,999, or over 100 per cent., in 10 years. In relation to population, the price of factory sites in ideal positions is probably lower in London than in any Canadian city. A few hundred dollars will secure a site which would, in all probability, cost as many thousands in the large Eastern centres. Extensive acreage recently added to the city, with every requirement of the manufacturer, has the additional inducement of fixed assessment for fifteen years, with a tax of only fifteen mills on the dollar.

The C.A.S.E. has made no mistake in deciding to go to London for its gathering. The city is noted for its hospitality, for its welcome to delegates. Its transportation facilities are good; its easy distance from Port Stanley, that delightful spot on Lake Erie, is an added attraction. The stage is indeed well and pleasantly set for the 1918 convention.

TRAINING ESSENTIAL TO FUEL CONSERVATION

Intelligent application of the principles of fuel conservation must be practised by every user of fuel throughout the coming twelve months to avoid a repetition of the past winter's plight. Wilful waste under existing conditions must not only be considered as a forerunner of woeful want but at the present time should be recognized almost as a criminal offence. "Keep the home fires burning," must not be taken too literally, but should apply rather to the fires of enthusiasm than to those of the hearth. The growing significance of this continental, if not world-wide, problem was forcibly presented at a recent meeting of the Canadian Railway Club, Montreal, when a paper on the subject of "The Fuel Situation in War Time" was ably presented by Mr. T. Britt, general fuel agent of the Canadian Pacific Railway; the substance of this paper appeared in the April issue of *Power House*. The largest gathering of the season was present, and the subsequent discussion indicated the extreme interest displayed in this momentous question.

Aside from the general adoption of methods and appliances to facilitate the saving of fuel the all-essential factor in the early or ultimate solution of this problem appears to be a better understanding of that ever-changing but equally unknown quantity—the human element. In suggesting that an educational campaign should be conducted among locomotive and stationary firemen, Mr. Britt pointed out the vital importance of personal instruction. He said:

"To my mind this should not be done by printed instructions but by actual illustration by competent firemen. While it is all very well to write a fireman and tell him what he should do, it is far more educational for a competent instructor to show how it should and could be done."

Mechanical devices such as automatic stokers, the superheater, the brick arch, automatic fire door, feed water heater, together with the general design of engine mechanisms have all played an important part in the fuel saving movement, but the highest efficiency of any of these can only be attained when judiciously operated by the engineer or fireman responsible. Commenting on the poor quality of the fuel supplied during the past winter and the difficulties accruing therefrom, W. H. Sample, master mechanic of the G. T. R., said:

"So far as the conservation of fuel with us is concerned, I feel we do not do enough. We have undertaken to do some things but there are a great many more things that we intend to do. We have put on two additional travelling

ON THE SHORES OF LAKE ERIE. PORT STANLEY IS THE FAVORITE SUMMER RESORT IN WESTERN ONTARIO.

firemen with a view of instructing the firemen. That not only helps to save coal but it also assists in getting the trains over the road. We had to hire a great many new men, which is as great as factor in the fuel consumption as anything we have."

In agreeing that the question of fuel conservation was probably the biggest of present day problems, and pointing out the advantages that had resulted from the installation of mechanical devices for this purpose, W. H. Winterwood of the C. P. R. stated:

"A great deal of coal could be saved if measures were taken to prevent it falling from tenders along the right of way. In this connection I wish to say that Sir George Bury, vice-president of the Canadian Pacific Railway, has been vitally interested in the matter of fuel economy for years, and an order issued by him in the past was that locomotive tenders were not to be overloaded, and that the proper amount of fuel to be carried on the tenders be ascertained and that amount not exceeded. This has resulted in a great saving of fuel. He is also responsible for a modification and improvement in the design of our locomotive tenders. This change in design consists of a coal space with a very steep slope at the back which is brought much closer to the shovelling sheet than on any other tenders. The sides of the hopper are somewhat higher, but the coal in the hopper comes down by gravity to the shovelling sheet, eliminating the necessity of a mechanical coal passer and which insures all coal in the hopper being available. This has resulted in a great saving."

It was pointed out that it was not sufficient to equip an engine house or locomotive with fuel-saving devices, but in order to obtain the greatest efficiency from such installations it was imperative that the users should understand them thoroughly. In this connection, E. S. McMillan said:

"The Grand Trunk has spent a large amount of money on mechanical devices to save fuel and also to assist the firemen; as to teaching the firemen, we do this all we can, but it is very difficult on account of the large number of new men employed. I think the men co-operating with the engine crew in train handling should be properly trained in their work, for if not they can waste more fuel by unnecessary work than the engine crew can save. This condition will discourage the firemen very quickly."

In commenting on the vagaries of the human element and the direct bearing this often had on industrial problems, T. C. Hudson, master mechanic of the Canadian Northern, remarked:

"I feel that we should give more attention to young and inexperienced firemen, for that is where we meet most of our trouble to-day. Although we may have ideal conditions—such as locomotives equipped with superheaters, pneumatic firedoors, injectors proper size, tubes cleaned, and front end of locomotives properly adjusted, yet unless you have a fireman who can and will handle the scoop properly, coal will be wasted. It is true that we have a lot to contend with on the railroads in breaking in new men for road work owing to the fact that many skilled engineers have volunteered for overseas service. I am strongly in favor of travelling firemen who can accompany new and inexperienced men and demonstrate to them the proper method of firing a locomotive. You may equip a locomotive with all the fuel-saving devices possible (and the railways of this country have spent considerable on fuel-saving devices) but in the end we must come back to the human element if we are to get the best results. Printed instructions on fuel economy are beneficial from which an energetic fireman may learn much which will help him in his work, but these should be emphasized, and this can only be done thoroughly by demonstrating with the scoop on the footplate of the engine. We must admit that some of the coal supplied this year is of an inferior quality. However it is all we can get to handle the tonnage, therefore the fireman becomes a large single factor in any campaign to secure immediate results. Owing to the shortage of supply it will be found cheaper to educate the fireman than pay for the coal."

The better training of locomotive firemen was dealt with at some length by E. W. Sawyer of the I. C. school, and the thoroughness of this company's methods of education was demonstrated in his statement; he said in part:

"We have had an expert riding engines on one of the larger roads in and out of Montreal for some time in an effort to work out a system which would better results from the coal now being used on the locomotives on the road referred to, and it seems that it is not so much a matter of economy at this time as it is to evolve a system of handling this fuel and to keep the engines hot, especially when the fires get dirty and the grates clog with ash and other debris which so frequently occurs where coal is furnished high in non-combustible material."

Departing from the general groove of the discussion, A. M. Barry, of the St. Lawrence Welding ompany, brought up the subject of the firing and operation of marine boilers and their relation to the general problem of fuel preservation. To quote Mr. Barry in this connection:

"We have heard from the railways on the responsibilities of this fuel question and we have also heard from the power house man. What about the steamboa man? The steamboat man brings us back to the question of the human element. The steamboat man generally is a "wop" and is the cheapest kind of man that can be got. He knows nothing about fuel economy. His type is strong in the arm and thick in the head; his business is to shovel coal. You can see these marine boilers all over the country, in dredges, boats and elsewhere, with leaky and dirty tubes, tubes blocked and boilers dirty—two or three injectors on some to keep the water in them. The railroad man here to-night is being blamed for this fuel shortage but it seems to me that the steamboat man is equally responsible. When the fireman gets to the end of a trip he goes on a drunk, and if he does not turn up again it does not matter as they can get along without him. I do not mean the deep sea men, but the men on the inland waters—lake boats, dredges, and so forth. The railroad companies and those owning power plants may have reason to use greater economy in fuel but it seems to me they are not as great transgressors as the steamboat men. Why not get after them as well with education?"

From the above it would appear that the experience of the past winter will act as a stimulant to the adoption of every mechanical means available for the future saving of coal, especially in those districts where long haulage from the source is necessary. In addition to this increased attention will be given to the education of those men that are directly responsible for the actual burning of the fuel, so that the same may be accomplished in the most efficient and economic manner.

ACCORDING to "The Engineer." an interesting form of spark plug for motor cars is being developed in the United States, utilizing 'catalytic combustion" to keep the carbon burned off the insulators. The method depends on the maintenance of a high temperature by burning part of the gas-air mixture by catalytic flameless combustion throughout the entire period of the compression stroke, when there is plenty of fresh air in the cylinder. The new plug is provided with a catalytic structure, in addition to the electrodes and inculators, which produces heat by oxxidizing the mixture above mentioned. The catalytic flameless combuston produced by this material is distinct from ordinary flame combustion of the kind that inflames and explodes the whole charge of gas and air. The insulator is kept nearly red hot, and therefore does not receive any deposit of soot, but it does not interfere with the electric spark.

IN one of his journals, Camille Flammarion gives the heights at which sounds from the earth are heard from balloons. The shout of a man was heard distinctly at the height of 1,600 ft., the short note of a mole-cricket at 2,500 ft., and the croaking of frogs in a morass at 3,000 ft. At 3,255 ft. a man's voice and the rolling of a cart were distinguished; at 4,550 ft. the roll of a drum and the music of an orchestra; at 5.000 ft. the crowing of a cock, the sound of a church bell, and sometimes the shouting of men and women. Nine hundred feet higher still he heard the report of a musket and the barking of a dog. The noise of a railway train penetrated to a height of 8,200 ft., and the whistle of a locomotive engine to nearly 10,000 ft.

Sixty Ton Electrically Operated Raw Water Ice Plant

Artesian Well, Hydro Power and Well Designed Equipment Characterize Local Plant of London Cold Storage and Warehousing Co.

By W. G. Walters

(Local Secretary, Canadian Association of Stationary Engineers.)

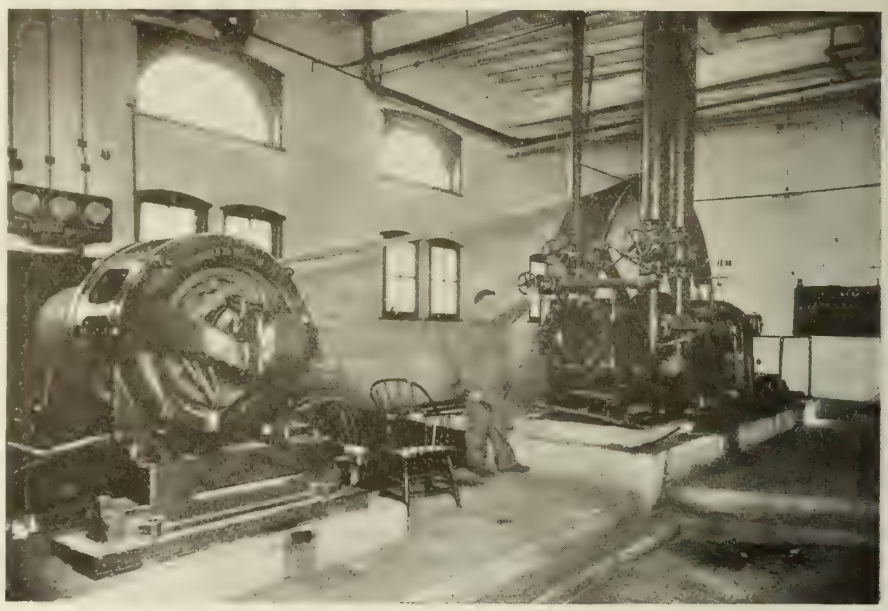
ONE of the important establishments of the prosperous city of London is the artificial ice plant owned and operated by the London Cold Storage & Warehousing Co. Some five years ago this firm, seeing the need for and possibilities of an industry of this kind, asked for tenders on a plant with a capacity of 60 tons of ice per 24 hours. The De La Vergne Machine Co. of New York were successful in securing the contract and designed the plant and furnished the drawings for the buildings in connection therewith.

The low cost of electric power in London was the deciding factor and led to the choice of raw water ice in preference to the more costly process of distilled water.

Water Supply

An artesian well on the premises was sunk to a sufficient depth to secure suitable water and in this respect the plant has a generous supply of beautiful sanitary and palatable water, which makes a very hygienic and pure ice.

The well is pumped by a Luitweiler double acting three stage pump which is driven by a 15 H.P. Crocker-Wheeler induction motor, and it might be as well to state at this time all the power equipment in the cold storage and artificial ice plant is now Hydro operated, at 25 cycle, 3 phase, 550 volts., the change from steam to electric drive being made by the writer in 1912. This Luitweiler pump discharges the water directly over the ammonia condenser, a branch pipe being taken off the discharge line to supply the ice plant for ice making purposes.The water from the condenser is collected and again circulated by a centrifugal pump direct connected to a 7½ H.P. Crocker-Wheeler motor.



60-TON ICE CAPACITY DE LA VERGNE COMPRESSOR DRIVEN BY 150 HORSEPOWER CROCKER-WHEELER THREE PHASE MOTOR.

ELECTRICALLY DRIVEN LUITWEILER PUMP INSTALLED IN ARTESIAN WELL.

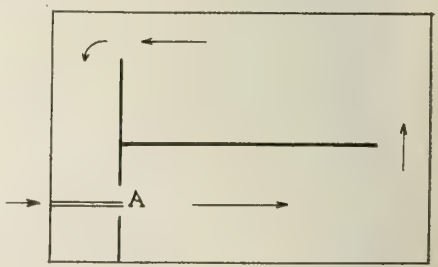
Tank Equipment

The tank room, ice storage, and precooling tank room are all contained in a building 48 ft. x 100 ft. There are 2 ice tanks, each being 41 ft. 6in x 20 ft. 9in. tanks 5 ft. deep. The tanks were constructed by the firm of E. Leonard & Sons, of London. The plates being of steel ⅜ in. thick, tanks were laid out and drilled at the above firm's shops and riveted together on the job. A cement floor was first laid under the tanks and covered with two plies of 2-in. cork board laid in hot asphalt; this with a heavy coat of hot asphalt made a good insulation for the bottom of the tanks.

The first tank was set up on timbers, riveted and caulked, filled and tested, and then lowered into position by the use of chain blocks. Owing to strains in lowering this tank several leaks were discovered. The tank was raised and made tight, and to avid straining again blocks of ice were placed under the tank which melted gradually and allowed it to take its position. This was so satisfactory that this method was adopted for lowering the second tank. The brick walls on the sides were heavily coated with hot asphalt and 10in. of granulated cork used for insulation. Each tank was constructed with a partition as shown, an agitator being placed at (a) which circulated the brine in tank. These agitators were belt driven by a 5 H.P. motor placed on the wall above the tanks.

Coils and Capacity

The ammonia coils for each tank are composed of 18 coils, 10 pipes high, made of 1¼ extra heavy pipe, all pipes being well tinned at the joints and sweated in, and all flanges well soldered. Top of tanks is covered with a wooden frame with doors lifting up to uncover 4 cans of ice. The arrangement of the coils in the tanks allows the placing of 272 cans



CIRCULATION OF BRINE IN TANK

INTERIOR OF STORAGE ROOM. NOTE THICKNESS OF CRYSTALLINE CORE IN SIDE VIEW OF BLOCK

of 4000 lbs. in each tank, size of cans being 57½in. x 22½in. by 11¼in. The capacity of each tank is 30 tons of ice every 24 hours, which means that each can has to be filled and frozen in about 4 ——

The brine for the tanks is made from rock salt, the amount for the first charge being about 60 tons, or a little more than 15 lbs. of salt per cubic ft. of brine.

Insuring Transparency

In the manufacture of raw water ice the hardest proposition that the manufacturers of ice making machinery have encountered is to get their ice transparent—all sorts of devices and equipment have been tried to get this effect. Although the ice is just as efficient and just as sanitary for any purpose even if it does look like snow, yet for commercial purposes it often depends more upon its appearance than it does upon its purity. Snow may be pure but it is white because of the presence of a large number of minute air spaces between the crystals of ice, and it is the same in water, which has not been boiled or distilled. The De La Vergne method of getting rid of the minute particles of air held in suspension in raw water and which was used on these tanks, is as follows:- 2 blowers were installed, one for each tank, and connected so that either blower could be used on either tank, or both used if required. An air line consisting of 2in. pipe was run down on both sides of each tank, and branch lines run over the tops. Each branch line supplies 8 cans. A ¼in. pipe is dropped down into each can.

In course of operation a certain number of cans are filled, air connected and started. The attendant marks on a chart the hour that the cans are filled, and after the freezing has been in progress 12 hours the lids are lifted, the air shut off, and what is known as a core sucker is used. This is an instrument that is dropped down into the can and is connected by hose with a pump, which removes all the water that is not then frozen. The ice in the can is then washed, the wash water removed, and the can refilled, after which the air pipe is placed and left until almost frozen. The air pipe is now removed, the impure water sucked out and again refilled, closed down, and allowed to freeze solid. By referring to view of ice storage this process will be more fully understood.

Capacity and Storage

Above each tank is a travelling crane which serves any part of the tank space. On each of these cranes or travelling cars is a Sprague ½ ton electric hoist, which removes 2 cans from the tank and delivers them to a thawing tank, which thaws the ice enough where it comes in contact with the can to allow it to come out. The hoist then delivers cans to a dump which is operated by the attendant's foot and shoots the ice into the ice storage.

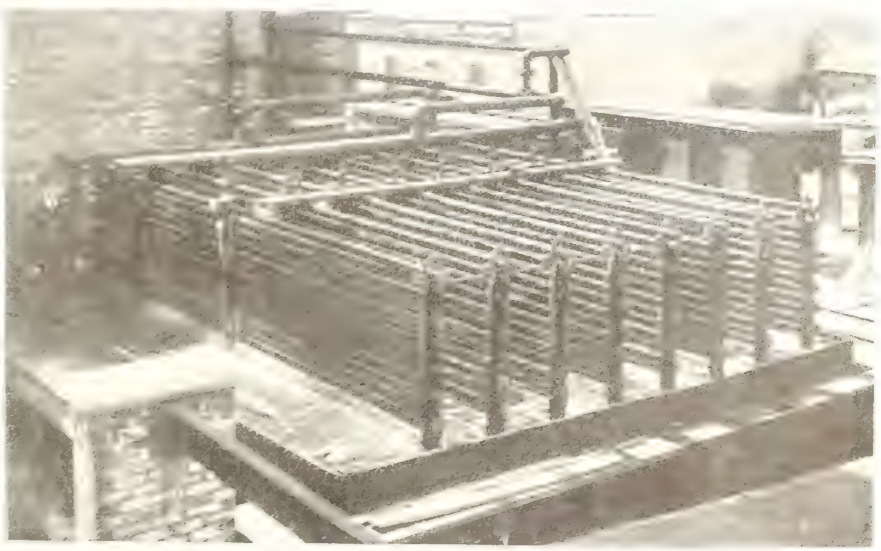
The water for ice making purposes is taken off the discharge from the deep well pump, put through an international filter and then into a pre-cooling tank. This tank has sufficient coils in it to bring the water to a temperature nearly freezing.

The ice storage has a capacity of about 500 tons of ice and is well insulated with cork board. See illustration of ice being piled. An elevator is being installed to hoist the ice up to the ceiling and also to hoist the ice for icing cars. Being right on the main line of the Grand Trunk Railway, considerable trade in icing refrigerator cars is taken care of.

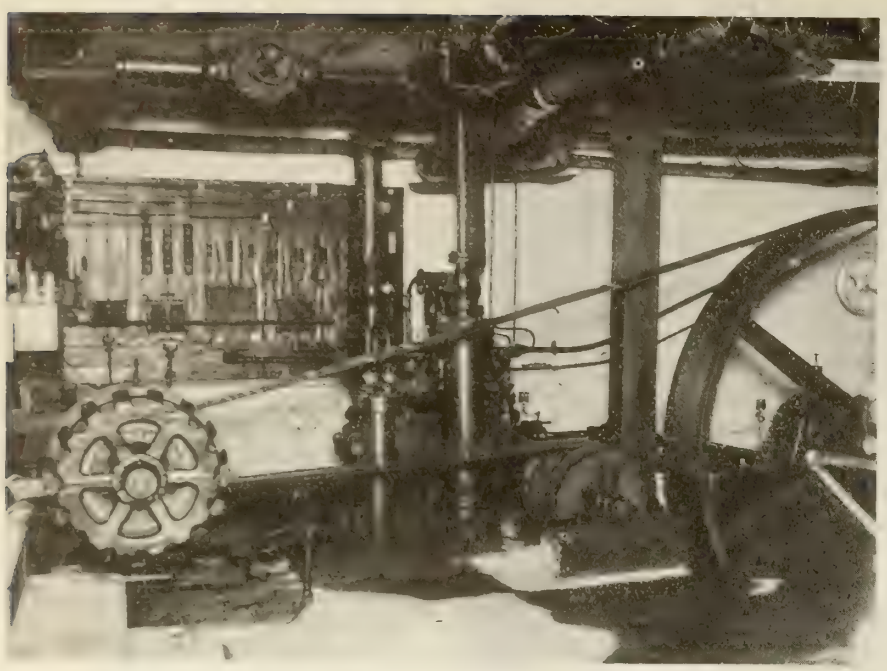
Compressor

The compressor (see view) is one of the largest in Ontario, and is a De La Vergne of 125 tons refrigerating capacity, or 60 tons ice-making capacity. This machine is belt driven, and is operited by a 150 H.P. Crocker-Wheeler slip ring motor with a Cutler-Hammer controller with 12 resistance grids of sufficient capacity to allow of a variation in speed from 8 revs. per min. up to full speed of 65 revs. per min.. A Condit Circuit Breaker with overload relays and no voltage release is provided. Belt is double-ply oak tanned leather 28 in. wide and is driven off motor by a paper pulley 28 in. by 28 in. The condenser used in conjunction with this machine is illustrated herewith, and consists of 8 stands of 2 in. pipe, 12 pipes high.

The piping from machines is so arranged that any one of four machines can be used on ice tanks or on the refrigerating rooms in connection with the cold storage. A section of the old engine room is reproduced showing one of the



EIGHT COIL COOLER FOR DE LA VERGNE COMPRESSOR. WATER IS SUPPLIED FROM LUITWEILER PUMP IN ARTESIAN WELL



VIEW OF SECTION OF OLD STEAM PLANT, SINCE CONVERTED TO ELECTRIC DRIVE BY REMOVING THE STEAM SIDE

35 ton Linde machines. There are two of these machines and also one 60 ton Linde machine, which are all driven by squirrel cage induction motors.

PROGRESS IN POWER PLANT DESIGN

Remarkable improvements have been effected since the older types of water wheels were replaced by turbines. In 1870 the average horse-power of each wheel made by one of the leading turbine makers was only 70; thirty years later it was 700; forty years ago the construction of a wheel giving 500 horse-power was considered something of an achievement; to-day there are at work wheels of 10,000 horse-power and over. It is estimated that in hydro-electric power houses there are now not less than 2,000,000 horse-power of turbines installed.

It was not until the year 1862 that the cylindrical boiler met with any degree of success, and it is a somewhat remarkable fact that this type now remains in almost universal use, and has only been altered in detail since that early period. The water-tube boiler now being manufactured by many firms can be adapted with more ease to the particular requirements it has to meet than any other boiler of the shell type. In marine engines the introduction of the triple-expansion type working at about 150-lb. pressure has enabled great economies in steam consumption to be effected.

Translated into fuel consumption the triple-expansion engine was said to require from 1.46 lb. to 2 lb. of coal per indicated horse-power per hour, while the compound engine requires from 2.32 lb. to 2.39 lb. The steam turbine for any power over 1,200 horse-power shows an even lower steam consumption. Summarizing the results of a large number of tests, it might be said that with 160-lb. pressure, 100 deg. Fah., and 27-in. vacuum, a 3,000-kilowatt turbo-alternator set would take only 16 lb. of steam per kilowatt hour. In the 40,000 horse-power turbine, recently constructed for a Chicago power house, the steam consumption was guaranteed not to exceed 11.25 lb. per kilowatt hour, with steam at 200-lb. pressure and a superheat of 200 deg. Fah. In the case of the geared turbine employed in marine service the London and South-Western Railway steamers Hantonia and Normannia, which are notable examples of this application, were said to show a saving of 40 per cent. over ordinary turbine steamers on the same service.

LARGE GAS ENGINES

The sphere of usefulness of the large-power gas engine is confined mainly to situations where so-called waste gas can be obtained, as at coke ovens and blast furnaces, or where chemical plant is already installed. Iron-masters are unfortunately even now by no means unanimous in their desires for these generators. There can be no doubt, however, that where waste gas is available the large-power gas engine is desirable. The side issues in works power plant also require consideration, as they frequently present the determining factors in the power plant problem. The utilization of exhaust steam in turbines, of blast furnace and coke ovens gas in large-power gas engines, and the development of the storage battery in connection with the fluctuating loads in large works are all problems of remarkable interest.

SMALL GEARED TURBINES

To drive small electric lighting outfits, exciter units for large alternators, or for direct mechanical drive, there has been a demand for a line of steam turbines which would be constructed along the same lines which give durability, ease of adjustment, and high economy to the larger turbine units. To meet this demand, which now comes principally from our new merchant marine for lighting sets, the Westinghouse Electric & Manufacturing Company has developed a line which is being manufactured in sizes from 15 to 50 Kw. for direct-current service; from 30 to 50 Kw. for alternating current service, and from 30 to 100 h.p. for mechanical drive.

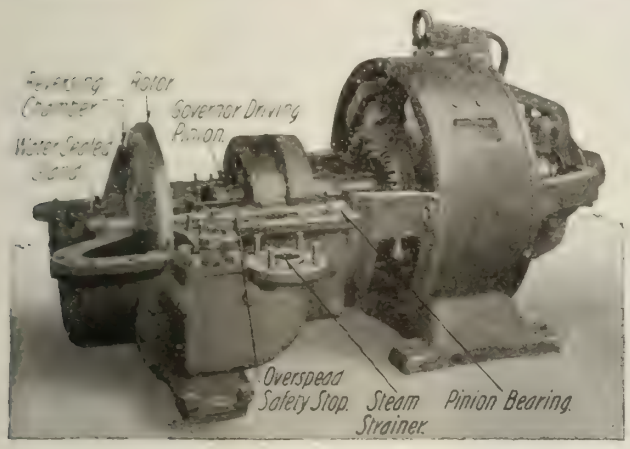
This machine is a geared unit, very compact, and of rugged construction, as shown in the view of the direct-current unit, Fig. 1. The turbine operates at a speed of 7,200 r.p.m. and it is suitable for both condensing and non-condensing operation. It is built for normal operation on any steam pressure from 75 pounds to 250 pounds and for non-condensing operation on any back pressure up to 20 pounds. It embodies the three-point suspension principle, being supported by two lugs on the generator and one under the centre of the turbine, thus maintaining perfect alignment of the turbine, gear and generator.

The generator is of the well-known Westinghouse "SK" type, compound wound, with commutating poles. This design insures sparkless commutation even at heavy overloads, without shifting the brushes—an important advantage since no attention is required to adjust for changing loads. Coils are impregnated by the vacuum process, making them proof against even extreme dampness. The outboard generator bearing is supported by a single-piece bracket bolted to the frame. In this a steel shell lined with babbitt forms the bearing itself; it is pressed and pinned into place and in case of trouble can readily be renewed by driving out with heavy hammer. Oiling is by a ring running over the shaft and dipping into an oil well. The shaft may be pressed out of the armature without disturbing the connection between coils and commutator. Liberal spaces for ventilation are provided.

The internal construction of the turbine is practically identical with that of the larger machines. It consists of a single rotating wheel with blades or buckets around its periphery; the steam from the directing vanes or nozzles impinging against these blades causes the wheel to rotate and the work to be performed. The full energy of the steam is extracted by using only one wheel with the aid of what is commonly known as the re-entry principle; that is, the steam after passing through the blades the first time is changed in direction by means of a reversing chamber and is directed against the blades a second time. The nozzle and reversing chamber are made of phosphor bronze designed specially to resist the erosive action of steam at high velocities. In the 15 and 25 kilowatt units, the nozzle block contains but one nozzle, while in units from twenty-five to fifty kilowatts capacity the block contains two nozzles, one of which is controlled by a hand-operated valve; at partial loads this valve may be closed and thus the water rates are greatly de-

creased, and a much higher efficiency is obtained.

Bearings on the turbine end of this machine are of cast iron, lined with babbitt. Those on the rotor and pinion shaft are of the adjustable type; thus making it possible to keep a perfect alignment between pinion and gear, at all times. The outboard generator bearing is a steel shell, lined with babbitt, pressed into the housing and pinned in place. It is ring-oiled. The pinion is milled out



TOP CASING REMOVED SHOWING GEARS AND TURBINE CONSTRUCTION.

of the solid rotor shaft, thus entirely eliminating the coupling previously used to connect the pinion and rotor shafts.

These machines are fitted with standard water sealed glands of brass, shrunk on the shaft. These glands seal the turbine casing around the shaft, and prevent steam from escaping when operating non-condensing, or they prevent air from entering when operating condensing. By using water glands in place of metallic or other similar glands, the friction loss is greatly reduced, and wear is entirely eliminated, thus doing away with the replacing of parts at regular intervals, as is necessary with metallic glands.

It is a recognized fact that no governor is more reliable than the slow speed governors used on Corliss engines. The governor on this unit is of the low speed vertical fly-ball type, identical in construction with the governors on the larger units. This slow speed is obtained by driving the governor with a pinion on the slow speed gear shaft. The fly-balls are pivoted on knife edges, and they are very sensitive to even slight speed variations in the turbine.

At the base of the governor, and driven by the governor spindle, is a gear oil pump which furnishes the oil for both turbine and gear. The bottom of the gear housing is used as an oil reservoinr, the pump lifting the oil from this reservoir to the top of the gear case from where it flows by gravity through the oil strainer and to the bearings and other parts needing lubrication. The oil is kept cool by a copper cooling coil in the bottom of the oil reservoir through which cold water is kept continuously circulating.

One of the special features on this unit is the automatic throttle valve, operated directly from the governor by means of a connecting rod. This valve is of the balanced type and very sensitive in operation, thus insuring a close speed regulation.

One of the latest refinements provided on very few small turbines is the overspeed governor release. This is a simple device contained in a small hole drilled in the shaft between pinion and rotor, and it consists of a cylindrical weight held in place by a coil spring surrounding it. In case the turbine should speed up to ten per cent. above normal speed, the weight due to centrifugal force overcomes the spring tension and protudes a short distance from its normal position. By so doing, it comes in contact with a lug, which, in turn, is fastened to a lever, the movement of which trips the throttle valve catch and allows the valve to be closed by a heavy coil spring.

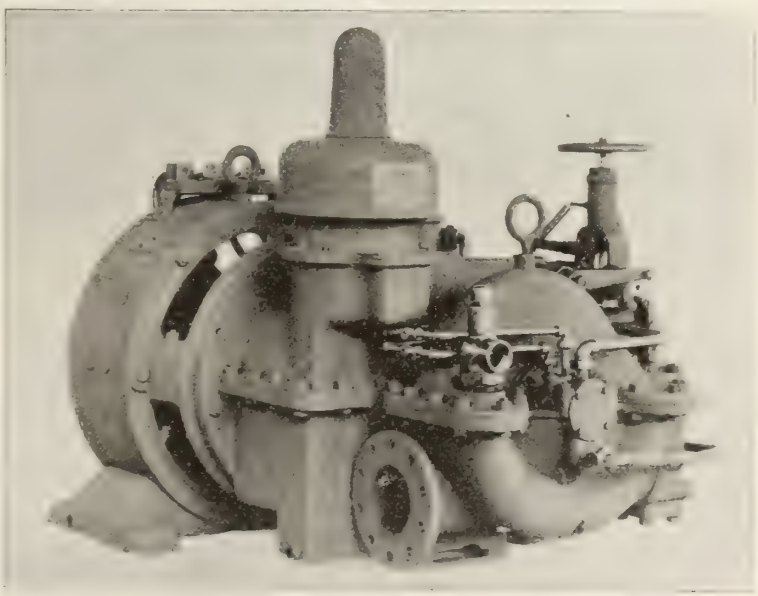
This line of turbo-generators conforms to the Navy Department's specifications for ship service, being provided in this case with both steam and water-sealed glands and non-corrosive brass piping.

THE ECONOMICAL RECONSTRUCTION OF BELGIUM

In view of the critical situation which will result for Belgium through the disasters caused by the depredations of the enemy—his removing of tools, raw materials, manufactured products, &c. — there has been created, with the co-operation of, and under the control of the Belgian Government, an organization having for its object the economical reconstruction of the country, and styled "Comptoir National Pour la Reprise de L'Activite Economique en Belgique" (Societe Co-operative). This organization has for its aim, by helping industry and trade, and by enabling the Belgian people to purchase tools and the necessary raw materials, not only to reconstruct the economical fabric of the country, but to put an end to the sufferings of the working classes by making it possible for them to start working in the reconstructed shops. In a letter which the newly formed body has issued it is explained that everything interests it, as everything has to be set up again: metallurgy, materials for construction of buildings, leathers, textiles, farming implements, chemical products, wood machines, electrical material, optical instruments, motor cars, vans, wagons, oils and greases of all kinds, refractory materials, &c. In order to enable it to place orders, manufacturers and merchants are requested to send their catalogues and price lists in triplicate to it at 110, Cannon-street, London, E. C. 4., England.

UNIFORM BOILER LAWS IN U.S.

THE American Uniform Boiler-Law Society, organized for the legal adoption, chiefly by state legislatures, of the A. S. M. E. boiler code, is to make a special effort this year to secure legislation in the States of Georgia, Kentucky, Louisiana, Maryland, Massachusetts, Mississippi, Rhode Island, South Carolina and Virginia, where the legislatures convene this year. Up to date the code has been adopted by most of the important industrial states, including New York, Pennsylvania, New Jersey, Ohio, Indiana, Michigan, Wisconsin, Minnesota and California. It has also been adopted by the cities of Chicago, St. Louis and Kansas City, independently of the State legislation.



TURBINE LIGHTING SET.

McClary's Power House Installations At London Ont.

WELFARE
WEALTH

From Every
Man
According
to His
Ability

* *

To Every
Man
According
to His
Needs

WORK
HEALTH

Factories' Power Plant

THE McClary Mfg. Co. has two main factories: the foundry, where much of the stove work is done, and the wares factory, where many of their other products are made. Each of these factories has its own power house supplying the power necessary over and above that available from the Hydro-Electric System.

The power house supplying the wares' factory is located in one of the factory buildings near the G.T.R. station and forms a compact and well arranged lay-out as will be seen from the plan.

Boiler Room

This plant is equipped with four boilers of 125 h.p. each, manufactured by E. Leonard and Sons. These boilers are 72 in. by 16 ft., and are enclosed in the usual brick setting with the breeching running directly into a Custodis radial brick chimney 5½ ft. by 125 ft. high.

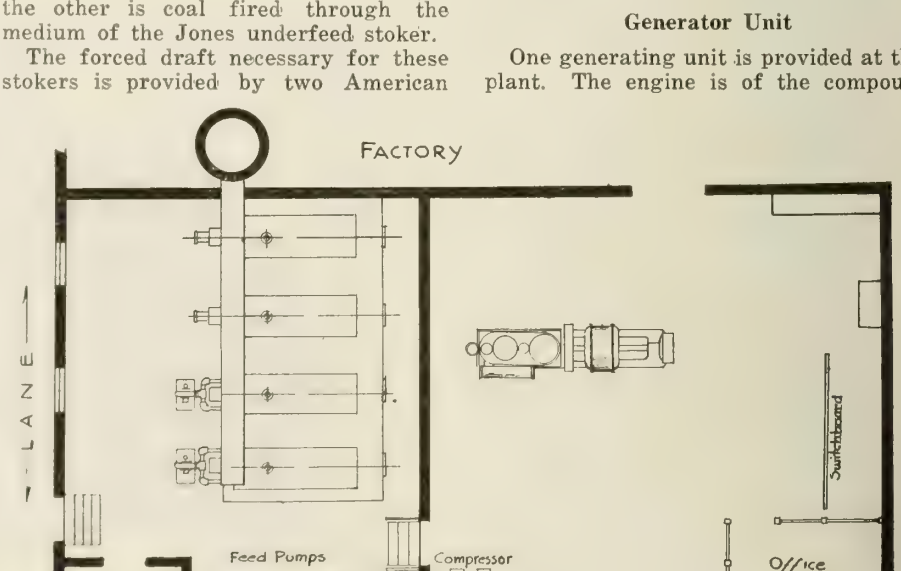
Natural gas is fired under two of the boilers, each boiler being provided with a Premix gas burner which, as will be seen from the accompanying view of the boiler room, consists of a fan driven by a countershaft. The gas is taken in through a 1¼ in. inlet located in the center of the air inlet which is provided with a circular shutter for air regulation. The mixed gases flow through two burners per boiler and impinge on a fire-brick baffle wall placed in front of the bridge wall of the boiler. The Jones underfeed stokers with which all boilers are equipped are left in position and it is a comparatively simple matter to start a coal fire under the two gas-fired boilers whenever desired. Of the other two boilers one is held in reserve while the other is coal fired through the medium of the Jones underfeed stoker.

The forced draft necessary for these stokers is provided by two American blower engines with 5 x 5 cylinders direct connected to fans of the same make.

The feedwater is taken directly from the city mains and is heated in a 500 h.p. Webster feed-water heater by exhaust steam. Two duplex feed pumps are provided, one made by Darling Bros. and the other of Canada Foundry make.

Generator Unit

One generating unit is provided at this plant. The engine is of the compound



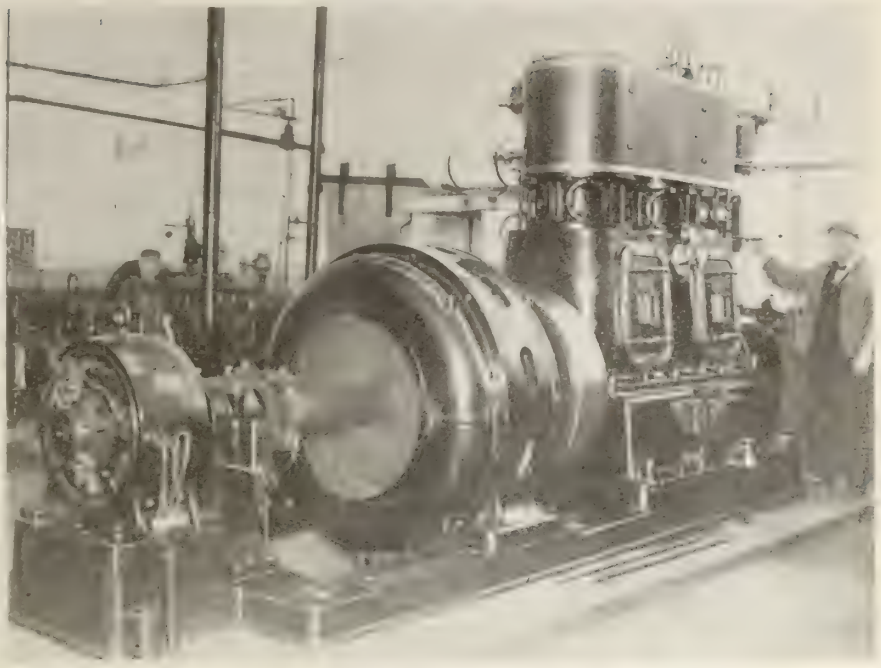
PLAN OF THE WARES FACTORY POWER HOUSE, McCLARY MFG. CO.

vertical quick revolution forced lubrication type made by E. Leonard and Sons. This engine runs non-condensing and has two cylinders 13 and 18 in. diameter by 8 in. stroke. The steam pressure is 115 lbs. and the engine is provided with both throttling and automatic cut-off governing. This combination results in a very economical consumption of steam under all the load factors encountered.

Factory operations requiring the use of exhaust steam and the use of exhaust steam heating in winter render it feasible to run this plant non-condensing.

A 125 kv.-a 550-volt 25 cycle generator of Canadian Westinghouse manufacture is direct connected to this engine. The stator of the generator is not split, and for access to rotor and stator coils an extra length bed-plate is provided, along which the stator is moved when required. A 5 kw. exciter is provided on the end of the shaft.

An additional engine is located in the stamping shop near by and is belted to the line shaft supplying the presses and other tools. This engine is of E. Leonard & Sons manufacture, horizontal, self-lubricating type with a 12 in. diameter by 12 in. stroke cylinder.



LEONARD COMPOUND ENGINE AND WESTINGHOUSE A.C. GENERATOR AT THE WARES FACTORY.

Switchboard

The switchboard controlling all plant requirements is located in the main engine room. All shop lighting circuits are controlled by a condit type D 300 amp. triple pole single-throw switch with an integrating wattmeter for metering the load. This equipment is mounted on the first panel to the left as shown in the accompanying photograph.

The generator control panel is located immediately next to the panel above described and is provided with Canadian Westinghouse ammeters, exciter, rheostat, main and field switch.

The third panel provides a means of feeding all shop circuits from either the Hydro-Electric system mains or from the generator. A rotary double-throw switch is provided for this purpose. A Westinghouse graphic wattmeter registers the power supplied by the Hydro system through a small sub-station located on the company's property, while the total plant load is measured by the integrating wattmeter seen at the top of the panel.

The next three panels are for the various departmental switches and feed the various motors used throughout the plant. In all 35 motors are installed, ranging from 100 h.p. to ⅛ h.p.

Oil Pumps for Enamelling Ovens

An interesting feature in connection with this plant is the pumping equipment installed for the supplying of oil to the enamelling ovens. Oil is received from the tank cars and placed in a receiving tank close to the tracks; from this tank it is pumped to a tank located in the factory yard, and from this it is pumped by the small Hall pump seen in the engraving and shown with the small reservoir underneath, to the oil burners in the enamelling ovens.

Compressed air for these burners is supplied by the air compressor shown, also manufactured by the Hall Pump Works, Pittsburg. This compressor has 12 x 12 steam cylinders and 12 in. air cylinders, and supplies air at 30 lbs. pressure for the atomization of the oil. This equipment is all about 30 years old and is still giving remarkably good service. The compressor takes steam for the full stroke, but as this exhaust is used for heating the feedwater, steam consumption is of secondary importance.

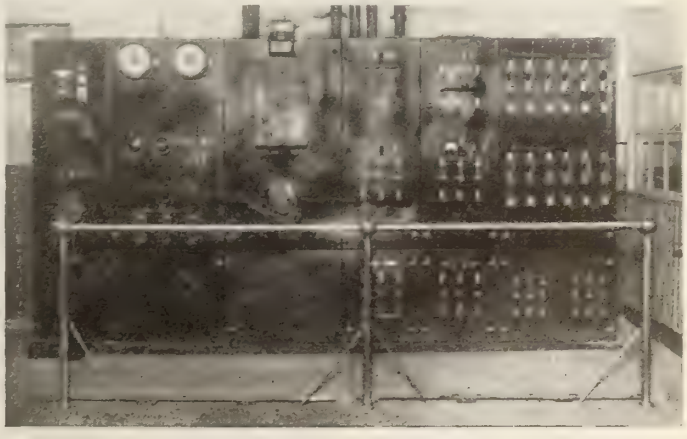
Fire Protection

Fire protection is a very important feature in a plant of this size and a very complete organization has been perfected. An automatic sprinkler system has been installed, and as it is impossible to keep the sprinkler pipes in the colder parts of the plant from freezing in the winter if filled with water, a Grinnel balanced valve system is used. This system is operated by an 8-in. Westinghouse air pump of railroad type, which serves to keep the sprinkler pipes full of compressed air at all times.

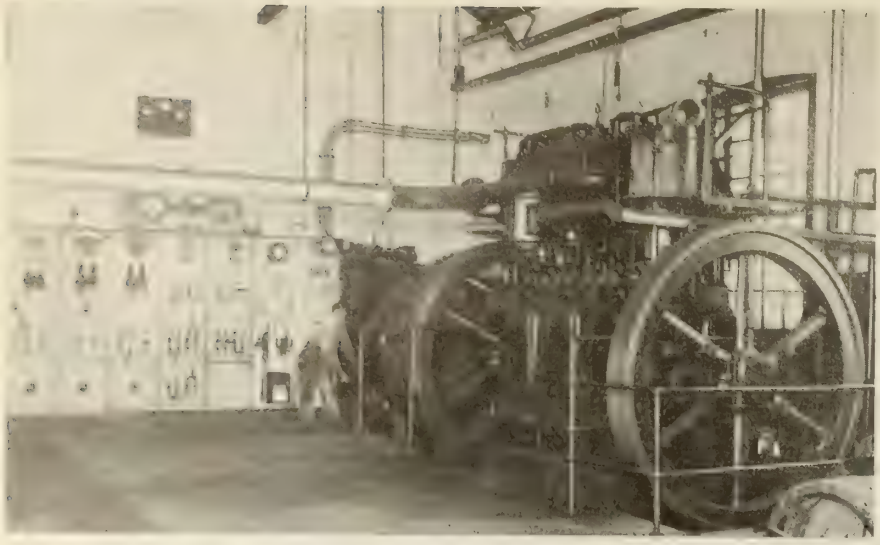
When a sprinkler head gives way the air pressure immediately falls and relieves the pressure on one side of the balanced valves admitting the water under pressure from the other side of the valve and flooding the fire.

In addition to the sprinkler system a Canada Foundry fire pump is installed in a heavy reinforced concrete fireproof

BOILER ROOM AT THE WARES FACTORY POWER HOUSE. NOTE THE GAS-BURNING EQUIPMENT.



SWITCHBOARD FOR CONTROLLING GENERATOR EQUIPMENT AND SHOP CIRCUITS.



WEBER GAS ENGINE UNIT AT THE FOUNDRY POWER HOUSE.

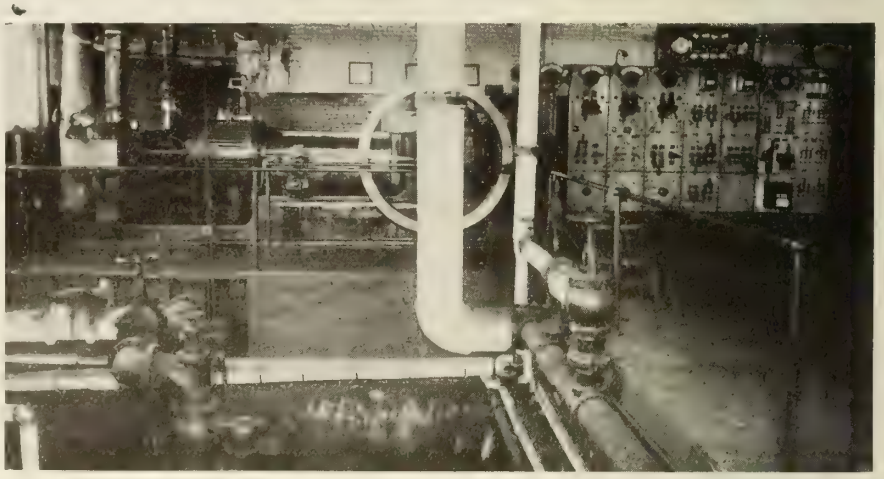
house a short distance from the power house. This pump is fed by an underground steam main and draws water from a 150,000 gallon underground reservoir.

When running at full capacity the pump delivers 1,000 g.p.m. and feeds four 1¼-in. fire streams.

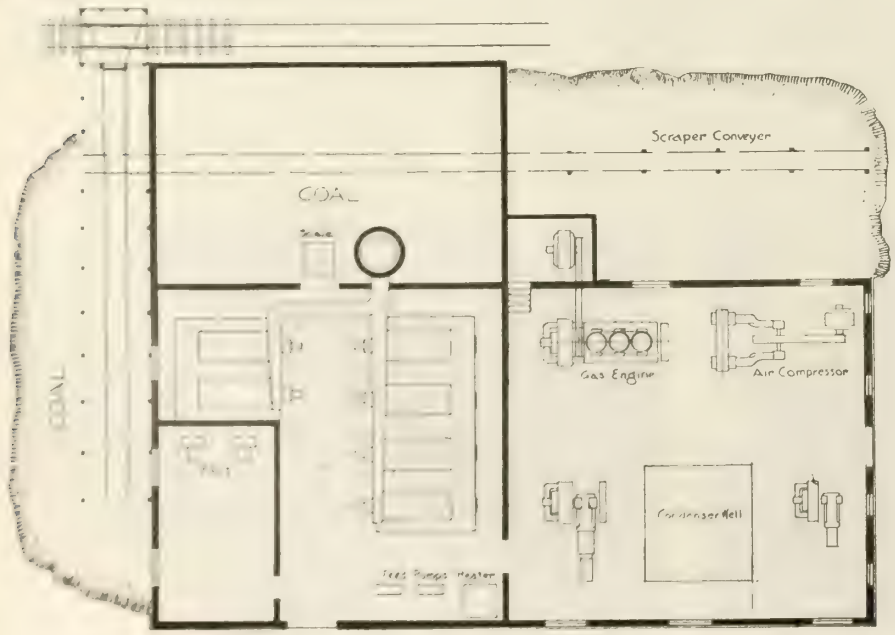
A standing fire brigade of eight men has been organized to fight any fires that may develop, each man having his own particular part of the work to look after. Mr. G. E. Moll, the chief engineer of the factory's power plant, is also chief of the fire brigade, and in addition to the fire brigade has the supervision and training of 150 men distributed throughout the various shops, forming a valuable first-aid to the fire department proper.

Foundry Power Plant

THE foundry power plant is located on the Thames River, closely adjacent to the Adelaide street bridge, and, space being somewhat more plentiful than at the wares factory, is housed in a separate building. This plant supplies what is known as the McClary foundry with 250-volt d.c. power.



LEONARD TANDEM COMPOUND ENGINE AT THE FOUNDRIES PLANT.



PLAN OF THE FOUNDRIES POWER HOUSE, McCLARY MFG. CO.

The London Public Utilities Commission also supplies about 500 h.p. of alternating current power at 550 volts.

Coal Storage

In view of the scarcity of coal during the past winter and the impossibility of securing shipments when needed provision has been made for plentiful storage space and adequate handling equipment. This equipment recently completed elevates the coal from a hopper under the railroad tracks close by and conveys it to either of two outside storage piles shown in the plan or to the main storage space provided behind the boiler room. A scraper conveyer serves to convey the coal from the main conveyer to the storage pile at right angles to its travel.

From the stock piles the coal is wheeled by hand, weighed and fed to the Jones underfeed stokers with which all boilers are equipped. These boilers are six in number, four of them of 125 h.p. and two of 90 h.p., made by E. Leonard & Sons.

It is a well recognized fact that a proper amount of combustion space over the grate bars plays a very important part in the securing of high boiler efficiency and smokeless combustion and a boiler set too low as is the practice in many cases does not allow complete combustion before the relatively cool boiler surface is reached by the hot gases. This trouble has been recogized at this plant and the stoker arrangement has been altered so as to provide a clear space of 5½ feet between the boiler and the stoker hearth, giving excellent results in operation.

Feed Water

Forced draft is supplied for the stokers by Buffalo Forge Co. equipment, consisting of two Spiro gear turbines direct connected to two conoidal fans.

The exhaust from these turbines and from all other station auxiliaries is used for heating the feed water, a Cochrane feed water heater being installed, together with a Lea vee notch recorder. The feed water and coal consumption being known, a close watch is possible on the general plant efficiency.

The feed water supply was formerly drawn from the Thames River near by, but so much trouble was experienced

with mud and sediment that this source was abandoned and the city mains called into service. The feed water is softened in a water treating system recently installed.

The feed water pumps are two in number and are located near the heater. One of them is of Canada Foundry make, 7½ x 5 x 10, and the other is a 7½ x 4½ x 10 pump made by the Smart Turner Company.

Engine Room and Equipment

The engine room is of ample size and houses the generator sets and a Canadian Rand air compressor, used for supplying the foundry pneumatic tools and other equipment. This compressor has a capacity of 465 cub. ft. per min. free air, and is of the two stage type with intercooler. The low-pressure cylinder is 16 in. x 12 in., while the high-pressure is 10 in. x 12 in. A Lancashire a.c. motor of 80 h.p. is belted to the compressor, a weighted idler pulley permitting the short drive installed.

The various requirements of the factories are met by both alternating and direct current motors. The London Public Utilities Commission supplies such 550-volt a.c. service as is required, and also the lighting load at 110 volts, while the 250-volt direct current load is largely carried by the steam plant.

Two direct-connected steam-driven units are provided, both of Westinghouse make. One of these is a 125 kw. 250-volt. d.c. machine direct connected to a Leonard tandem compound Peerless engine with 12 and 20 in. cylinders and 14 in. stroke. The other generator is of similar type and make to the one described above but is only of 50 kw. capacity. It is driven by a 11 in. x 10 in. engine of 75 h.p. and is also of the same make as the one driving the 125 kw. unit.

Both engines are run condensing two Northey jet condensers being provided. These, together with the two outside-packed plunger pumps are located in a condenser well between the two engines forming a compact and easily accessible arrangement. In the winter time the exhaust steam is used for heating the various buildings, a Dunham vacuum system being installed throughout.

A third Westinghouse generator forms part of the equipment and at present is driven by a 200 h.p. Westinghouse motor supplied with 550-volt a.c. power from the Public Utilities Commission. This generator is of the same size and type as the 125 kw. machine above described, and originally formed part of a gas engine-driven unit. This engine, at present disconnected and held in reserve is of the three-cylinder, four-cycle type, and is rated at 200 h.p.

Switchboard

A 7-panel marble switchboard is installed, three panels being taken up with the generator control apparatus. I. T. E. circuit breakers are provided on all three panels. Two panels are provided for d.c. power feeders to the various parts of the foundry and factory. One panel is devoted to the incoming hydro line and its control apparatus. On this panel is mounted a type K General Electric oil switch fitted with a plain overload release, a Westinghouse graphic wattmeter and voltage tap switches for controlling the voltage on the lighting transformers located in the boiler room behind the boilers. The last panel is devoted to the lighting switches for the various shops.

We are indebted to Mr. J. M. Gunn, foundry manager, and to Mr. J. H. Smith, chief engineer and vice-president of London No. 30 C.A.S.E., for the above information concerning the efficiently operated isolated plant.

BOILER ROOM AT THE FOUNDRIES POWER HOUSE. JONES' UNDERFEED STOKERS IN THE FOREGROUND.

Welfare Work

INDUSTRIAL relations between employer and employee are ceasing to be a mere question of dollars and cents. The present time of questioning and search into things long taken for granted will probably bring about vast changes in the attitude at present existing, though with many exceptions, between capital and labor. Human labor is ceasing to be a mere commodity and a growing sense of the employers' responsibility in the welfare of the worker is apparent.

The question of the employee's welfare and comfort is being recognized as one in which the employer has a large

COAL UNLOADING EQUIPMENT.

interest and duty to perform, and it is not alone necessary that each should have a certain interest in the work; the hearty co-operation of employer and employee is essential in any undertaking promoting the welfare of the employee and establishing amicable relations between them.

The McClary Manufacturing Co., of London, have had for some time past a welfare organization well worthy of attention and careful scrutiny. The welfare work is divided into two distinct and separate bodies, known as the Benefit Society and the Welfare Department. The Benefit Society is operated exclusively by the employees, while the Welfare Department is the company's connecting link between itself and its employees, and exists for the purpose of facilitating a better mutual understanding, and serves, as its name signifies, to promote the employees' welfare.

Welfare Department

While the McClary factory is divided into two separate and distinct units, the foundry and the wares factories, the welfare organization embraces both in its efforts to maintain and add to the sincere spirit of friendliness that is characteristic of the company's management.

Lt.-Col. Gartshore, the company's vice-president, has for many years been keenly interested in welfare work, and the success of the welfare organization is in a large measure due to his interest and guidance. The members of the general committee are appointed by Lt.-Col. Gartshore, and from them are chosen the various branches of the department's work. As working head of the department and in touch with the activities of all committees is the welfare supervisor, Miss Frances Rankin.

The department has its foundation in the firm's welfare investment, that is the original investment of space, equipment and time put into the work by the company. This covers the three dining rooms and their furniture, the cafes and their equipment, the two emergency hospitals and their supplies, the professional services of a trained nurse as supervisor, and all clerical work necessitated by the various activities. An annual deficit on account of wages in the cafes is also absorbed by the company.

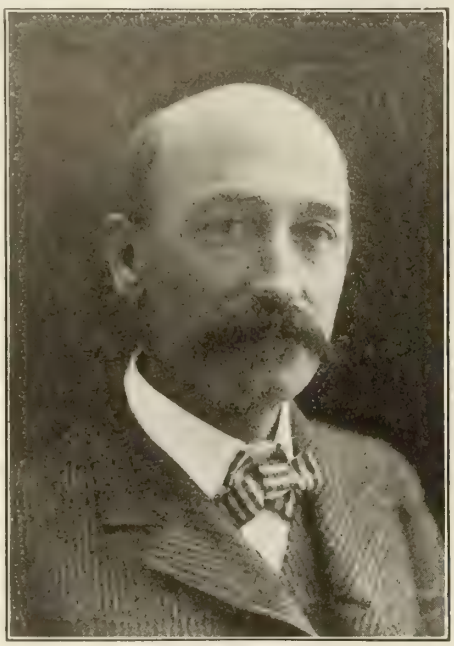
Departments and Organization

The Welfare Association is a body composed of individuals appointed to it by the president, whose duty it is to make suggestions and further by every other means they find possible the spirit and deed of welfare throughout the institution.

From among the members of this association are chosen the committees—the dining room committee and its subcommittees on amusements; purchasing committee, advertising committee, and the garden committee.

The scope of the dining room committees, convened by Mr. John Walton, at the foundry, and Mr. F. Westbury, at the factories, is well outlined by their names, suggestions and improvements relative to the noon-hour service and recreations. A piano and games are provided in each dining room, and effect a very beneficial relaxation between the strain of morning and afternoon work hours. Allied to these are the amusement committees, through whose endeavors are provided talent for a first-class concert once a week. The chairman of these two latter committees are Mr. Tapp, foundry, and Mr. G. E. Moll, factories.

The weekly concerts are a means of developing the musical talent of the employees, and also serve to bring before them the best musical talent of the community and of outside points. In addition to the weekly concert a very enjoyable noon hour is provided one day a week at each plant, at which an address and music are given. Social events and entertainments other than the noon-hour



COL. W. M. GARTSHORE,
Vice-President of the McClary Mfg. Co.

meetings have been greatly curtailed for the duration of the war.

Dining Rooms

Perhaps the most tangible benefit to the employees results from the dining room service. The three dining rooms are of ample dimensions, the largest seating 400 people, and food is is sold at prices very much lower than is possible elsewhere. For those who wish it, a hot meal is served for 25 cents. Tea and coffee are served for 1 cent a cup, bread and butter the same, sandwiches 3 cents, pie 4 cents, and soup for 3 cents, prices which, needless to say, are very reasonable.

The purchasing committee is part of the welfare organization, and buys large quantities of certain provisions, mainly market stuffs, and re-sells to employees only at a slight advantage to the latter. This is, of course, done under arrangement with the city and mainly as a convenience to the employees.

A very welcome source of revenue has been found in the sale of advertising space on the lunch room walls and on menu programmes, etc. Neat frames are attached to the blank spaces of the walls where convenient, in which the advertising matter is placed, and this arrangement proves a good investment to the users of such space.

Gardening

With the call for increased production of foodstuffs last year a gardening committee was formed and proved itself a splendid success. Under its management a considerable tract of otherwise idle land was secured, plowed up by the company's teams, and given out by lot to the applicants for garden plots. Seeds, implements and insectides were bought in bulk and sold to the gardeners at cost. Speakers were secured, who gave lectures on various phases of gardening, which would prove most helpful to those who were amateurs at the work. A competition was also held, several inspections of the gardens entered being made during the season, and prizes and credits awarded at the close.

This committee, in view of the present shortage in foodstuffs, is particularly commendable, and the work planned for the coming season is expected to be of still greater benefit to the employees participating.

Another very much appreciated feature is the savings department operated through the timekeeper's, the paymaster's and the cashier's departments. It constitutes what is perhaps the most painless method of saving known. The employee merely expresses to the timekeeper the weekly amount he wishes to deposit out of his wages, and this sum is deducted from his pay, placed to his credit on the company's books at 5 per cent. interest, and repaid to him, unless he chooses, as many do, to leave it on deposit, early in the last month in the year. Sums as small as 25 cents weekly are accepted. Last year the employees saved over forty thousand dollars.

This year, in addition to the above arrangement, the employee may, if he so wishes, place the amount saved toward the purchase of Victory bonds and war saving certificates.

Each plant has quite a comprehensive lending library run in connection with and forming a part of the dining rooms.

Hospital and Health Conservation

Each has an emergency hospital, the complete appointments and stock of remedies of which make it possible to treat accident patients and those suffering from illness during working hours to the best advantage. The scope of this work may be realized when it is known that Miss Rankin gave 1,322 consultations and made 713 dressings, besides making 1,206 outside visits during the last year. In addition to this hospital service, the welfare department always has on hand such supplies as extra linen, hot water bottles, crutches, invalid chairs, etc., which are loaned to those in need of them.

The Benefit Society

The McClary Mfg. Co.'s Employees Benefit Society was founded in 1882, and is a distinct organization from the wel-

fare department described above. This society is composed entirely of employees, and its affairs of government and administration are directed entirely by officers and committees elected annually by the vote of the members. Its purpose is that of aiding members in distress, especially that occasioned by illness. Two physicians are employed, who give medical attendance and advice free of any individual charge to any member of the organization. In addition to the medical attention, the patient receives a weekly sick benefit.

In cases of death, if it be that of a member, the family receives a claim of $50, and if it be that of a member's wife, the husband receives a claim of $25. Last year there were paid out in sick benefits $3,189.50; in death claims, $375, and in physicians' fees, $1,291.86.

No better evidence of this society's usefulness and popularity can be given than that 95 per cent. of the employees, including the office staffs, are members of the organization.

The society also spends a considerable amount each year in such directions as the annual picnic, Christmas trees, Christmas hampers, and will, on resolution of its committee, make loans, or, where necessary, grant outright funds to members in temporary need of financial assistance.

THE STANDING SHOP FIRE BRIGADE OF THE McCLARY MFG. CO. MR. GEORGE MOLL, CAPTAIN AT THE RIGHT.

We are indebted to Miss Margaret Wade, editor of McClary's Wireless, and to Mr. G. E. Moll, chief engineer of the factories' power plant, for much of the information contained in the foregoing articles.

MECHANICAL ECONOMIZERS

By K. M. E.

THE greatest advances of the past decades have been made in the basic field of the raw materials of mechanism. Modern metallurgy, for example, has made enormous strides, and grows less and less dependent upon initial material of high relative purity. This has set free large quantities of low grade material hitherto not utilizable for highest quality of products, and recently it has been found expedient to allow higher percentage of deterious ingredients to increase production. The increase in permissible contents of phosphorous and sulphur in steel has not been attended with any visible ill-effects, provided always that circumstances condition use. Thus the field of supply has been extended in a double sense with benefit all round.

Hand-in-hand more modern organization serves to give increased individual production, while productive means themselves have been also improved. The economies of waste by its limitation have also been duly studied, and especially process economy in material has been duly enhanced in importance. Practically at every point of the compass the saving virtue of thrift imposed by real necessity has served to give benefits, whose ultimate outcome is difficult to foresee. Elimination of waste, the utilization of inferior raw material without detriment to the finished product, greater ingenuity in mechanism itself, better organization, increased specialization, economy of material itself, substitution of one material for another, all these make productive engineering a field of surpassing interest which will increase rather than diminish in the future.

Problem after problem has been attacked and made to yield some economic result. The entire art of metal working from first to last is altering visibly year by year; at no point is it stable or lacks definite improvement, and no detail is so small as to escape analysis in competent hands. It is quite possible that in the near future iron castings will give way to steel in a universal sense, while the electrical furnace will shift the centre of gravity of the steel trade to new quarters.

To attempt the enunciation of the economic value of all the advances made would be extremely difficult, but as a total they must be immense. Their full exploitation may indeed so enable productive costs to be cut that increased average wages will not hamper the profits of industry and solve the most difficult of all the outstanding problems—that of labor.

THE VEGETABLE SHOW HELD IN ONE OF THE EMPLOYEES DINING ROOMS.

IN the course of an address to the American Institute of Electrical Engineers recently, the president, Mr. E. W. Rice, jun., said that something like 150,000,000 tons of coal were consumed by the American railroads in the year 1917. From the results obtained from electrical operation of railroads it would be possible to save at least two-thirds of this coal if electric locomotives were substituted for the present steam locomotives.

ANNUAL EMPLOYEES FLOWER SHOW.

The Cultivation of Efficiency

Manufacturers of Power Plant Supplies Co-operate With Employees — Work is Made a Pleasure and Pleasure is Made Profitable—Factory Construction and Individual Comfort Are Features of Conditions

By J. H. MacMillan

LOOK backwards a matter of a very few years and consider the working environment of the factory employee. In ninety-nine cases out of a hundred the employer had no interest in "Jim Smith" or "Mary Jones" other than procuring from them a day's work for a day's wages paid. Sanitation was practically confined to hospitals, and the very word was suggestive of the doctor.

Slowly, but just as surely, the manufacturers have been brought to the realization that, in order to obtain one hundred cents on the dollar paid to the employee that consideration had to be given to the mental and physical condition of the human unit of their organization.

Factory construction was the first item that showed the trend of affairs. Daylight buildings of concrete and steel and a maximum of window space appeared. "Texas" and "Saw-Tooth" roofs put in an appearance. Where a board-walk alley had previously been considered sufficient for a passageway between buildings, roadways of full width, cement paved, sprung into view. Hot and cold air systems for mechanically and automatically washing and freshening the atmosphere were added. Sanitary drinking fountains displaced the old germ-laden community drinking cup and dust-laden water barrels. Individual towels, laundered by the company relegated the "wipe" or roller towel to the background, and light, airy toilet rooms took the place of the disreputable foul-odored corners that housed the sanitation facilities (?) of the manufactory of not so long ago. Doctors are employed and paid for by the company to regularly examine those whose duties entail the slightest opportunity for contracting a disorder.

All this, and much more, has taken place to guard the physical welfare of our muscle power.

Then the factory owner even went a step further. Based on the fact that a sick brain is only a small percentage efficient, means of recreation came into being; means to lift the mental power of the human unit away from the daily task in order that the operating functions of that power should be become stagnant by being overfed with the monotony of the day's labor. Club rooms were furnished for the men and women, and from them have grown the spacious rest and recreation buildings that to-day provide the human element of an organization with mental stimulus to render 100 per cent. efficiency at the daily task. All of this is based on the old proverb of "all work and no play," etc.

When you stop to consider that the average employee spends a good deal more time at work than he does at play and at home combined—if you deduct the sleeping hours—it is not any more than fair that his place of employment should be as pleasant as possible.

For many years the various factories and branches of the H. Mueller Mfg. Co., Ltd., manufacturers of water plumbing and gas brass goods, etc., have been carrying out these ideas. To say they are costly is incorrect. The results that accrue more than equalize and justify the cost and upkeep of the institution.

The illustrations presented herewith show, conclusively, the lengths to which the Mueller Company has gone in their Sarnia plant. The plants at Port Huron, Michigan and Decatur, Illinois are equipped likewise. The consensus of the Mueller employees' opinions is the proof conclusive as to the success of welfare work. This work has a moral effect that is alone worth the value of the investment.

The Mueller Company employees have several internal associations, officered and operated by the employees themselves. Foremens' clubs, departmental clubs, etc., an employees' aid society, supported by nominal fees, disburses sick, accident and death benefits. The company itself is back of and supports both morally and monetarily any meritorious, welfare movement that is advanced. Hot tea and coffee is served gratis to each employee at meal times in the recreation building and music is provided and dancing permitted following the meal. Prizes are continually offered for effort along various lines, and co-operation rules in every angle of the big organization.

The writer of this article remembers, some twenty-five years ago, working in a broom factory for one dollar per week. That factory was one of the largest in the business at the time. Every available foot of space was crammed with material and stock at all times. Daylight was at a premium, and fresh air almost unknown. We had a clean-up day every second week for which we didn't get paid—Sunday morning. Anybody caught sweeping the floor around his bench at any other time was fired—with a capital "F." Sometimes the refuse from the broom corn (partially decayed field mice, too, included) was knee high at my bench—I was a "hurl cutter." More than once my stomach revolted and that too, would have to lay. We were positively not allowed to leave our benches except when the whistle blew. Slave-driving methods constituted efficiency of those days. When we contrast conditions such as they were with the modern factory of to-day, we can be excused from wondering how the worker stood his job under the conditions of not so long ago.

There are numerous industries of to-day that have not as yet "seen the light," but they are few and far between. The average factory employee of to-day is the best-cared-for individual in the commercial world—and why not? The human unit is fundamentally necessary to the operation of any industry. We must oil and repair our steeds of steel and fabric; why should be neglect to apply the mental and moral lubricant to our muscle power?

OFF PEAK USE OF ELECTRIC ENERGY FOR HEATING

The use of electricity for heating our homes has been the subject of much controversy during the past few years. The difference of opinion was principally due to the general way in which the subject was treated and the lack of definite detail in the various over-optimistic arguments advanced. The recent coal situation has brought about a more serious study of facts, and the figures now available show that, even if all of our numerous water-powers of Canada were converted into hydro-electric energy, the quantity would still fall short of that required to heat our homes during the winter.

To say that hydro-electric energy cannot replace coal entirely for heating purposes does not mean that it cannot be utilized or that it must be confined to raising the temperature of a cold room a few degrees in the late spring and early autumn. It may, indeed, stimulate the use of more easily available fuels, such as wood and peat. The principal objection to the use of many fuels for domestic heating is that a fire cannot be banked up to last over night, say from 11 p.m. to 7 a.m. Now, this is just the period when a large portion of the hydro-electric equipment installed in the country is lying idle, and the surplus energy then available might well be used to supply heat in at least a few of our homes. This would not only mean a direct conservation of coal, but would render feasible the use of other fuels not requiring to be transported such long distances.

As an example, the hydro-electric energy used in the Montreal district is some 150,000 h.p. with a load factor of about 75 per cent. This "load factor" means that 25 per cent. of the total possible output during the 24 hours is unused, though it could be utilized at certain hours. In other words, during the six colder months, approximately 121,000,000 k. w. h. could be used for heating purposes, without the addition of a single horse-power in the present installations. This is equivalent to some 20,000 tons of coal.

One of the difficulties would be to prevent the energy being used for heating purposes except during the hours when very little energy is required for power and light. This could probably be accomplished by installing at the various heating services a disconnecting relay operated from the central station.

DEVELOPMENT OF AIRPLANE GUN AMMUNITION

CONDITIONS under which airplane fighting has been developed show that a continuous process of evolution has taken place conjointly between protective and destructive equipment. As the war progressed, the more vital parts of the airplane were protected with light armour, so that it became necessary to introduce armour-piercing bullets similarly.

As the gasoline tanks were particularly susceptible to incendiary explosion, it was necessary to procure a bullet containing an inflammable substance, ignited upon discharge, which would carry the spark or flame into the tank upon piercing it.

Tracer Bullet Introduced

As the target, the enemy airplane, was within fighting range for only brief moments at a time, and as there were no means of determining the fire effect as on land, a tracer bullet containing a bright-burning composition, which would indicate the path of the bullet in daylight as well as in darkness, and thereby allow the aim of the machine gun to be corrected, was introduced. The composition is set on fire upon discharge and the bullet flies through the air as a bright spark plainly visible to the machine-gun operator.

All of these cartridges are of the small rifle calibers—caliber .30 or thereabout. The 3/10 of an inch diameter and short length of this bullet left little space therein for the armor-piercing element or for the tracer or incendiary composition. Nevertheless, combinations of armor piercing and tracer and armor piercing and incendiary bullets have been made.

Meet Tests Fully

At the outbreak of the war, further information was promptly gathered from the allies and this subject was studied by those responsible for this work in the United States. Of course, on account of the difficulties of the problem, none of the special bullets possessed by any country is entirely satisfactory or what might be termed "perfect" in operation.

The bullets developed by the United States Ordnance Department have been tested on land and from airplanes to see if there is any difference in their performance when fired from a quickly moving airplane in the upper atmosphere and when fired on land.

These tests indicate that the United States has developed a class of special cartridges with a performance fully equal to that attained abroad.

The Ridout St. Station of the London Public Utilities Commission

By W. F. Sutherland†

HORTON ST. ELEVATION OF THE RIDOUT ST. PUMPING STATION.

URBAN life is increasingly dependent upon adequate provision for sanitation, water supply and light and power. To such an extent is this true that it may be truthfully said a city's possibilities and prosperity depend upon the extent to which provision has been made for the health and comfort of its citizens in these respects.

The city of London is fortunate in the advantages derived from its plentiful supply of pure water and cheap light and power. These, together with its central location and excellent railroad facilities have made it an admirable location for the many manufacturing interests there established.

†Associate Editor Power House.

Public Utilities Commission

On the advent of hydro power in 1914 London availed itself of the advantages offered by centralized control of the public utilities and vested in the Public Utilities Commission, then formed, the supervision of the waterworks, the hydro system then being installed and the parks of the city. That this policy has been advantageous is evident from the progress and development of these municipal enterprises under Mr. E. V. Buchanan, the general manager.

Waterworks, Historical

The waterworks system dates back to 1879 when the first pumphouse, reservoir and mains were built. The present Springbank plant has been formed of the original plant since supplemented and increased by additional steam and electrical equipment.

The buildings have been remodelled and in one instance rebuilt after a dam-

THE WATERWORKS PUMPING STATION AT SPRINGBANK PARK. THIS STATION IS A COMBINATION OF WATER, STEAM AND ELECTRIC DRIVE.

RIDOUT STREET ELEVATION.

aging flood on the Thames River and the mains have from time to time been enlarged and extended, keeping pace with the growth of the city until in all there have been laid 132 miles of watermains varying from 20 inches down to 1½ inches diameter.

In 1917, a volume of 1,650,000 gallons of water was pumped, a per capita consumption of 78 gallons per day.

Water Supply

The supply of water is obtained from three sources; the main pumping station at Springbank, the motor operated wells at Foster's Flats and the air lift wells at the pumping station on Ridout Street.

The Springbank plant is located on the Thames River about three miles from the city. The station and the springs from which the water is pumped form the centre around which an exceedingly attractive park has been formed comprising in all about 400 acres of park land with the usual amusement devices, two band stands, pavilion, bath house and baseball diamonds.

The water collected in the springs and wells at Springbank is pumped to the reservoir of 5,000,000 gallons capacity, 230 feet above Dundas Street, and from there flows by gravity into the distributing mains.

The question of an additional water supply for future requirements has been gone into very carefully, and as a result five wells at Foster's Flats were driven. These wells, which are of 12-inch bore, gave large quantities of water on test and the two which have been fitted with deep well turbine pumps remote controlled from Ridout St. station show no appreciable diminution in capacity although producing 500,000 gallons of water per day each.

Ridout Street Station

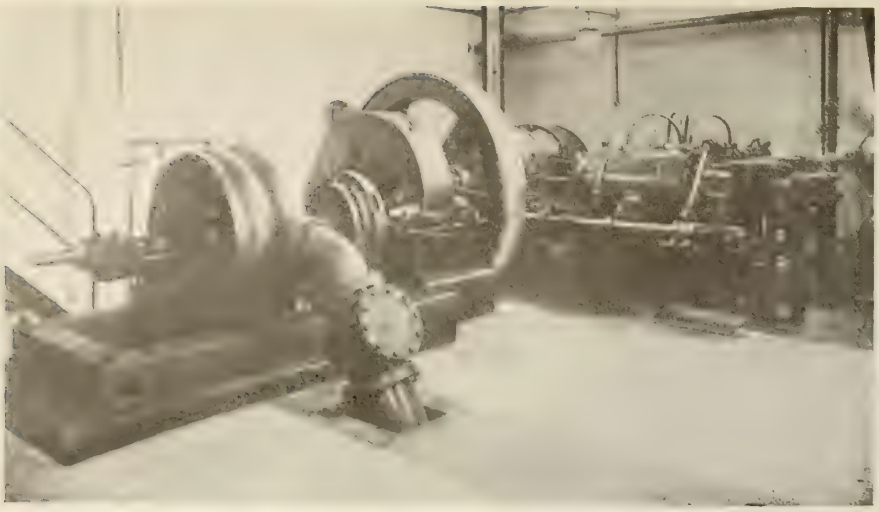
The combined pumping and electrical distribution station located on Ridout and Horton Streets forms an additional source of water supply, supplementing the supply derived from Springbank and Foster's Farm.

As will be seen from the accompanying illustrations the station is L-shaped in plan, the reservoir from which the station pumps derive their supply being located in the centre.

At the rear of the station and at one end of the reservoir a stores building and garage are located. The buildings throughout are of fire-proof construction; brick walls, reinforced concrete and steel combining to make an admirably arranged station of good appearance. The symmetrical and careful arrangement of the architectural features shows little trace of the extensions carried out from time to time consequent upon increased demands for power.

The air lift wells at the Ridout Street station are located on both banks of the Thames River and are eighteen in number. These wells are of 10 in. and 8 in. bore and are all fitted with air lift pumps of the shallow submergence intermittent type. The wells are only 80 feet deep on account of the sulphur-

INTERIOR VIEW OF RIDOUT ST. STATION SHOWING PUMPING EQUIPMENT, EXCITERS AND AIR COMPRESSORS. THE SUBSTATION EQUIPMENT IS SHOWN IN THE BACKGROUND.



GAS ENGINE DRIVEN PUMPING UNIT. THE SYNCHRONOUS CONDENSER UNIT HAS SINCE BEEN ADDED AT THE LEFT OF THIS ILLUSTRATION.

laden water found if any greater depth is reached. The air lift pumps serve to raise the water to a sufficient height in the individual discharge tanks at the top to cause it to flow by gravity into the reservoir of 1,000,000 gallon capacity. This reservoir is of reinforced concrete, and being roofed over keeps the water at all times pure and wholesome.

From this reservoir water flows into a semi-circular pumping reservoir formed at one side and from which the turbine pumps in the Ridout St. station derive their supply.

The station may properly be divided into three parts; that housing the pumping equipment, that supplying the lighting and power load of the city, and that supplying the energy for the street railway and the London and Port Stanley electric road.

Pumping Equipment

From the accompanying photographs and line drawings a good idea of the arrangement of the pumping equipment may be gained. Three turbine pumps serve to pump the water from the station reservoir to the city mains, while the air supply for the air lift pumps is provided by several air compressors.

The main floor has been omitted in that part of the station in which the pumps are situated leaving ample head room from the basement floor to the second floor for the installation of a hand-operated crane.

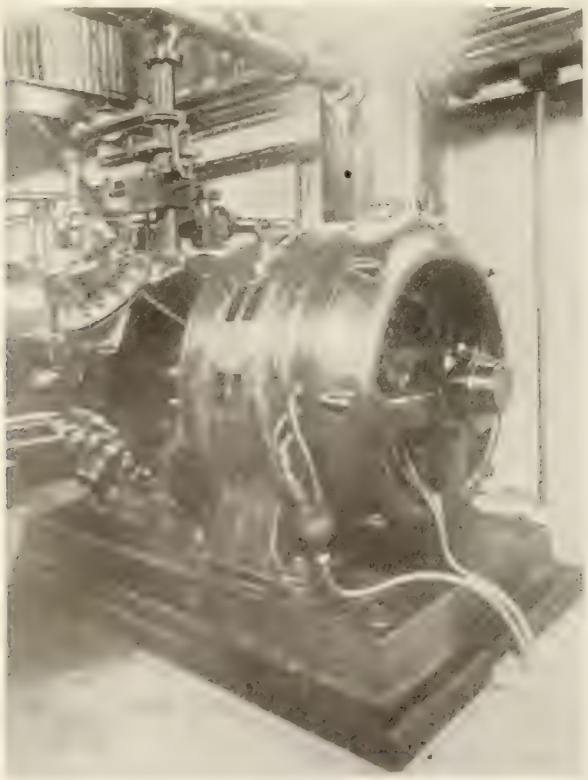
A unique feature in connection with this crane is the method of supporting the crane runways. These are bolted to substantial castings embedded in the walls and also hung from the floor beams above. The weight is taken by the walls and the turning movement of the crane runways is taken care of by the bolted connection to the beams above.

The portion of the electrical substation contained in the same wing of the station as the pumping equipment forms the No. 1 substation, this part having formed the original installation.

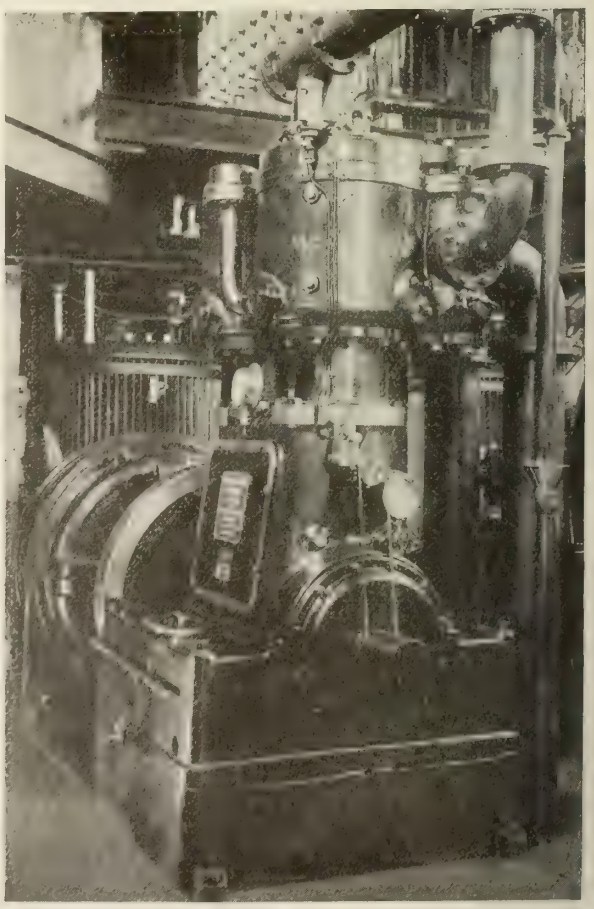
Turbine Pumps

The three turbine pumps are all of the same capacity, 1,500,000 gallons per 24 hours, and are of the Worthington type, manufactured by the Caledonia Iron Works, Montreal. These are two stage pumps with 28 in. impellers, and when running at their rated speed of 750 revs. per min. operate against a static head of 100 lbs. per sq. in. The diameter of the discharge from each is 8 in.

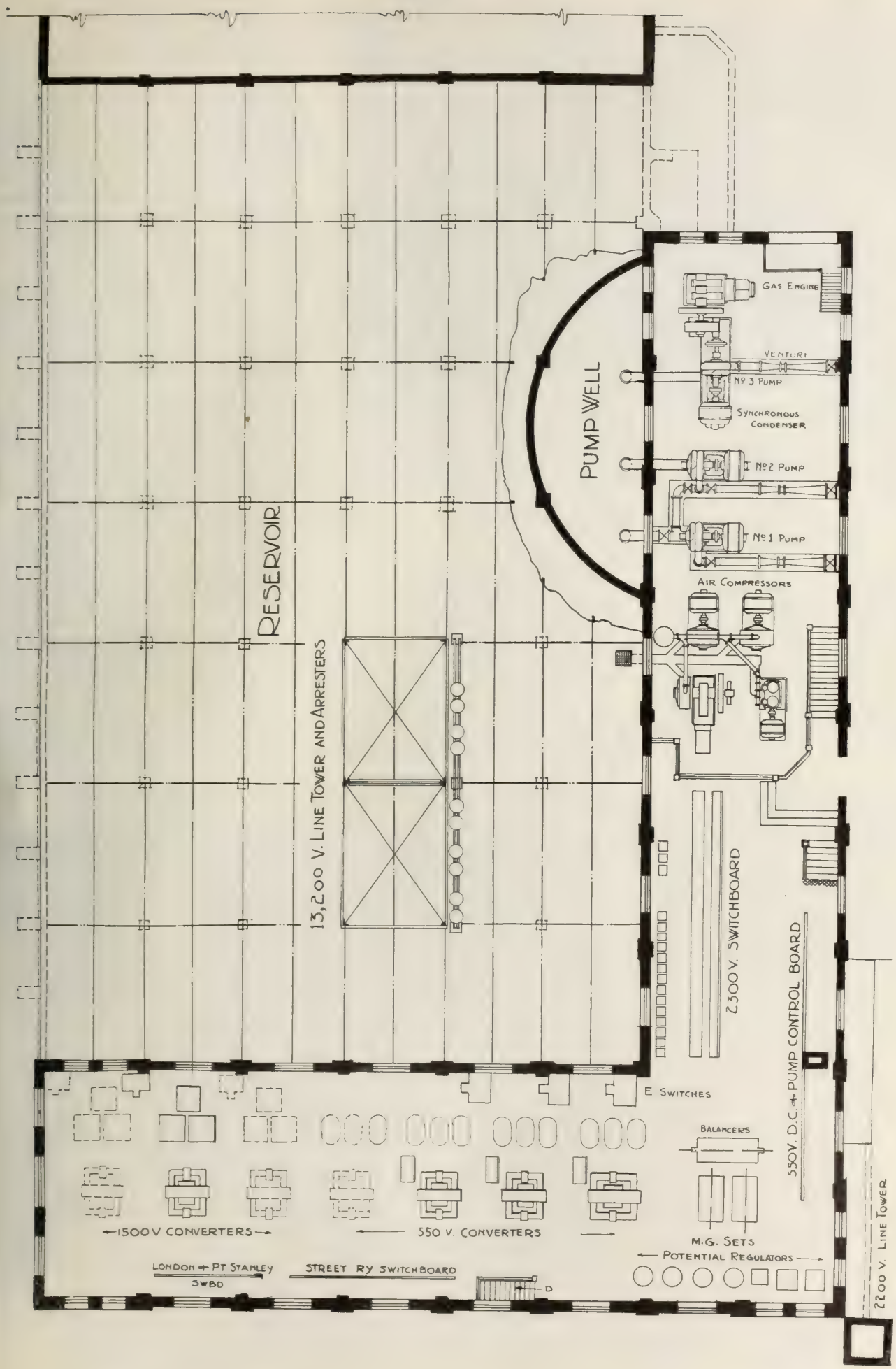
No. 1 and No. 2 pumps are driven by two synchronous motors of 200 h.p., manufactured by the Lancashire Dynamo and Motor Co. These motors take 3-phase current at 575 volts from the substation busses, and are started up as induction motors, this being accomplish-



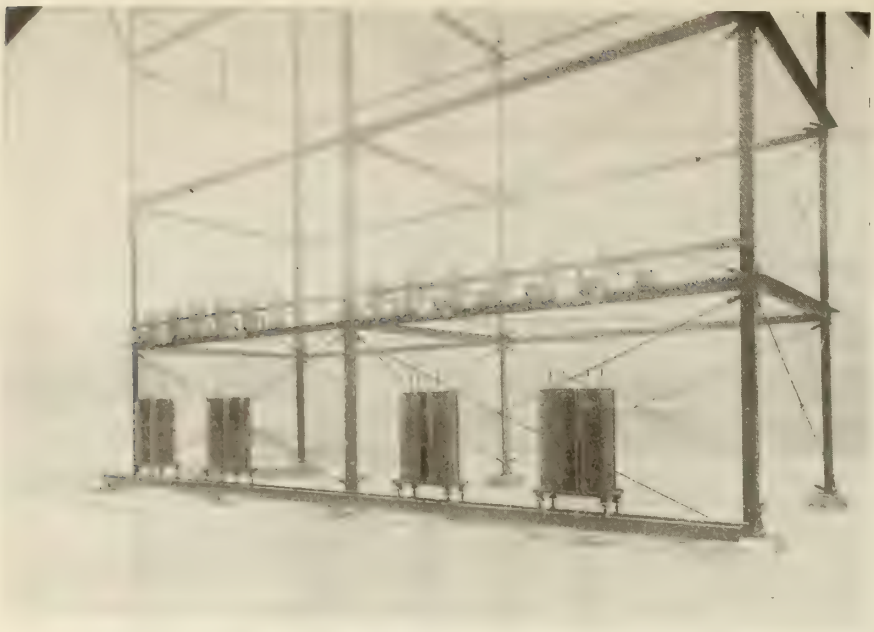
FOUR CYLINDER REAVELL AIR COMPRESSOR DRIVEN BY LANCASHIRE SYNCHRONOUS MOTOR.



BELLISS MORCOME AIR COMPRESSOR DIRECT CONNECTED TO C.G.E. SYNCHRONOUS MOTOR.



GROUND FLOOR PLAN OF THE RIDOUT ST. STATION OF THE LONDON PUBLIC UTILITIES COMMISSION. THIS STATION IS A COMBINATION OF WATERWORKS, PUMPING AND ELECTRICAL DISTRIBUTING STATION.



13,200 VOLT, LINE TOWER AND ARRESTERS.

ed by inserting resistance across the rotor slip rings. As the motor speeds up this resistance is gradually cut out and when up to synchronism the exciter is cut in and the exciter current adjusted to the proper value.

These two pumps are arranged in such a manner that they can be connected up in either series or parallel so as to obtain either the normal operating pressure or 140 lbs. for fire purposes.

While the third pump is similar to the other two it is driven either by a two cylinder gas engine or by a synchronous condenser which under normal conditions is run solely for power factor correction. The gas engine is of the four cycle type, manufactured by T. H. and J. Daniels, of Stroud, Eng. The cylinders are 15¼ in. dia. by 23¼ in. stroke, and the flywheel is 6 ft. 10¼ in. dia. When running at its usual speed of 175 revs. per min. the engine has a horsepower of 150.

A set of enclosed gears serves to transmit the power to the turbine pump giving a speed ratio of five to one and a jaw clutch serves to disconnect the engine when it is desired to use the synchronous condenser as motive power.

Synchronous Condenser

The synchronous condenser mentioned above is of Canadian General Electric manufacture, type A. T. I., and is rated at 500 kv. a., with an operating voltage of 575. When run to capacity it takes a current of 502 amperes and affects a power factor correction of about 20 per cent. under average conditions on the station load. The turbine pump is connected to it by means of a Hill type jaw friction clutch.

The three pumps discharge directly into the city mains and their duty is measured by means of three Venturi meters of 12 in. throat located in the discharge pipes.

Air Compressors

The compressed air necessary for the operation of the air lift pumps is supplied by several air compressors located in the Ridout St. station. Three of these compressors were built by Reavell and Co., Ipswich, Eng., and have four cylinders arranged at 90 degs. around a common crank shaft. This results in an exceedingly compact arrangement well adapted to the compressing of air economically. Two of these pumps have 14½ in. diameter cylinders, 4 in. dia. connecting rods, 6⅞ in. stroke, and are of the single stage type with 10 delivery valves in each cylinder. When driven at 250 revs. per min. by 100 horsepower synchronous motors they have a capacity of 500 cubic feet of free air per minute. The motors used are similar in type to those directly connected to the pumping units and were also built by the Lancashire Dynamo and Motor Co.

The third Reavell compressor is of the same type and general dimensions as the other two but has 15½ in. cylinders and is driven by a T. H. and J. Daniels gas engine at 200 revs. per min. This compressor has also a capacity of 500 cub. ft. per min. The gas engine is of the four cycle type of 110 h.p. The cylinder is 17 in. dia. by 27 in. stroke and the flywheel is 7 ft. diameter.

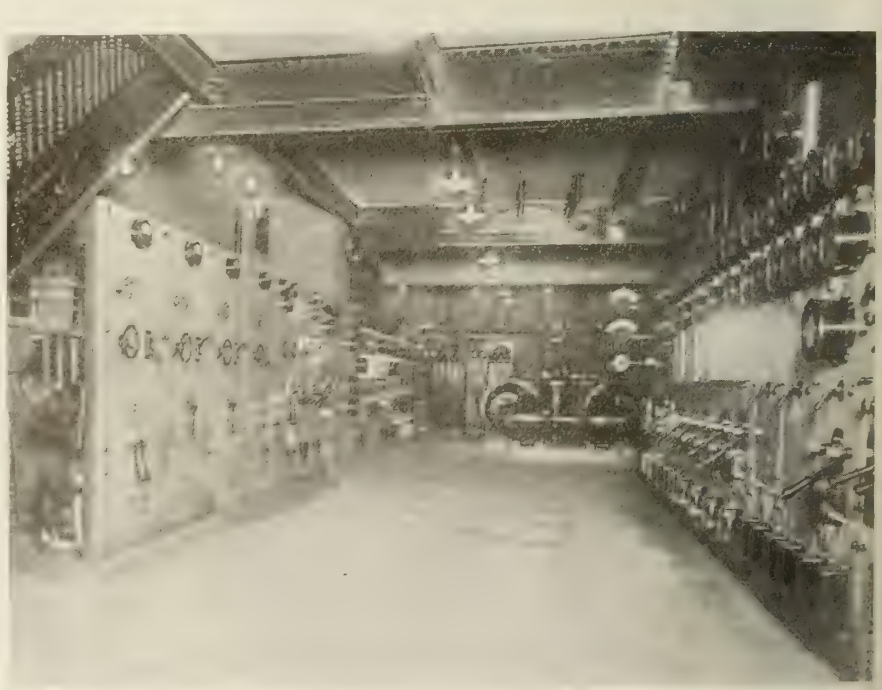
It will be noticed that gas engine drive is provided for one pump and one air compressor. This has been done in order to provide a reserve feature in the event of power failure.

The fourth air compressor is a Belliss and Morcomb two-cylinder single stage vertical compressor, in general features closely resembling the well-known high-speed engines of similar make. The cylinders have a diameter of 16 in. with a stroke of 14 in., and when running at 375 revs. per min. the compressor delivers 710 cub. ft. of free air per minute at 30 lbs. pressure. This unit is driven by a direct connected C. G. E. synchronous motor of 165 horsepower taking current at 575 volts from the station busses.

The Electrical Installation

The electrical installation at Ridout St. station has been developed from the original equipment installed when Hydro power was first made available in London. This original equipment was located in that part of the station now known as substation No. 1, the street railway and Port Stanley equipment being placed in a later addition known as No. 5 substation.

Power is received from the transformer station of the Hydro-Electric Power Commission about two miles distant through three 13,200 volt, three-phase 25 cycle feeders. These feeders dead-end on a high tension distributing tower



GENERAL VIEW OF SWITCHBOARDS MOTOR-GENERATOR SETS AND POTENTIAL REGULATORS.

shown in the accompanying illustrations. On this tower are also mounted the five sets of 13,200-volt Canadian Westinghouse lightning arresters which protect both the incoming lines above-mentioned and the two outgoing feeders, one of which supplies the Springbank plant and the other several of the smaller transformer houses located in the districts where the demands for power are unusually heavy. The horn gaps for these arresters are also located on this tower.

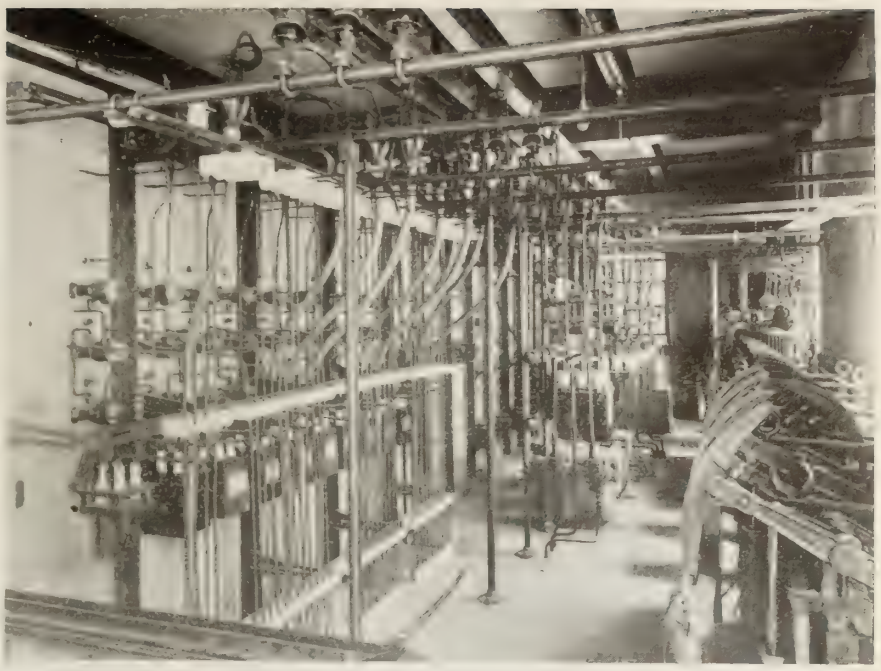
Switch Structure

From the tower the 13,200-volt lines pass into the station through wall bushings protected by a hood. Westinghouse potential transformers are provided on the incoming feeders for the metering of the load. Choke coils are provided on all feeders and disconnecting switches serve to isolate the incoming lines from the station busses to which they are directly attached, no oil switches being provided as the incoming feeders are controlled from the other end.

The high tension switching equipment is mounted in a concrete switch structure and type E Westinghouse remote-controlled solenoid-operated switches are installed throughout on all the 13,200-volt outgoing feeders and the high-tension side of all transformers, the E switches for the rotary converters being placed adjacent to the machines which they control on the main floor.

2,300-Volt and 550-Volt Feeders

Six outgoing 2,300-volt three-phase feeders are provided for serving the residential and other lighting requirements, as well as the lighter 110 volt power demands of the city. The 2,300-volt current is stepped down by means of the usual pole-type transformers and is locally distributed at 220/110 volts by means of a three wire system.



VIEW BEHIND 2300 V. SWITCHBOARD, SHOWING BUSSES AND SERIES LIGHTING TRANSFORERS.

These feeders are regulated by means of six G. E. 3-phase potential regulators. One 2,300-volt three-phase power feeder is provided and is also regulated by similar apparatus to that used on the lighting feeders.

The above 2,300-volt distribution system is energized by means of three delta-connected banks of single-phase Canadian Westinghouse 13,200/2,300-volt oil insulated, water-cooled transformers.

550-volt alternating current power is supplied through the medium of four three-phase feeders unregulated, and for these feeders six single-phase transformers, also of Westinghouse make, are provided. These transformers also supply the 550-volt power load of the station itself, including that necessary for the synchronous motors and condenser in the pump room.

INTERIOR VIEW SHOWING STREET RAILWAY ROTARY CONVERTERS AND D.C. SWITCHBOARD.

Transformer Arrangement

The two sets of transformers above-mentioned are located in the basement and are provided with wheeled bases, running on tracks sunk in the floor. When it is desired to remove any transformer it is rolled on the tracks to the center of the bay and placed on a truck fitted with rails aligning those in the floor. This truck runs in a pit provided with rails and conveys the transformers to a location where they can be picked up and handled by an eight ton hand-operated crane. The pit during normal times is covered by checkered plate flooring cut into convenient sections for ready removal.

Two three-phase 1,500 kv.a. transformers of Canadian General Electric make are located in the new wing of the sub-station and these also supply the 2,300-volt lighting feeders.

D. C. Power

A certain amount of direct current load is carried by this station in addition to the street railway and the London and Port Stanley Railway requirements, and to take care of this load four three-wire 550 225-volt feeders are required.

For this direct current service two motor generator sets are installed. The generators are of 70 kw. each and are of the Westinghouse three-wire type, the neutral wire being connected to the neutral balancing coils by means of slip rings on the end of the armature shaft. These generators are driven at 675 revs. per minute by means of two alternating current 550-volt, 120 horsepower, three-phase Lancashire motors. A balancer set is provided for use when the motor generator sets are not available, in which case the supply is taken from the 550-volt rotaries supplying the street railway load. This balancer set consists of two Westinghouse type S motors direct connected and of 40 h.p.

Switchboards

Two switchboards are provided in the No. 1 substation, controlling all circuits except those connected with the rotary converters.

The main switchboard controls the 13,200-volt incoming lines, and the 2,300-volt outgoing feeders. The 13,200-volt switches are remote controlled and for this purpose the usual control switches and indicating lamps are provided. The 2,300-volt lighting and commercial feeders are all controlled by means of type B Westinghouse switches mounted on a separate pipe framework at the back of the board and serving also to carry the 2,300-volt busses.

The 2,300-volt series street lighting circuits of which there are sixteen are also controlled from this board, single-phase type D switches being mounted directly on the marble panels for this purpose. From the switches the street lighting feeders run to the constant current regulators or transformers, seven of which are of Adams Bagnell make and the remainder Canadian General Electric. These sixteen feeders carry a total of 4,827 series street lamps of 75 watts each.

All 2,300-volt feeders leave the switchboard through porcelain bushings in the floor and are racked on the ceiling of the basement to the distributing tower up which they are carried in lead-covered cable to standard underground potheads for connection to the overhead lines.

All circuits are provided with inverse time limit relays and with the usual indicating ammeters, all of Westinghouse make. The incoming 13,200-volt lines are provided with graphic wattmeters for totalizing the station load.

The second switchboard is located directly opposite the first one and controls the station pumping and compressor equipment. Six panels are provided for the pump and compressor motors and are all equipped with starting rheostats and switching equipment, exciting current control and ammeters. One panel is allocated to the two exciter units which are located on the pump floor. These units consist of 60-volt, 500 ampere 1,440 revs. per min. shunt-wound generators direct connected to 575-volt three-phase motors, all of Lancashire make.

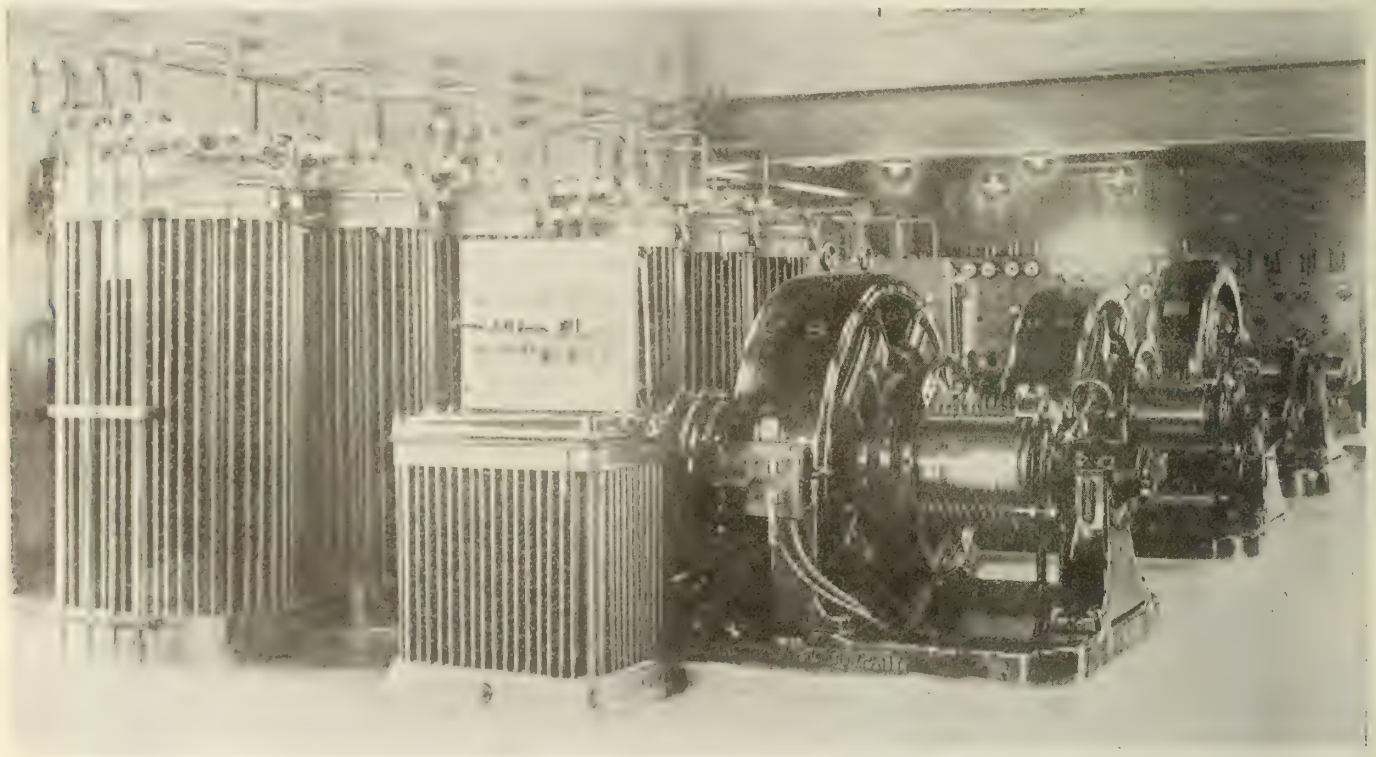
Station Service

The station switchboard panel is located on this board and contains the usual station lighting switches and motor generator and battery control. The lighting circuits have all been arranged for either alternating or direct current operation, and in case of trouble or power failure can be readily thrown on the station battery. The electric control for the type E switches and the relay and tripping circuits of the 2,300-volt feeder switches are of course all operated by the station battery.

An instrument panel forms part of this board and is given over to various indicating and recording instruments. Two panels are provided for the 13,200-volt outgoing sub-feeder.

The 550 alternating current volt power for the operation of the pumping plant and for outside feeders is all taken off a set of bus-bars at the rear of the board and the transformer and feeder panels form part of its equipment.

The 550/250-volt direct current requirements are met by four feeders which with the control for the motor



550 VOLT ROTARY CONVERTOR EQUIPMENT, C.G.E. CONVERTORS, TRANSFORMERS AND REACTANCES.

generators and balancer set occupy two panels.

D. C. Railway Equipment

The power necessary for the operation of the London street railway is furnished by this station, three 500 kw. Canadian General Electric rotary converters being provided. These machines are fed from the 13,200-volt busses, type E, oil switches being provided for their isolation. The rotary transformers are located immediately behind the rotaries which they feed and reactances are provided for better voltage regulation. The transformers are single-phase, oil insulated water-cooled, and those for one rotary are delta connected, giving the phase current while the other two rotaries and transformers are connected six phase. As will be seen from the illustrations the starting and field break-up switches are mounted immediately above the reactances which are of 45 k.v.a. rating.

The street railway switchboard is of the usual type, machine control, and feeder panels being provided, with the usual ammeters and circuit breakers. Volt meter plugs are provided for the reading of the feeder voltages on a Weston voltmeter bracketed on the end panel.

Thompson switchboard-type integrating wattmeters are provided for totalizing the load and a Westinghouse graphic wattmeter records the fluctuations in the power required.

London and Port Stanley Equipment

Owing to the length of the road and the distance between sub-stations a voltage of 1,500 was chosen for the operation of the London and Port Stanley road.

The London end of this system is taken care of by the Ridout street station, a 500 kw. Canadian General Electric 1,500-volt rotary converter being provided. This rotary also has its own type E oil switch and transformer and is supplied with a Westinghouse starting panel with a type B double-throw oil switch for the starting and running positions and a similar switch for the field breaking. This panel is mounted near the machine and is separate from the main switchboard which is provided with hand-operated oil switches instead of the usual knife type on account of the high voltage carried.

GRAPHITE IN OIL

IN preparing mixtures of graphite and oil for lubricating purposes, it was for a time thought essential that the graphite should be ground to the utmost practical degree of fineness in order that it might remain suspended in the oil without any tendency to settle by gravity or choke the passages of the lubricators, and in pursuit of this aim, methods of preparing graphite were evolved capable of giving a powder in which no particle exceeded 1-250,000 in. in diameter.

When, however, such fine particles are mixed with oil, a curious phenomenon is observed. The particles begin spontaneously to coalesce, and when the mixture is examined under a powerful microscope, it is seen that the particles are in perpetual zig-zag movement through the oil. The explanation, as given by the Brownian hypothesis, is that the movement is due to the particles of graphite being struck by free electrons, whereby a particle, in being struck, starts with a jerky movement, and continues moving until arrested by the fluid friction of the oil, provided it has not already been struck by another electron, causing it to bound off in another direction.

During these erratic movements the particles of graphite collide with each other, and, as a result, adhere; they in turn are struck by other particles, and in this manner there is gradually built up a mass of adhering particles which is subject to the action of gravity, and results in settling out. Various expedients have been resorted to in order to negative this tendency. The one most commonly made use of is that of coating the finely-ground particles with a foreign substance and then effecting a high dispersion of those coated particles throughout the oil.

The coating material is usually a vegetable compound, such as castor oil, or it may be tannic acid or an allied tanning compound. By these means the permanent suspension of the ultra fine graphite particles in oil has been successfully achieved, but of late the question has been raised whether this extreme fineness, to the securing of which so much effort has been directed, does not of itself render the graphite ineffective.

It is to be borne in mind that in the bearing properly constructed, lubricated, and in operation, the bearing surfaces are completely separated by the oil film, and the particles of graphite simply float in the film, exerting no appreciable effect, either beneficial or otherwise. In such a bearing the graphite is not intended to play any part, its role begins when, for any reason the oil film between the bearing surfaces is destroyed. Then, as the oil film is squeezed out, the graphite particles are carried along with the oil from between the bearing surfaces until the film is reduced to a thickness corresponding to the dimensions of the largest particles of graphite, which at this stage will be arrested and held between the surfaces. Upon the complete destruction of the film these particles so held are crushed and embedded into the grain and pores of the surfaces, and thus are made to perform their function of solid lubrication.

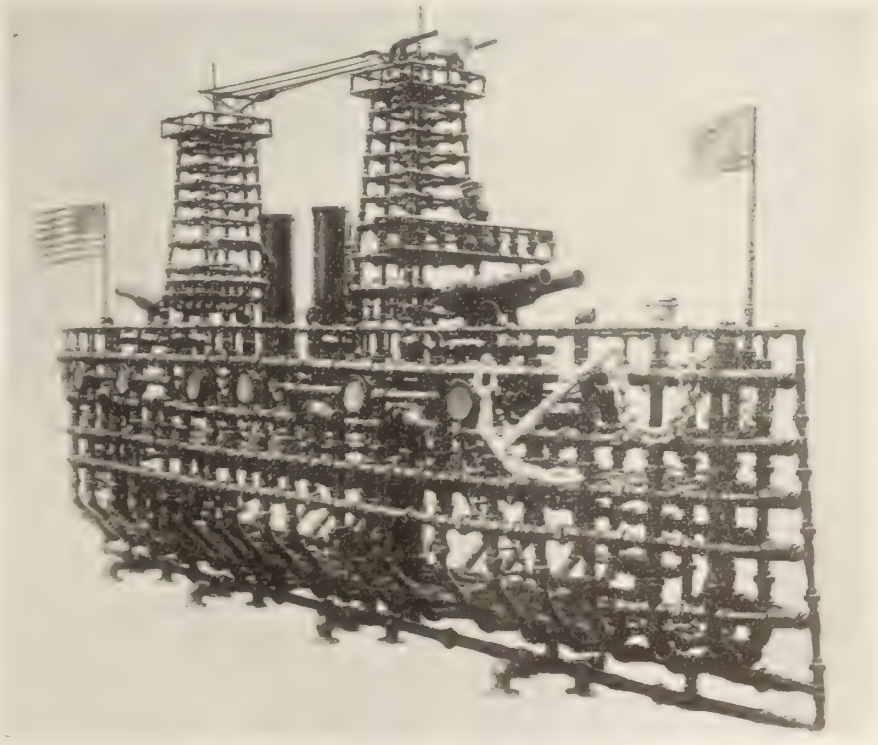
A BATTLESHIP OF PIPE FITTINGS

By K. C. P.

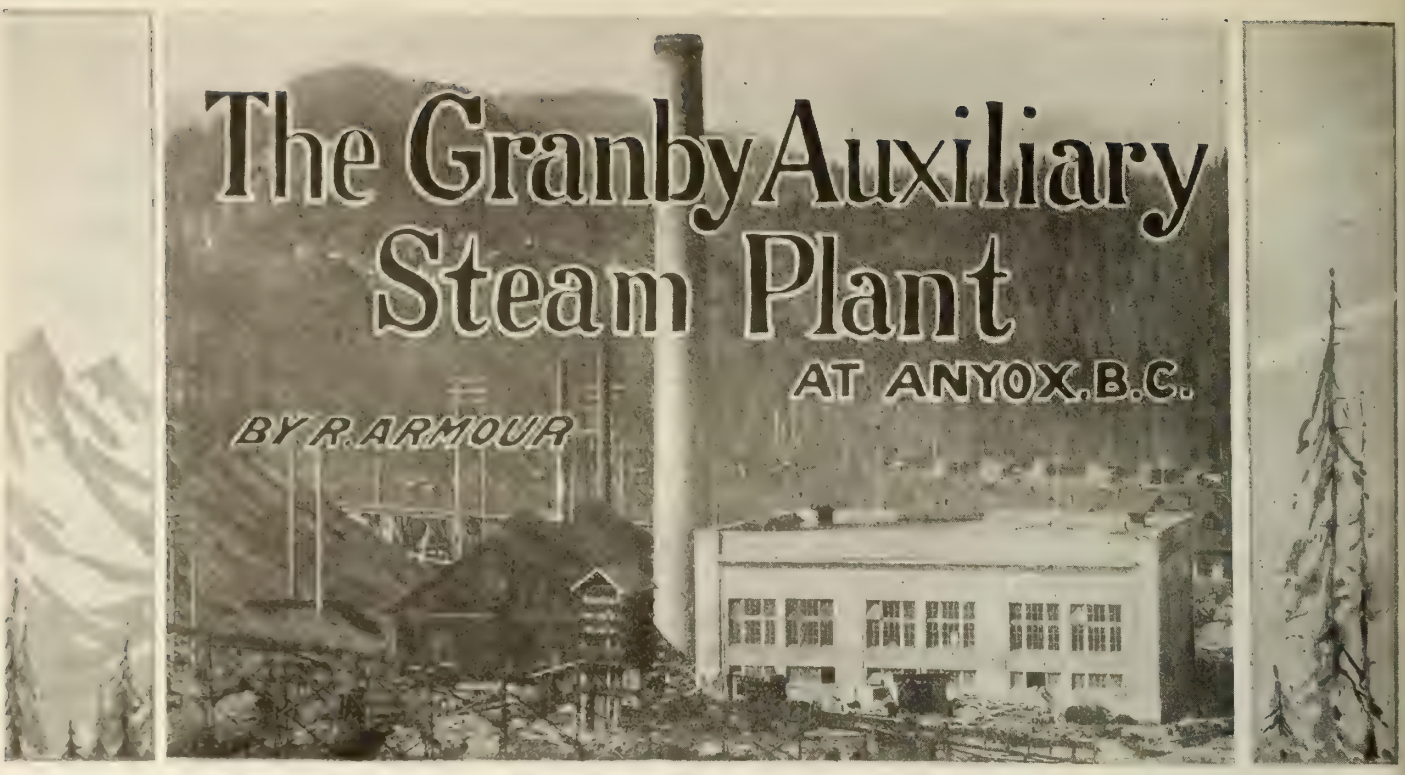
THE accompanying illustration shows the model of super dreadnought "New York," made entirely of pipe fittings and valves of a Chicago manufacturer.

It is of interest to note that the model has a length of 186 inches, a breadth of 34 inches, and a molded depth of 42 inches, the total height from keel to top-mast being 102 inches, while its net weight is 3,308 pounds. Six thousand six hundred and sixty-nine separate parts enter into its construction. It is complete to the smallest detail, and the ordinary working parts of a battleship are movable.

There is a small electric motor which gives action to the propeller. This ship is electrically wired throughout, the wires running in conduit, and by the pressing of a button action may be seen everywhere; the propeller turns, the commander salutes, lights flash, guns roar, the wireless crackles, the searchlight throws a searching beam. The entire action is automatic and may be repeated indefinitely or until the pressing of another button stops it.



BATTLESHIP MADE ENTIRELY OF PIPE FITTINGS.



PART II.

The many uses for power in the various metallurgical operations connected with the refining of metals necessitate more than usual provision for adequate and unfailing supply. The following article deals with the steam plant auxiliary of one of the largest smelters in British Columbia.

NO. 1 main unit is a 3,750 k.v.a. Westinghouse turbo-generator, the steam turbine and generator being direct connected and running at 3,600 rev. per min. The generator is 3-phase, 60 cycles, 2,300 volts, the machine being entirely enclosed in a casing, with fans on either end of the rotor blowing air into the centre of machine to keep the winding cool.

Turbine

This turbine is of the impulse reaction double flow type, that is the steam acts first on small impulse blades, at the middle of the machine and then on the other blades which get larger toward the ends and finally exhaust at both ends of the machine into the condenser. This machine like most high speed turbines is fitted with an operating governor and a safety stop governor. The safety stop is much the same as that described under feed pumps. The main throttle valve is a balanced valve having steam pressure top and bottom of a piston within the valve itself. The steam from the bottom of the valve is pined to the bottom of safety stop and if the machine should run over a predetermined speed, in this case about 4,000 r.p.m. the safety will trip, thus allowing the steam pressure on the bottom side of the throttle valve to exhaust to atmosphere when the throttle valve immediately closes, to its seat, being closed by the steam pressure on the top side of piston within the throttle valve. Before the safety trip can be put back into place the throttle valve must be screwed down to its seat. In this way it makes the machine safe, for if it were possible to put the safety stop back to place with the throttle valve wide open, steam would be turned into the machine the full bore and pressure in the pipe. In a word, this automoatic throttle makes it fool proof. When starting the machine again, the throttle must be opened very slowly and when the machine is up to speed so that the governor has control, the valve can be opened wide and the governor will then take care of the regulation of steam.

The condenser on this machine is much larger than is necessary, with conditions here. This entire unit was purchased from the Havana Electric Light & Power Company, Cuba, through the Westinghouse Co., as it was impossible for them to furnish the Granby Co. with a suitable generator at the time on account of the large number of orders on hand. The condenser is a Wheeler surface condenser and was made to suit the condensing water at Havana which has a fairly high temperature, about 85 degs F., as compared with our average temp. here of 36 degs. F.

Previously this condenser was taking the circulating water in at the top and discharging at the bottom. This arrangement allowed the exhaust steam which enters from the turbine at the bottom of condenser to strike the hottest water in the condenser first, which results in more equal expansion of the tubes; this was rather detrimental in this case, for if the circulating water stopped for any reason, the water in the condenser would drain out; so the connections were changed and since have given no trouble such as occurred at first. Considerable trouble was also due to other causes, principally to the failure of the circulating pump. The circulating pump is located at No. 1 power house and is motor driven, the pump taking the water from the tail race of the water turbines. As this water is highly charged with air and the suction lift fairly high, probably 16 or 18 feet, the pump occasionally becomes air-bound and loses its priming. The condenser has 4,020 tubes, three-quarter inch diameter by 18 feet 2 inch long, and has an approximate cooling surface of 14,800 sq. feet, though half this surface would be quite sufficient under present conditions. There is one thing about condensers which engineers in British Columbia must bear in mind; that is, between the turbine or reciprocating engine and condenser there must be an automatic relief valve to the atmosphere and, by having a stop valve near condenser in the event of trouble to the condenser this stop valve can be closed and engine can exhaust to atmosphere until condenser repairs are made.

In the No. 1 unit the stop valve between the steam turbine and condenser is a 48-inch gate valve and the automatic relief to the atmosphere is an 18-inch valve. There is a considerable difference in the size of these valves but in the

larger one the steam pressure is only about 1 lb. absolute, while in the smaller valve the pressure might be about 40 lbs. gauge or 55 lbs. absolute. The circulating water pipes to the condenser are 12 inches diameter.

The auxiliaries consist of a Terry steam turbine of about 100 h.p., and direct connected to the air and hot well or condensate pumps. There is space on the bed plate for a circulating pump, but it is being used at No. 1 power house to supply the condensers with water.

The condensate pump is fitted on one end of the turbine, and is a Wheeler pump of the ordinary centrifugal type. This pump is set lower than the condenser so that the water may flow by gravity into the pump. The suction pipe is 4-inch and the discharge pipe 3-inch. There is also a 2-inch equalizing pipe which connects to the side of the condenser near the top at one end, the other end of the pipe connecting to the suction side of condensate pump. This pipe equalizes the pressure on the top and bottom of the condenser and allows water to flow freely into the pump. The discharge from this pump goes into the feed water heater in the boiler room and the exhaust steam from the steam turbine driving these pumps also enters the feed water heater and raises the temperature of feed water before entering boiler.

Air Pump and Oiling System

A Thysen air pump, of the centrifugal type, supplied by the Wheeler Condenser Co., is installed. Directly beneath the pump is a concrete sump or well about 8 ft. long by 6 ft. wide and 6 ft. deep. This sump is divided into two compartments by a wall about 30 in. high. The air pump draws water from one side of the sump and discharges it into the other, a continuous circulation of water being maintained through a screened opening.

The air pump suction is provided with a foot valve. As the water is used over and over again it, in time, gets warm and a 3 in. make-up line is provided, the overflow being taken care of by a line running to the sewer.

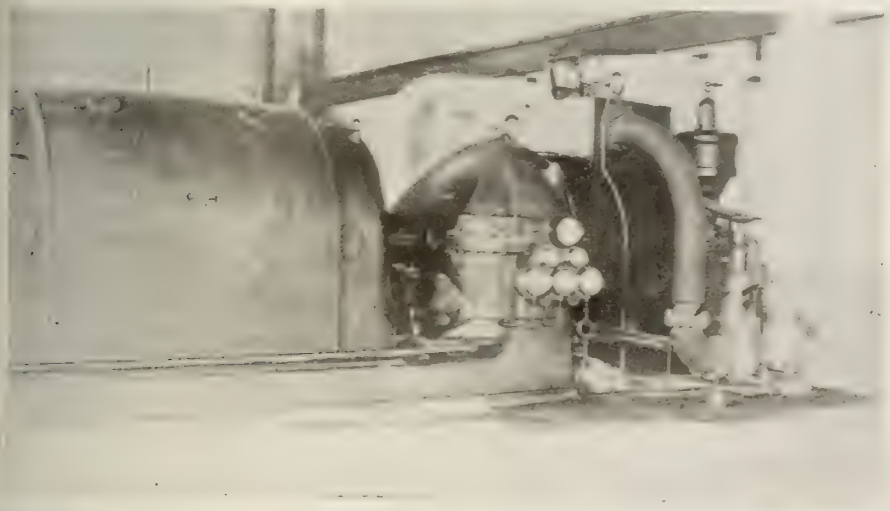
The pump runs at 1,600 revs. per min., and draws the air from the top of the condenser, discharging it along with the circulating water into the discharge side of the well. The air pipe is 7 in. diameter.

A 3 x 2 x 3 in. duplex oil pump is provided for each turbine unit about 4 to 5 lbs. oil pressure being maintained on the turbine and generator bearings by this means when starting up. When the machines are running centrifugal pumps on the turbines provide the necessary oil pressure, an oil cooler serving to carry away the heat. The oiling system of No. 1 unit holds about two barrels of oil and that of the No. 2 unit about one and one half barrels. A special grade of oil is used.

Gauges

There is a gauge board on each turbine with a number of gauges. One gauge shows the steam pressure on boilers, another the pressure of the steam turbine which varies according to load. A vacuum gauge is also provided, although the machines are also fitted with mercury columns which give a more accurate reading, the vacuum gauges going out of working order easily. There is also a gauge to show the pressure of oil on bearings which runs about four or five pounds. A gland gauge is provided showing the pressure of water on the glands at each end of the turbine, about 5 to 6 lbs.; this water pressure seals the glands so that air cannot enter into condenser and without this seal a good vacuum could not be maintained. There is also a vibration tachometer or speed gauge which shows the speed at which the turbines are running and when running on load the speed in this case is 3,600 rev. per min.

GENERAL VIEW OF TURBINE ROOM WITH SURFACE CONDENSER IN BACK GROUND.



NO. 2 TURBO GENERATOR INSTALLATION 2500 K.V.A. WESTINGHOUSE GENERATOR AND TURBINE.

No. 2 Unit.

This machine is a 2,500 k.v.a. Westinghouse turbo-generator delivering 2,300 volt 3-phase 60-cycle current. This turbine is of the impulse reaction single flow type, that is the steam enters at one end of machine on the small blades, goes through each stage of the blading and enters the condenser from the other end of turbine. As far as operation goes this machine is practically the same as the No. 1 unit except that No. 1 unit has a relay on governor making it more sensitive, while No. 2 machine has a centrifugal governor without any oil relay. This is a new machine recently installed. There is considerable vibration from the No. 1 unit, but this is entirely absent in No. 2 unit.

Clearances

The high economy which these machines produce is due principally to the small steam clearances. Great care is required in the actual adjustment of the rotating blades. This is done by having a thrust block with a number of grooves turned in the shaft and rings on the bearing which fit into these grooves. The upper and lower halves of the thrust block can be adjusted separately by micrometer screws, with dials to show the exact positions of the blades. If the up-

NO. 2 TURBO-GENERATOR UNDER CONSTRUCTION. GENERAL VIEW.

per half of the bearing tends to press the shaft to the right, then the lower half will tend to press the shaft to the left. These clearances are about 10-thousandths of an inch and the machine is arranged so that the gland runner and its casing will be the first to come in contact, thus partially protecting the blades.

The clearances between the end of the blades and the steam cylinders of the turbine, or the radial clearance, runs about 35 thousandths of an inch. The adjustment for radial clearance is made by having four pads on each bearing top and bottom and both sides. Under these pads are liners of known thickness and liners are taken out or put in until the blades give a slight rub when turning over by hand. After the blades have given a slight rub on one side liners of .030 or .035 of an inch thickness are put in under the pad on the side where the rub occurred. By this means the clearance is known exactly. Top and bottom and both sides of every bearing is adjusted in this way and a careful record of setting of these bearings ought to be kept.

Condenser. No. 2 Unit

This unit is fitted with a Westinghouse La Blanc jet condenser. The air pump works on the same principle as the air pump described for No. 1 unit. The auxiliaries of No. 2 unit, that is the air and hot well pumps, are driven by a small Westinghouse steam turbine running at 3,600 rev. per min. A set of enclosed reduction gears running in oil is provided between turbine and pumps and water is passed through a coil in the oil to keep it cool. The slow speed shaft of the gears is attached to the shaft of air and hot well pumps, the pumps running 72 rev. per min. In this way high steam economy is obtained from the steam turbine and the pumps are run at a suitable speed. The exhaust steam from the turbine exhausts into the exhaust steam header and this header as before mentioned carries the steam to feed water heater. The steam pipe to turbine is 2½ in., and the exhaust 4 in., with a copper expansion joint on the exhaust pipe close to turbine. The water pipe on the suction of the air pump is 6 in., with a foot valve on the end of the pipe in the sump. The discharge pipe from the air pump is 5 in. pipe, and of course goes back into air pump sump. The water pump has 6 in. outlet. The injection water is carried into the condenser by a 9 in. pipe, the regulating valve being close to condenser and an extension handle passing up through the floor so that any changes in the amount of injection water can be made either from the basement or the main turbine room floor.

There is a vacuum breaker fitted to this condenser so that if water rises too high in the condenser or the vacuum is lost, the vacuum breaker valve will open and trip the lever of the butterfly valve on the injection line, thus completely shutting off the injection water entering the condenser, the atmospheric relief valve will then open and the turbine will exhaust to the atmosphere. All pipes to the condenser, injection inlet and outlet, air pump inlet and outlet, and the exhaust steam from turbine are fitted with metal tubes to hold a thermometer, so that temperature of the steam or water passing can be easily taken at any time. There is a vacuum gauge connected to the air pump suction and one on the condenser close to the pump so that when adjusting the pump it can be seen just what changes are occurring.

The gauge on the pump suction is run at about 10 in. vacuum. These gauges are in addition to the gauges provided on the gauge board in the turbine room, which contains steam inlet, vacuum, gland, tachometer or speed gauge and bearing oil pressure gauges. Between the turbine and condenser there is a copper expansion joint the full size of low pressure exhaust opening into condenser this being 30 in.

There is a 16 in. atmospheric relief valve which opens if vacuum is destroyed and allows turbine to exhaust to atmosphere through a 16 in. exhaust pipe. The high pressure steam pipe to this machine is 6 in. dia.

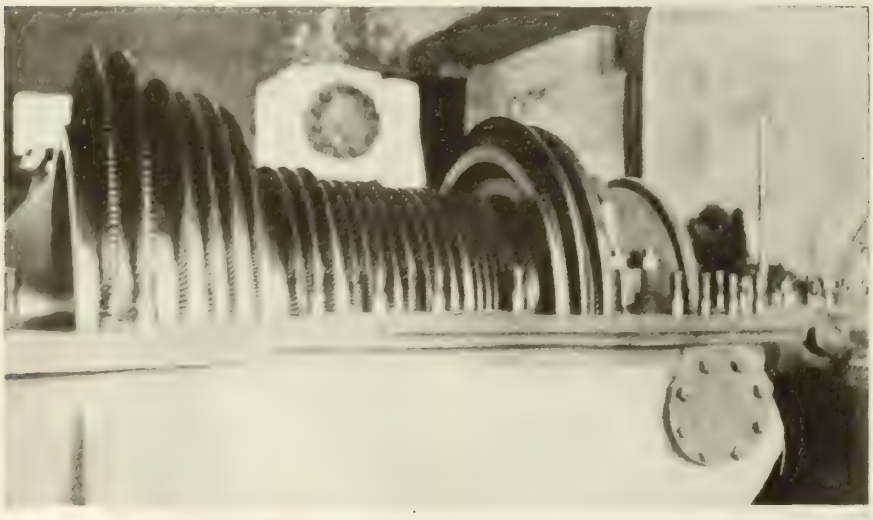
Exciter Unit

The exciter unit consists of a Westinghouse steam turbine direct connected to a 100 k.w. Westinghouse d.c. generator running at 1,800 rev. per min. This machine supplies exciting current to No. 1 and No. 2 generators, an alternative course of exciting current being furnished by an exciter at the No. 1 power house. The turbine is fitted with a governor of fly-ball type enclosed in a casing and also with a safety stop arrangement which works on the same principle as provided for the generators.

The exciter unit steam line is a 4 in. pipe and the exhaust is a 12 in. pipe, a 12 in. copper expansion joint being fitted on the exhaust between the turbine and exhaust header. The exhaust of this machine also goes to feed water heater. There is a 12 in. valve on exhaust line between turbine and main exhaust header.

No. 3 Unit

No. 3 unit is a De Laval Rotary air compressor and is still under construction. In this machine we have a 1,000 h.p. steam turbine on one end, the compressor in the centre and direct connected to the turbine. and an induction motor on the other end. By this arrangement the compressor can be run either by steam or motor. There is a set of re-



NO. 2. TURBO-GENERATOR UNDER CONSTRUCTION SHOWING TURBINE BLADING.

duction gears between the compression and the motor, the turbine and compressor running about 3,000 rev. per min., and the motor 70 rev. per min. The compressor has 14 stages, will generate air to 100 lbs. pressure, and has capacity of 3,500 cubic feet of free air per minute. The motor of this installation is a Westinghouse constant speed induction motor of 800 h.p., 3-phase, 2,200 volts, 190 amps. per terminal, 7,200 alternations per minute. The turbine of this machine is to have a Koerting jet condenser, the exhaust opening from turbine to condenser being 18 in., the steam inlet to turbine a 4 in. pipe and the exhaust to atmosphere will be a 12 in. pipe.

The makers claim high efficiency for this unit, the speed of the turbine being such as to secure good results. As a lower speed is essential in the motor, the reduction gears are fitted, the makers claiming 98 per cent. efficiency for the gears. Like the reduction gear already mentioned on the auxiliaries of No. 2 unit, the gear on this machine will be running in oil and the oil cooled by a coil circulating cold water in the oil chamber. The hot well pump for this unit is a De Laval centrifugal pump driven by De Laval steam turbine. The pump and turbine are direct connected running 2,800 rev. per min. The turbine has 2 in. inlet and 4 in. exhaust. The pump has 2½ in. inlet and outlet openings. The turbine is rated at 4 h.p. The hotwell pump will take the water from condenser and discharge it into the feed water heater. There is a 7 in. injection water line to condenser of this unit.

The feed water heater is a Blake and Knowles open heater rater at 3,000 h.p. The heater is 4 ft. 10 in. by 9 ft. long and 6 ft. 6 in. high. There are six doors heater, four of them large enough to take out the filtering pans, and two doors near the bottom of heater on the side for cleaning out. This heater has a series of perforated plates inside. The exhaust steam enters through a 16 in. pipe at the top and is broken up, going through these plates, then drops to the bottom of heater and mixes with the water. The water in heater then passes through charcoal and is filtered. The feed pumps are placed about 15 feet below the heater so that the hot water runs from the heater into the feed pumps. There is a 4-inch cold water make-up line with a regulating float valve for keeping sufficient water in the heater and the valve is set so that it will shut off when the heater is about 1-3 full. There is also a regulating float valve on 4 in. outlet from the heater to sewer and if water rises too high in heater this valve will open and allow water to run to waste. With the use of the feed water heater, the feed water is raised in temperature from about 100 degs. F. to an average of 200 degs. F. This heater has a 2½ in. safety valve and a 16 in. atmospheric relief valve.

Switchboard

The switchboard for this plant is comparatively small on account of all distribution being attended to from No. 1 power house, the switchboard consisting of only six panels. On the extreme right end of the board there are two swinging brackets, each bracket having two meters. The highest one carries the A.C. volt meters, with a range of 0-3000 volts. One of these meters shows the voltage on the main bus, and the other can be used on either No. 1 or No. 2 generators by means of plug switches on switchboards. On the other swinging bracket is the frequency meter showing the cycles and a synchroscope for using when generators are being put in on the line so as to get the machine being started running in synchronism with the machine already in service. This meter can be used for either generator by means of plugs on the switchboards.

Panel No. 1

The first panel is used for No. 1 generator. There is one a.c. ammeter which will show the current on any phase by means of plug switches on the board. On this panel is the power factor meter, also a direct current ammeter showing the field amperes or exciting current.

Panel No. 1.—The first panel controls the No. 1 generator. One a.c. ammeter serves to meter the load on any one-phase through plug switches. The field rheostat and ammeter are also mounted on this panel, and indicating and integrating wattmeters serve to meter the generator load. The generator circuit is privided with an oil switch mounted on the panel and provided with an inverse time limit relay which serves to trip the switch in the event of short circuit or other abnormal conditions.

Panel No. 2 is for the No. 2 generator, and has three alternating current ammeters, one on each phase of the machine. A kilowatt meter which shows the momentary load on generator in kilowatts and also a direct current ammeter show-

COMPOUND ENGINE AND TWO STAGE AIR COMPRESSOR. THIS PICTURE WAS TAKEN BEFORE THE ADDITION WAS ADDED TO THE NO. 2 POWER HOUSE.

ing the amperage the machine is taking for exciting purposes are provided, also a field switch and the main switch which is an oil circuit breaker, fitted with overload time limit relay. There are also synchronizing lamps and plug switches so that synchroscope and voltmeter can be used on this machine when starting up.

Panel No. 3 has a graphic meter which records on a paper chart the total load in kilowatts at all times, and it is from this chart that the maximum demand (which is the highest load for five minutes) and the maximum power (which is the highest load for fifteen minutes) are taken. The main kilowatt hour meter is also on this panel, this meter showing the total work done by both generators.

Panel No. 4 is only a small panel, having the direct current switch used for exciting purposes from No. 1 power house, this being used instead of running the steam exciter. On this panel is a signal lamp to the smelter to warn the smelter foremen in the event of a sudden shut down, so that arrangements can be made to clear the smelter furnaces, to avoid the coolin of the copper in the furnaces, when the air is shut off, for if the copper is allowed to cool in the furnace it must be removed later by blasting with dynamite.

Panel No. 5 is the direct current steam exciter panel, having ammeter and voltmeter, main switch, rheostat and a Thompson kilowatt hour meter showing the power used.

Panel No. 6 is for the De Laval rotary air compressor, and has an ammeter showing current taken by the motor. There are also three starting switches of an oil circuit breaker with overload time limit relay. A kilowatt hour meter shows the power taken by the motor to run the rotary compressor. There is a transformer in the basement directly under the switchboard from which the leads to the starting switches for the motor are connected.

In order to keep the exciter voltage uniform under changing load conditions a Tyrril regulator is provided on the extreme left end of the switchboard.

Future Unit

The turbine room has been laid out with a view to future expansion and for this purpose space has been left for another unit similar to those already installed.

The installation of heavy apparatus such as is found in the larger power houses is a difficult task without adequate provision for cranes, etc., and to facilitate erection a fifteen-ton crane has been installed. This crane is of Herbert Morris make.

A cold air duct is provided supplying air to the fans of the turbo-generator units. This air duct is 5 ft. square and draws in air from outside the building.

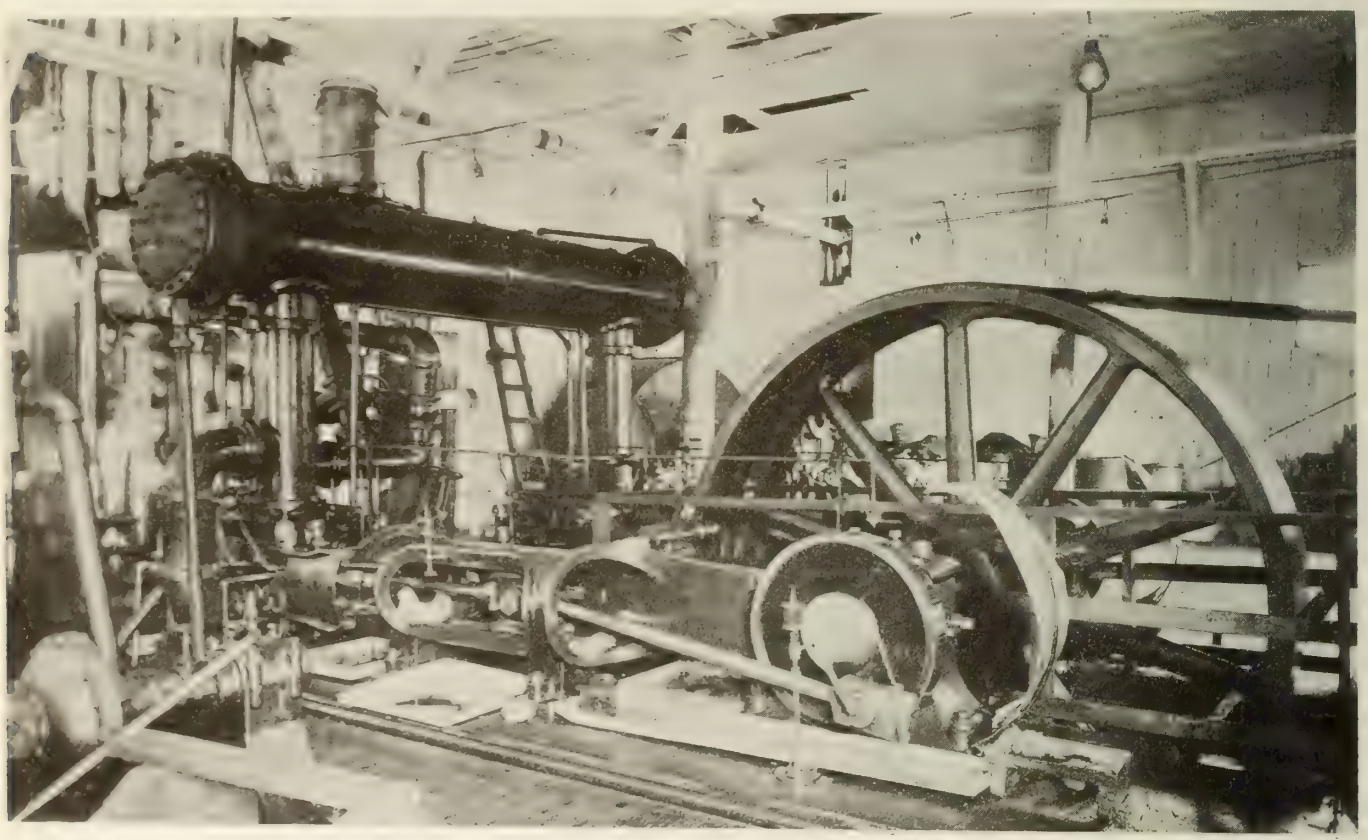
The No. 2 Power House Addition

An addition to this power house is under construction, much of the equipment of which is under operation at present.

Two boilers are being set up, both of the horizontal return tubular type, and of 175 b.h.p. combined rating. These boilers are being equipped with a Staples and Pheffer oil-burning system.

When completed these units will supply steam for heating, to the smelter concentrator and also to the boarding house and rooms. Approximately 1,000 men are served with meals at the Beach boarding house alone, and considerable steam is required for this purpose alone in addition to that used for laundry purposes, the boilers in No. 2 power house furnish this steam and are taking about three barrels of oil per hour. The uptake of these boilers will be the brick chimney used by the No. 2 power plant.

There are two air compressors in the building. The larger one is a Rand compound two-stage air compressor. The cylinders on the high side are steam 18 in., and air 20 in. dia. by 36 in. stroke, and on the low side the cylinders are, steam 34 in., air 32 in. x 36 in. stroke, running 86 revs. per minute. This machine was formerly run by steam, but the steam piston rods have been disconnected and the machine is now run by motor. The motor running this machine is a Westinghouse induction motor of 400 h.p. and takes current at 2,200 volts, 3-phase, 60 cycles. The motor speed is 290 revs. per min. at full load. The engine flywheel and pulley have fifteen grooves on their faces and are suited for rope drive. The rope used is 1½ in. The compressor is fitted with Corliss valve gear. The air is taken into this machine through the low-pressure cylinder, is compressed and then discharged into the intercooler, where the heat of compression is driven off by means of coils of pipe and cold water passing through coils. The air is then reduced in volume, and being under pressure a



CANADIAN RAND TWO-STAGE AIR COMPRESSOR. THIS COMPRESSOR IS DRIVEN BY A 200 H.P. WESTINGHOUSE MOTOR.

lot of moisture is taken out of the air and the air is then taken into the high-pressure cylinder where it is again compressed and passes out into the delivery line and into the air receivers. There is a safety valve on the inter-cooler so that if the pressure rises too high the valve will relieve the pressure.

The air passes from the receiver into the delivery line leading to the smelter and mine, and as the mine is about a mile distant a reheater is installed on the line. This consists of a form of small boilers where the air passing through the tubes is heated and absorbs some of the moisture in the air, thus keeping the air pipes from freezing, and dryer and better air is the result. This air compressor has a capacity of 33.34 cubic feet of free air per revolution, or 2,870 cubic feet of free air per minute. The air pressure carried is 120 lbs. The other air compressor to be installed in this building is at present running in a small frame building near No. 2 power house. This has 14 in. and 22 in. stroke cylinders and runs at 120 revs. per minute. There is a 200 h.p. Westinghouse motor driving this machine.

In the turbine room on a gauge board there is a Foxboro steam recording gauge which records the steam pressure on a chart for a 24-hour run. On the same board is a Foxboro pyrometer which records the temperature of the flue gases.

Venturi Meter

This meter stands about 6 feet high and has three dials. The top one is a recording gauge which records on a chart in thousands of pounds the amount of water passing into the boilers at any time during the day's run. The second dial is a meter which meters the amount of water going into the boilers in pounds. The third dial shows the momentary amount of water passing into the boilers in thousands of pounds per hour. This meter is made by the Builders' Iron Foundry, Providence, R.I.

CO_2 Recorder

This instrument is a Hay's CO_2 and draft recorder which records on a chart the draft and the percentage of CO_2 or carbon dioxide in the flue gases. This apparatus is a small laboratory in itself, and as the name implies, is automatic, and once started works well with very little attention, the charts being changed every twenty-four hours, and the caustic potash solution renewed once in three or four weeks. Flue gas analysis is quite a study, and something every engineer should know, but it is difficult to get any reading matter on this subject which is plain enough so that the average engineer can understand it. There are several good books by the inventor of this instrument, Jos. W. Hays and in his book, "How to Build Up Furnace Efficiency," he claims that the very worst smoke will not produce more than 2 per cent. fuel loss, while you can have as high as 40 to 50 per cent. loss by allowing too much air to enter the furnace and have no smoke. This has been proved in our plant here, for when the CO_2 recorder was installed at first the average CO_2 was 5 and 6 per cent. This was caused by having the stack dampers open too wide, and now 12 and 13 per cent. of an average CO_2 is being obtained and a great deal more work is being done with the same amount of oil.

The CO_2 recorder at this power house is placed at the end of the battery of boilers nearest to smoke stack. An inch pipe runs through the back ends of all boilers and a branch pipe is taken into this header from each boiler with a valve on the branch close to header. In this way a sample can be taken from any one of the battery of boilers. In order to get a good CO_2 percentage the fires must be good and only sufficient air admitted to burn the fuel as excess air is the greatest enemy in this respect. The brickwork of the boilers should be in good shape as the air leaks in brickwork will spoil your sample of gas, when good results are really obtained from the furnaces. The draft should be regulated by the stack damper for air leaks in the setting will still flow into the flue just as rapidly as ever if only ash pit dampers are regulated. When the stack damper is checked all draft to uptake is checked.

Plant Performance

In the foregoing pages it will be seen that the plant is well equipped with instruments so that performance of the plant can be seen at any time by going over the different recorded charts.

Jan. 15 to 31, 1918.

Average Load per day (average 24 hours)	
days)	62,000 K.W. Hours
Average Load per hour	26,000 K.W. Hours
Average bbls. oil per day (350 lbs. per bbl.)	310 bbls.
Average bbls. oil per hour	13 bbls.
K.W. hours generated per bbl. of oil	200
Fuel oil used per K.W. hour	1.75 lbs.
Water evaporated from and at 212° F. per lb. of oil	15 lbs
Average load per boiler	1,000 K.W.
Rating of boilers	550
Aver. steam temp.(superheated)	530° F.
Temp. of Saturated Steam (at 175 lbs. Gauge)	377° F.
Degres of superheat	153° F.
Aver. temp. of flue gases	520° F.
Aver. temp. of feed water in heater	200° F.
Aver. pressure of fuel oil	80 lbs.
Aver. temperature of fuel oil	194° F.
Steam pressure to oil burners	150 lbs.
Calorific value of fuel oil, B.T.U.	18,500

CONDENSER READINGS

Surface Condensor No. 1 Turbo-Gen.

Vacuum in inches (observed)	28.9
Vacuum compared with 30" Barometer	28.8
Temp. inlet water to condenser	34° F.
Temp. outlet water to condenser	58° F.
Temp. of exhaust steam	85° F.
Temp. of condensate	85° F.
Air pump sump, temperature	40° F.
Load on generator	2600 K.W.

READINGS NO. 2 UNIT

(La Blanc Jet Condenser)

Vac. by mercury column	28 in.
Load on turbine	800 K.W.
Temp. injection	32° F.
Temp. discharge	55° F.
Temp. air pump inlet	48° F.
Temp. air pump outlet	50° F.
Temp. exhaust steam	140° F.
Vac. at condenser injection inlet	20 in.
Vac. on air pump suction	10 in.
Speed of pumps	712 rev. per min
Steam pressure	175 lbs.

The entire plant of the No. 2 power house just described was furnished by the Taylor Engineering Company, consulting and contracting engineers, Vancouver, B.C.

CHIMNEYS

By O. C.

THE boiler house chimney is a good example of that still lingering class of engineering contrivance which has to be proportioned by precedent rather than by abstract calculation. It would seem at first glance to be a simple matter to calculate what the height and area of a chimney should be to fulfil a stipulated set of conditions.

The composition and the volume of the furnace gases can be approximately foretold; the calculations of the velocity which such gases should have in a chimney of any given height appears to present few difficulties, the amount of air required for the complete combustion of a given amount of fuel is ascertainable, and from these figures it would seem that one ought to be able to say what minimum height and area of chimney will answer for the maximum requirements of any given plant.

It would be extremely convenient if this were so, for chimneys are costly affairs and there is no doubt that most chimneys are built somewhat too big for their job, and so cost more than, with more exact knowledge of chimney proportioning, would be necessary. But in fact all these simple calculations based on composition, temperature, volume, weight, and velocity are vitiated by the presence of uncertain and theoretically incalculable factors. Climatic conditions outside the chimney affect the temperature of the gases within and alter their weight and volume, and the chimney must be of such dimensions as to give a good average of efficiency between the extreme ranges of heat and cold, wind and calm. Air infiltration through the brickwork of the flues and of the chimney itself may materially affect the draught, and has to be reckoned with. The type of furnace and manner of firing and operation has an important influence on the amount of draught required at the furnace, and this is a factor that can be measured, but hardly calculated. The length and disposition of the flues leading from the furnace to the chimney base is another influence that can only be estimated by experience.

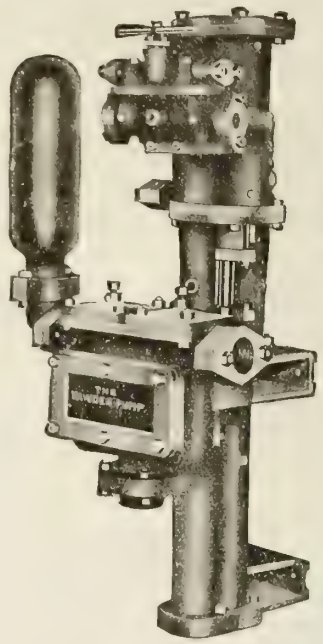
Because of these and other elusive factors the proportioning of a chimney is a matter of intelligent guesswork, based on a knowledge of the performances of actual chimneys serving plants of approximate type and size to the one under consideration. Naturally, in arguing from the imperfect actual to the perfect desirable, formulae can be used embodying constants based on ascertained data, and the chimney formulae found in engineering handbooks and textbooks are of this kind. Most of these can be relied on to give proportions for a chimney which will be adequate, but many of them give figures which allow in particular instances an unnecessarily large margin of capacity, being based on assumptions which under modern power house conditions no longer hold good.

Canadian-Built Centrifugal Pumps of Modern Design

Canadian Industrial Developments Demand High-grade Apparatus—Steam, Electric and Gasoline Driven Pumps Are Features in Product of Pump Building Concern

FOR some years the Bawden Pump Co., Ltd., Toronto, have been manufacturing steam and centrifugal pumps which have proved very successful. They have made extensive investigations of the duties required by pump users and in order to meet these duties have developed a full line of pumps of all types which embody some interesting features the particulars of which will be noted below. The centrifugal pumps are designed for general purposes such as water works, sewage disposal, fire service and boiler feed.

The company has also developed a complete line of pumps for heavy duties met with in pulp mills, such as handling pulp stock, chlorine liquor and acids, etc. Due to these heavy duties and the demand for a high class pump for this class of work, they have made a special study of the requirements of the pulp mill, and have accordingly developed a pump specially suitable to this work, and a few of the more recent installations are included in the following: Abitibi Power and Paper Co., 4 pumps; Port Arthur Pulp and Paper Co., 15 pumps varying in capacities up to three million gallons per day; Whalen Pulp and Paper Co., 16 pumps varying in capacity up to three million gallons per day; Frasers Ltd., 14 pumps varying in capacity up to four million gallons per day; Bathurst Lumber Co., 6 pumps varying in capacity up to four million gallons per day. They have under construction all the steam and centrifugal pumping equipment for the new Parliament Buildings at Ottawa, as well as a five million gallon high lift turbine booster pump for the city of Toronto.



MARINE TYPE BOILER FEED PUMP.

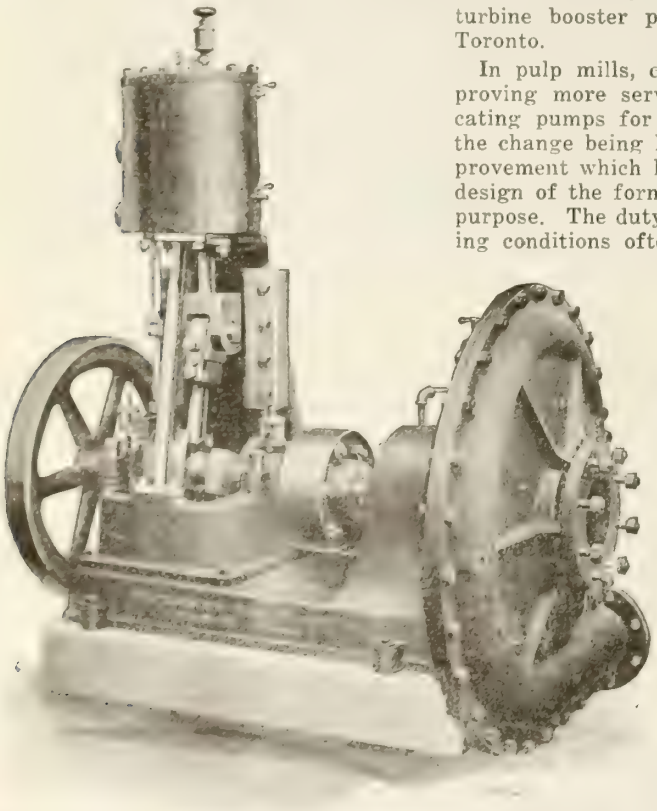
In pulp mills, centrifugal pumps are proving more serviceable than reciprocating pumps for handling pulp stock, the change being largely due to the improvement which has taken place in the design of the former for this particular purpose. The duty is severe and operating conditions often abnormal, thus requiring pumps with impellers of special design to meet the situation. In the design of all the different types of pumps, the company aims at efficiency in operation, accessibility of the various parts and standardization in manufacturing.

Centrifugal Pumps

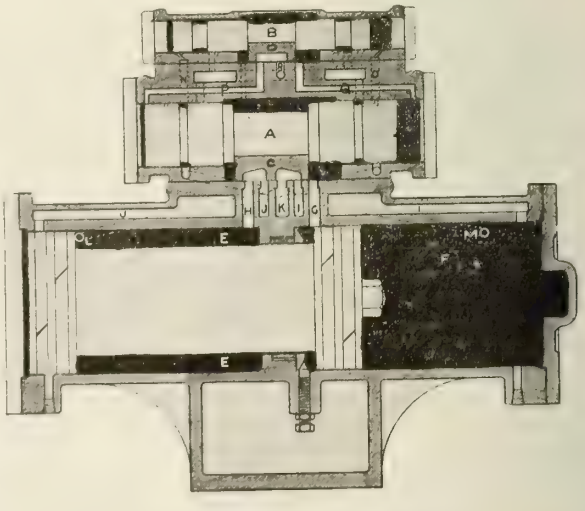
The Bawden Pump Co. makes standard single and double suction, single stage pumps, and also multistage centrifugal pumps. The single and double suction pumps are known as type "SS" and "S" respectively. The pumps are made for any kind of drive, the bearings being constructed accordingly. The general design is the same for all types except for certain details which will be described later. The pump casing is made in two castings split on a horizontal plane passing through the centre line of the shaft, so that the shaft and impeller can be removed, and the interior of the pump examined without breaking any pipe joints.

The bottom half of the casing containing the suction and discharge connections is bolted rigidly to the base. The top half or cover can easily be moved by means of eye bolts located on the top. All joint surfaces are machined to a smooth finish and therefore require only a very thin joint of prepared paper. All passages are free from sharp radii and are designed to give the fluid pumped a constant and even flow.

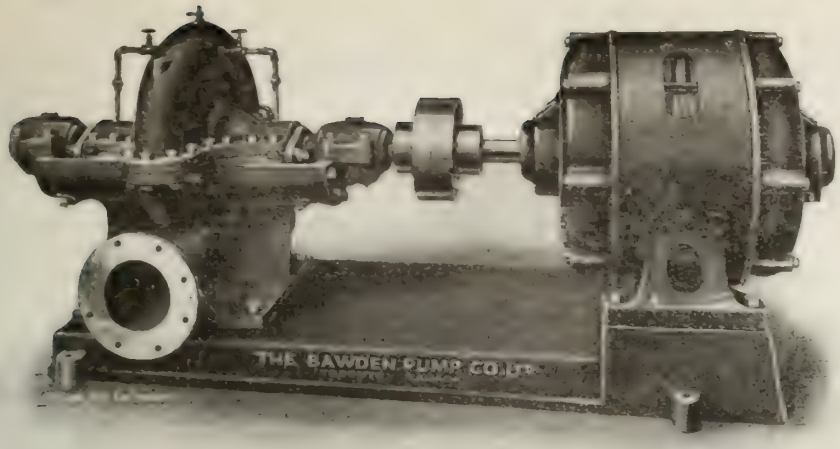
The design of the impeller is an important feature in these pumps. It is enclosed and is single or double suction according to the type of pump. It is balanced both for static and running balance. The impeller has two neck rings of different diameter, the one on the discharge side being larger than the one on the suction, therefore the effective area



STEAM DRIVEN CENTRIFUGAL PUMP FOR CONDENSERS, ETC.



VALVE ARRANGEMENT ON HORIZONTAL PUMPS.

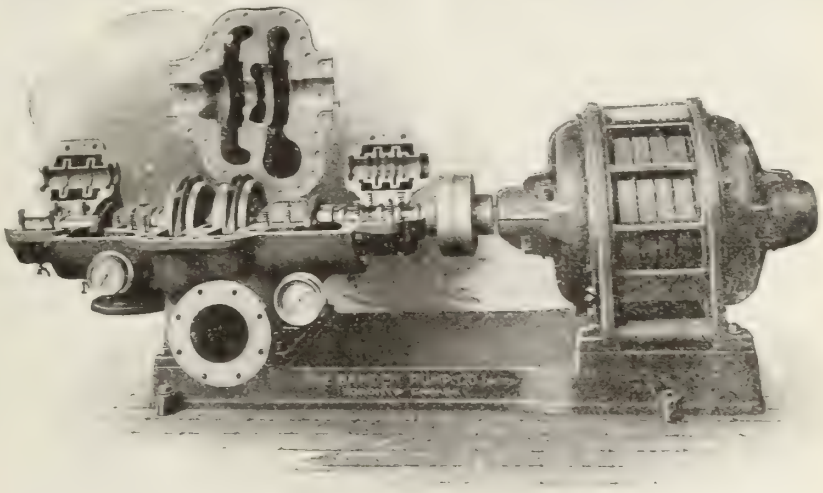


NO. 8. TYPE S DOUBLE SUCTION MOTOR-DRIVEN CENTRIFUGAL PUMP.

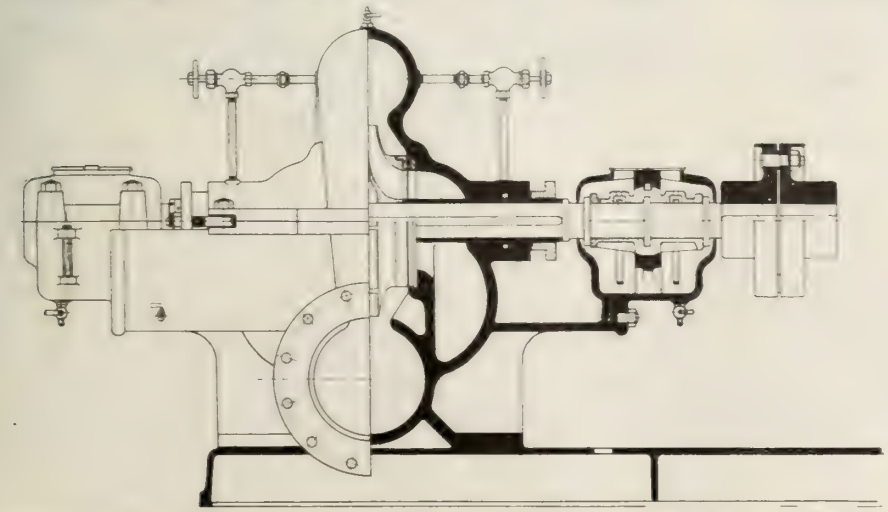
is larger on the suction than on the discharge side. The pressure being equal on both sides, combined with the relief and balance chambers, keeps the impeller and shaft in perfect hydraulic balance. The pumps have also a water seal. The blades of the impeller are carefully filed to templates so as to give the correct inlet and discharge angles therefore enabling the fluid pumped to enter and leave without shock. The neck rings are of the labyrinth type made of the same material as the impeller. One ring is secured to the impeller and the other to the bottom half of the pump casing. The design of the neck rings is such that liberal clearances are permissible without undue leakage.

The bearings, which are held on brackets, are entirely separate from the pump casing and stuffing boxes, water therefore cannot enter the oil chamber. The housings are split and are fitted with projections on the lower half so as to prevent the bushings from turning, at the same time allowing both halves of the bushings to be removed for inspection without disturbing the shaft and pump casings.

The bearing bushings are made of phos. bronze and not babbitt, giving less friction and less possibility of a breakdown through failure of the babbitt. The bearings which have ring oil lubrication are exceptionally long. To allow the impeller to float the shaft has ⅛-inch end motion. Both stuffing boxes are fitted with brass water seal rings connected through pipes to the pump casing or to the outside supply. The couplings on the end of shaft are of the flexible pin type. The coupling is made of cast iron, machined and polished, and fitted with steel pins covered with rubber sleeves, giving smooth running. This type of coupling is fitted to all double suction and multistage pumps, the single suction pumps having a solid pin coupling. The pump base is of substantial construction as will be observed in the illustrations.



TOP CASINGS REMOVED SHOWING ACCESSABILITY OF IMPELLER SHAFT AND BEARINGS. TYPE SS PUMP.



CROSS SECTION, TYPE S, DOUBLE SUCTION SPLIT CASING CENTRIFUGAL PUMP.

Special Service Pumps

The above description covers the standard types of pumps. The pumps for handling pulp stock differ in one or two details. For stock pumps the neck rings on the inside are removed and replaced by a wearing plate. The stock pumps are single suction, open impeller type. Pumps for handling acids are usually of the double suction type. They are made of special bronze, having acid resisting qualities. In these pumps all parts coming in contact with the acid are made of bronze, and the packings are made of asbestos. Pumps for handling chlorine liquor are made of cast iron throughout, the enclosed type of pump being used for this service.

Multistage and Turbine Pumps

Multistage centrifugal pumps have the same features as the single suction pumps. Each impeller is balanced individually, the method being the same for any number of impellers. The impellers have labyrinth neck rings on both sides. All neck rings and middle chamber bushings are made of "lumen" metal.

The turbine pumps are of the double-suction type and are suitable for special service where high heads are required with comparatively low speeds. The Bawden high lift turbine pumps are similar to the centrifugal pumps except that they are fitted with specially designed impellers and guide passages.

Circulating Pump

Another type of pumping unit which the Bawden Pump Co. has developed is a steam driven circulating pump for marine and stationary work, for condenser service, and also for contractors. The pump is designed for delivery of a large column of water at a low head. The pump is similar to the single suction type with hydraulically balanced impeller. The engine and pump form a complete unit, being mounted on a common base. It will be observed in the illustration that the engine is open type and the parts easily accessible. The engine is equipped with a balanced piston valve.

Balanced Valve Feature

The basic feature of the Bawden steam pump is the valve, which is of the balanced piston type. In this type of valve all tappets, levers, springs, rocker shafts, tubes or other gear have been dispensed with. A special feature of the Bawden piston valves is the arrangement for catching leakage steam due to wear and tear, for preventing them from getting into equilibrium at their driving ends. The steam piston is automatically cushioned at each end of the cylinder by a special design of the two main steam ports, therefore dispensing with all adjusting mechanism to compensate variations of speed, etc., and together with allocation of the drain cocks, makes the cushion effective under any emergency. The pump has no dead centres and makes a full length stroke at any piston speed and on any duty.

These pumps when of the vacuum type have long strokes and are well suited for producing high vacuums, and are equally effective when exhausting into any kind of condenser. The water ends in all types of pump are designed so as to offer facilities for inspection and repairs. These pumps have been found to be very suitable for boiler feeding purposes on account of their steady water pressures under varying loads and speeds. They can also be used as fire pumps as they can be operated at high piston speeds due to the absence of external valve motion.

Compound Pump

The Bawden compound pumps have the same valve gear as the simple pumps but are more economical in steam consumption. In the compound pump the high and low pressure pistons work in one cylinder, the steam ports are of the shortest length and so arranged that the high pressure steam in exhausting to the low pressure cylinder never leaves the main cylinder casting. There are no external passages, therefore radiation and condensation are reduced to a minimum. Only one steam chest is required and one valve to distribute the high and low pressure steam. The compound pump has also been proved to be a reliable and economical pump for boiler feeding purposes.

Special Types of Steam Pumps

The company also makes a duplex pump. The chief feature about this pump is that either side will work independently of the other, that is, if one side breaks down, the other side can be continued in operation. The Bawden oil pump is specially designed for pumping oil or other heavy liquids. The steam cylinders are the same design as in the standard pump, but they have a longer stretcher to more effectively prevent the liquid from being carried into the steam end. The pump pistons have split rings instead of packing. The valves are of the wing valve type and are usually brass double beat valves. The vertical boiler feed and sinking pumps are similar in design to the horizontal types but are built specially strong to withstand rough usage.

A special feature is cushioning of the piston which is positive under all conditions. They are self-starting even if submerged and will run fast or slow without any kind of adjustment. The special pump for fire service is of the compound type with the standard steam end. The water end is of the group valve type.

Standard Types of Pump

The standard boiler feed pumps for high pressure service are made in three main types, packed piston, packed piston pot valve and centre packed rain types. The water cylinders are constructed for pressures up to 100, 150 and 200 pounds respectively. The last two mentioned are made as either simple or compound pumps.

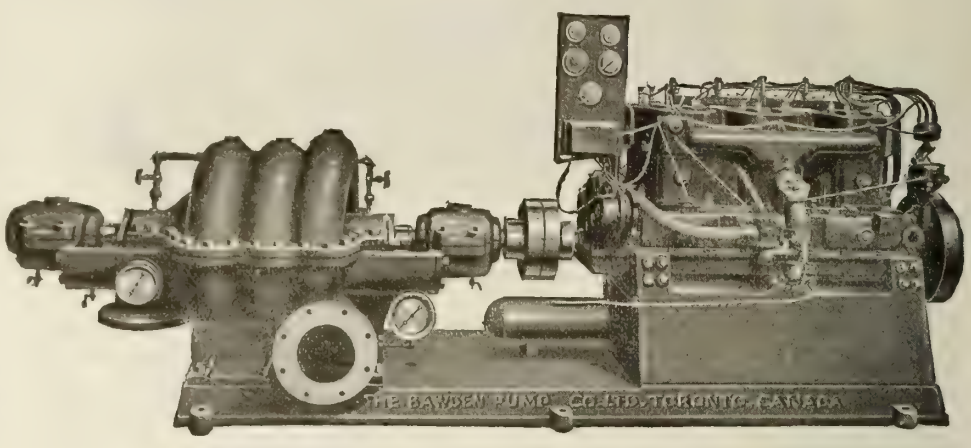
The general service pumps for medium pressures, 100 and 150 pounds, are made in two types, packed piston and packed piston pot valves. Two other general service pumps for high pressures 200 and 250 pounds are both centre packed ram type. The standard vacuum pump has a long stroke. The pump valves have large areas and are all water sealed.

Steam End Construction

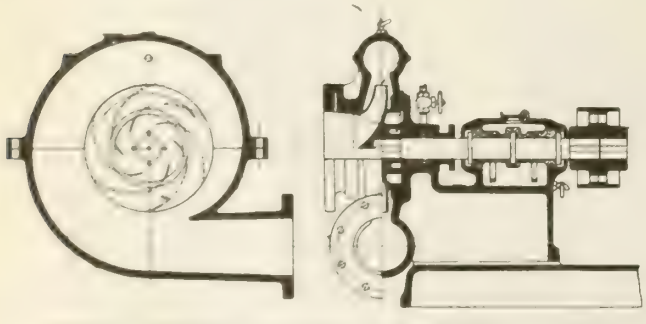
The principal features of the Bawden pumps as they affect the steam end have already been detailed. A few particulars regarding the general construction may now be in order. The construction of the steam end, except for sizes, is identical for all the standard types of pumps. The standard pumps are all centre outside packed, simplex horizontal, double acting, with steam thrown piston valves. In the compound pump the same balanced valve motion is used as on the simple steam pumps, enabling the high and low pressure pistons to work in one cylinder with one specially designed two-ported slide valve to distribute the high and low pressure steam.

The steam cylinders are designed to carry modern pressures. They are fitted with cast iron block pistons, self-adjusting cast iron rings and tobin bronze piston rods. The steam parts are of ample area and are designed to reduce steam clearances to a minimum. The pilot and main valves are of the back pressure "D" slide valve patterns, and are made of cast iron.

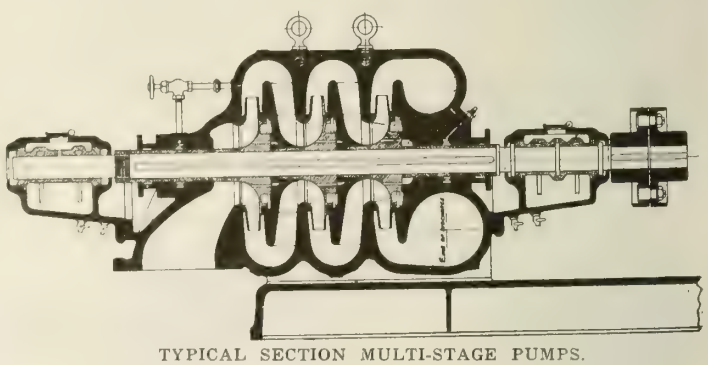
The valves are operated by pistons or plungers which are also ground into their respective steam chests, so that both valves, when so fitted and arranged to operate in conjunction with the main



8-INCH THREE-STAGE GASOLINE ENGINE DRIVEN EMERGENCY FIRE PUMP.

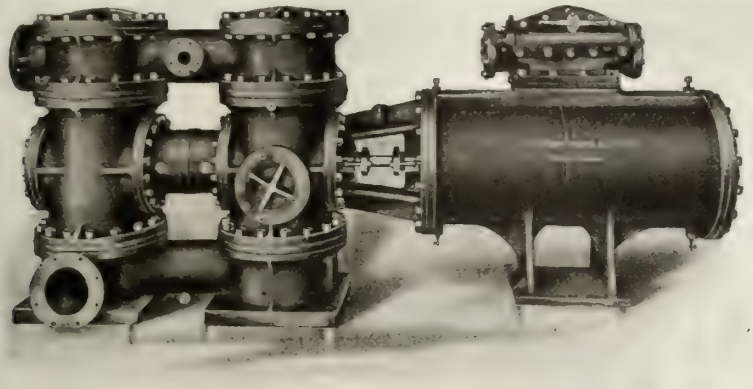


TYPICAL SECTION OF TYPE S.S. CENTRIFUGAL PUMPS.



TYPICAL SECTION MULTI-STAGE PUMPS.

piston ensures efficient cushioning of the latter under any duty, also instant operation of the valves therefore practically eliminating steam wire-drawing. The pumps are built up construction, the steam and water ends being separate units. They are held together rigidly by means of a stretcher which is machined to give perfect alignment. The stretcher is of flanged construction, heavy ribbed type, having the flanges containing the steam and water ends. The packing glands are easily accessible.



BAWDEN PATENTED GROUP VALVE INSIDE-PACKED COMPOUND FEED OR FIRE PUMP.

Water End Construction

The water ends of these pumps vary in design according to the type and service, etc. The water cylinders are of course designed to carry any pressure required. The cylinders have brass liners and are fitted with pistons packed with hydraulic packing. The rams are made of cast iron having brass sleeves pressed over the entire length and are securely cottered to the piston rod. The piston rod is made of tobin bronze machined to receive the ram and steam piston. In the packed piston type of pump the valves are made of iron or brass, the valve seats being brass with flat faces.

In this type of pump the valves are accessible through a hand hole at the side. In the pot valve pumps, the valves are made of specially selected rubber and are contained in separate valve boxes. Their seats are made of commercial bronze with flat faces. They are pressed into their respective valve pots and held in position by means of brass valve stoppers, screwed in through valve box covers and then locked in position with brass nut. All the rubber valves are supported with brass plates machined and recessed to receive the compression springs.

For the vacuum pump the steam end is the same design as the standard simple type of pump. The vacuum pump has a long stroke and the pump valves have large areas and are all water sealed. The pump body is lined with brass and the piston rod is tobin bronze. The suction valve deck is cast in one with the body. The discharge deck and pump cap are made in separate castings. The deck is accurately machined to receive the valve seats and is designed with a liberal factor of safety to withstand the duty designed for. The valves are made of specially selected rubber, the seats being made of good commercial bronze with flat faces, and pressed into their respective valve decks. The suction valves are pressed into position and held by means of the suction brass stoppers secured to the discharge seats, which are in turn held by the discharge valve stoppers in through the discharge cap and afterwards locked in position with brass lock nuts on the outside of pump proper. All rubber valves are supported with brass plates accurately machined and recessed to receive the compression rings. The water plunger is of the inside packed piston type and is made of cast iron. It contains two parts, the piston proper and the follower. The piston is accurately machined to give the proper tension to the water packing which is held in position by the follower.

The Bawden Pump Co. has recently developed a condensation pump and receiver. The outfit is in one unit and consists of a tank, pump, motor and automatic cut-out switch. A small centrifugal pump is bolted to a boss on one side of the tank and is connected to a one h.p. electric motor on the opposite by means of a phos. bronze shaft running through the tank. The shaft runs through suitable stuffing boxes and is connected to the motor by means of a flexible coupling.

By this arrangement the packing glands are only subjected to a head of approximately three feet of water. The discharge pipe is connected to the top of the pump and the return pipes from the heating system are connected to the side of the receiver near the top. As the tank fills, the copper float inside lifts and throws in the automatic switch, thus starting the motor and emptying the tank.

POWER PLANTS TO BE RATED BY U. S. FUEL ADMINISTRATION

The problem of how to obtain maximum economy in power generation throughout the country is being approached in a novel and commendable manner by the Fuel Administration of the United States. According to investigations conducted by that body, it is possible to effect a saving of ten to twenty per cent.—from 25,000,000 to 50,000,000 tons of coal per year—by helping owners of power plants to operate them correctly with their present equipment. This includes plants in the industries, in office buildings, hotels, apartment houses, etc.

Certain procedure will be followed in carrying out the programme as follows:

1. Personal inspection of every power plant in the country.

2. Classification and rating of every power plant, based upon the thoroughness with which owner of said plant conforms to recommendations.

3. Responsibility of rating the plants, which will fall upon an engineer in each district, the rating to be based upon reports of inspectors, who will not express opinions, but will collect definite information. The State Fuel Administrator, in his judgment, may entirely or partially shut off the consumption of coal to any needlessly wasteful plant in his territory.

4. Inspectors are to be furnished from one or more of the following sources: (a) Inspectors of the steam-boiler insurance companies; (b) State factory inspectors; (c) engineering students from technical colleges; (d) volunteers.

The ratings will be based upon recorded answers to questions, each of which will be given a value depending upon its relative importance to the other questions. Depending upon the efficiency of methods in use in any plant, it may be rated in class 1, 2, 3 or 4.

Advance Notice of Inspection

In advance of the first inspection a questionnaire will be sent to every power plant in each district, with notice to the owner that within 60 or 90 days his plant will be inspected personally and the questionnaire will be checked up by the inspector upon his visit. This action, it is believed, will tend to prepare the minds of plant owners for what will follow and will operate to produce a desire to improve plants, if necessary, so that they may be rated in a high class by the time the inspector calls.

The Fuel Administration has prepared a 50-minute film of moving pictures showing good and bad operation in the steam-boiler plant, methods of testing boilers, fuels, etc. These pictures will be available for each State in connection with its educational propaganda.

The administration is also preparing a series of official bulletins on engineering phases of steam and fuel economies. Some of these are now ready for printing. They will include: Boiler and furnace testing; flue gas analysis; saving steam in heating systems; boiler-room accounting systems; saving steam and fuel in industrial plants; burning fine sizes of anthracite; boiler water treatment; oil burning and stoker operation.

In addition to this service, a list of competent engineers has been prepared in Washington for each State and is available for use of each local administration. As the work develops, still further constructive assistance is contemplated for helping owners to bring their plants up to a high plane of economic operation.

Electricity and Hydraulics

PRINCIPLES AND OPERATION OF MODERN ELECTRICAL EQUIPMENT—IV.

By A. M. Pere.

THE operation of all dynamo electric machinery is based on the production of an electric current in a conductor by the action of magnetism.

Magnetic flux is a term used to express that property of a magnet whereby its action is made known in its effects on magnetic objects, such as iron or steel, and by its property of generating an electric current in a conductor under suitable conditions.

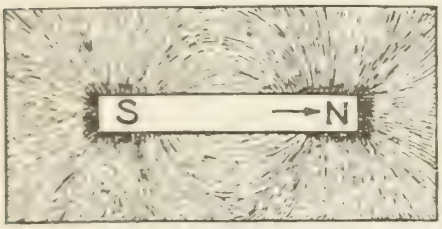


FIG. 1 MAGNETIC FIELD AROUND BAR MAGNET.

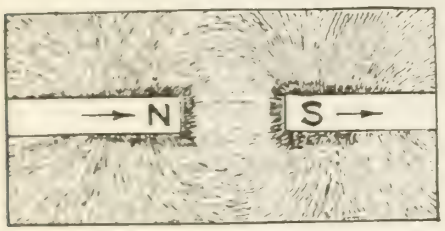


FIG. 2—MAGNETIC FIELD AROUND NORTH AND SOUTH POLES.

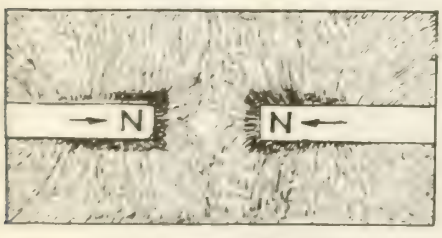


FIG. 3 MAGNETIC FIELD AROUND TWO NORTH POLES.

The act of magnetization not only alters the steel, but alters the space around the steel, causing it to assume a state of stress or strain.

If a magnet be plunged into clean iron filings they will be found to adhere in tufts, clinging chiefly to the ends or polar regions of the magnet. If such a tuft be examined it will be found that each hair or strand of the tuft consists of a lot of filings which have arranged themselves as a chain. This property of a magnet may be shown very clearly by covering the magnet with a sheet of cardboard upon which iron filings have been sprinkled; and if the cardboard be gently tapped the filings will assume the form of a series of curves, arranging themselves in more or less continuous lines from one pole to the other, as is shown in Fig. 1.

These curves, while interesting in themselves, render visible to the eye the paths of forces which would be otherwise invisible, and the mechanical forces which magnets exert upon each other and magnetic objects in their neighborhood can be very clearly depicted by this means. Wherever we find these lines of force crossing any part of space there is a mechanical tension or pull, just as if the lines were stretched threads of rubber or some other elastic substance. This state of strain really exists in the neighborhood of the poles of the magnet, and is only made visible by the behavior of magnetic objects brought into its field of action.

If two bar magnets be brought near each other in such a manner that a north pole and a south pole are adjacent to each other and a sheet of cardboard be placed on top, sprinkled with iron filings and lightly tapped, the curves formed by the filings will show that the lines of force proceed from one pole to the other, spreading out on the way, as shown in Fig. 2. But if two north poles are brought together the filings will arrange themselves as if the two magnets and the lines of force repelled each other, much as is shown in Fig. 3. Such is the case, and under all conditions like poles repel and unlike poles attract. This is explained on the assumption that the magnetic flux has sense or direction. It is understood that the magnetic flux flows out of the north pole and in at the south pole of any magnet.

The Earth's Magnetism

The earth itself is a magnet, and to this fact we owe that useful instrument, the compass, for if a magnet be freely suspended it will be found to turn and point in a direction almost due north and south.

The north magnetic pole of the earth is not of the same polarity as that of the north pole of a magnet, for we have just shown that like poles repel. The north and south poles of a magnet, strictly speaking, are the NORTH SEEKING and SOUTH SEEKING poles respectively. Fig. 4 shows an elementary diagram illustrating this. The north pole of the magnet is shown as having the flux coming out of it, proceeding to the north pole of the earth, emerging at the south pole and entering the south pole of the magnet. This fact once established, no difficulty is ever encountered in remembering the relation of a magnet's poles to the earth's magnetism.

FIG. 4—RELATION OF THE EARTH'S MAGNETISM TO THAT OF THE BAR MAGNET.

The true magnetic poles of the earth do not correspond exactly in location to the geographical poles, but are a considerable distance away and shift slightly from year to year. The magnetic north pole of the earth is more than 1,000 miles away from the actual pole, being in lat. 75° 5′ N. and long. 96° 46′ W.

Magnetism and the Electric Circuit

Magnetism and electricity are very intimately related; so much so, in fact, that one can hardly be studied without the other.

When an electric current flows along a wire a magnetic field is set up in a circular direction around the wire. Fig. 5 represents a conductor in which the current is flowing from the observer to the paper. This direction is indicated by the cross in the centre of the wire. This cross represents the tail feathers of an arrow travelling in the direction in which the current flows. The opposite direction is represented by a dot shown in Fig. 6, which indicates the tip or point of the arrow. This convention is often made use of, and is very convenient. In Fig. 5 the direction of magnetic flux around the wire is in a clockwise direction. If the current travels in the op-

posite direction the flux is also reversed, as in Fig. 6, and a compass needle, as shown, points the opposite way.

Many analogies are used as an aid in remembering this relation between the directions of magnetic flux and current, and perhaps the most useful of them is that of the right-hand nut and screw. If a right-hand screw be held in the hand

FIG. 5 — MAGNETIC FIELD AROUND A WIRE CARRYING CURRENT IN A DIRECTION FROM THE OBSERVER.

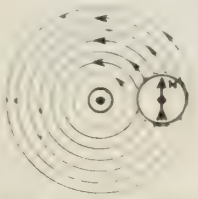


FIG. 6 MAGNETIC FIELD AROUND A WIRE CARRYING CURRENT IN A DIRECTION TOWARDS THE OBSERVER.

and the nut spun around on it, the direction of travel of the nut along the screw represents the direction of flow of current, while the direction in which the nut is rotated corresponds to the direction in which the magnetic flux travels.

The Solenoid and Electro-Magnet

If a coil of wire be wound, as in Fig. 7, and a current is sent through it, as shown by the arrows at the ends of the wires, the magnetic field created around the wire will form magnetic poles at the ends of the coil similar to those of the common bar magnet. A little consideration will show that the magnetic flux around the wire will travel in the directions indicated by the arrows, and that the effect of the coils will be considerably stronger than that of a single straight wire.

A useful rule for connecting the direction of the current and the direction of the magnetic flux in a solenoid or elec-

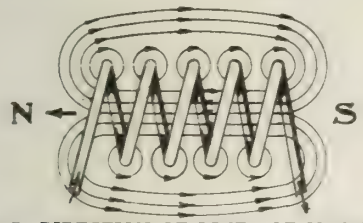


FIG. 7—DIRECTION OF LINES OF MAGNETIC FORCE THROUGH A SOLENOID.

tro-magnet is as follows: Grasp the solenoid or coil with the RIGHT hand in such a manner that the fingers point in the direction in which the current flows around the coil and place the thumb on the top of the coil as shown in Fig. 8. The thumb will then point in the direction in which the magnetic flux flows, i.e., towards the north pole of the solenoid or electro-magnet.

If a bar of iron is placed in the centre of the coil of wire shown in Fig. 7 the magnetic effect of the current will be found to be very much increased. Iron has the peculiar property of being a much better conductor for magnetic flux than other materials and thus increases the strength of the magnetic field in much the same manner that a wire of copper will pass a greater quantity of electricity than will an iron one of the same size and length, under the same voltage. This quality is called the permeability and is shared to a slight degree by cobalt and nickel. Practically all other materials are much poorer conductors of the magnetic flux and all are about equal in this respect. The permeability is measured by taking that of air as the standard and making it equal to one. Wrought iron and cast (machinery) steel have about the same permeability, which may easily reach a value of 1,200 or 1,500. This means that in a closed magnetic circuit such as would be formed by winding a coil of wire around a ring of soft iron, 1,200 to 1,500 times as much flux would pass through the iron as would pass through an air current of the same dimensions for an equal current strength.

Flux Density and Saturation

In many problems it is important to be able to express the amount of flux as a numerical quantity and a unit has been chosen for this purpose called the Maxwell. This name is somewhat out of use at present and in place of saying so many Maxwells it is more usual to say, so many lines of force. The flux density or the strength of the magnetic field is measured in lines per square centimetre. This quantity is important because iron has a peculiar variation in its permeability such that when magnetized to a high flux density the permeability or capability for further magnetization greatly decreases. Under such conditions the magnetic material is said to be getting saturated and with very high flux density is said to be saturated. Saturation is a rather indefinite term. With good wrought iron or steel it would be reached at something like 20,000 or

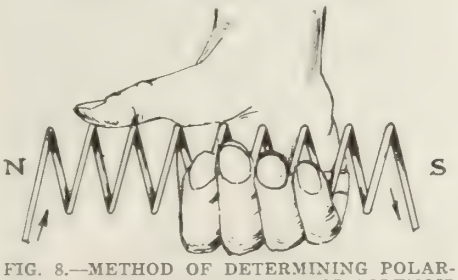


FIG. 8.—METHOD OF DETERMINING POLARITY OF AN ELECTRIC-MAGNET OR SOLENOID

more lines per sq. cm. while in cast iron it would be at 8,000.

Ampere Turns and Magnetic Flux

The magnetic flux created by a current increases as the current increases, decreases as the current decreases, and is reversed in direction when the current is reversed.

The amount of flux created in a magnet varies as the number of turns in the winding, and as the number of amperes passing through it. This is to be expected for it may reasonably be supposed that two turns would cause twice the amount one would. This is correct when low densities are considered but when the iron approaches saturation naturally it no longer holds good. The product of the number of amperes and the number of turns is called ampere-turns and equal numbers of ampere-turns create equal magnetic flux in similar circuits. This is true no matter whether one ampere and ten turns or ten amperes and one turn be considered.

Answers to Last Month's Problems

1. The current produced through a resistance of 5 ohms by an e.m.f. of 10 volts will be $10 \div 5 = 2$ amperes.

2. An e.m.f. of 15 volts will produce a current of 3 amperes through a resistance of $15 \div 3 = 5$ ohms.

3. To produce a current of 4 amperes through a resistance of 4 ohms will require an e.m.f. of $4 \times 4 = 16$ volts.

4. The current will be $500 \div 20 = 25$ amperes.

5. The dynamo must generate a current of $20 \times .2 = 4$ volts.

6. The smallest e.m.f. that will ring the bell will be $400 \times .03 = 12$ volts.

7. The resistance necessary to limit the current to a value of 5 amperes will be $500 \div 5 = 100$ ohms.

8. The total resistance of the circuit neglecting the line resistance will be $150 \div 25 = 6$ ohms. The resistance of the dynamo is one ohm. Deducting this leaves a value of 5 ohms for the resistance in question.

This Month's Problems

1. In what direction does the magnetic flux flow out of a magnet?

2. Does the north magnetic pole of the earth correspond to the north pole of a bar magnet, as regards the direction of flux travel?

3. Draw a diagram showing the relation between the magnet and the earth's magnetism and then compare it with Fig. 4.

4. In what direction does the magnetism flow around a conductor carrying current; does any other analogy besides that given in the course occur to you in this particular?

5. What is the effect of coiling a conductor carrying current into a helix or coil?

6. What method may be used for determining the polarity of a solenoid?

7. What is meant by the term ampere-turns?

8. If 25 amperes flow through a coil having 100 turns, how many ampere-turns result?

READER'S QUERY

The factory with which I am connected obtains its power from an outside source. Three single-phase transformers of 250 kv.a. capacity each serve to transform the incoming line voltage of 13,200 down to 550 volts, at which voltage it is distributed throughout the shop for the operation of the various three-phase motors.

We are experiencing considerable trouble with the secondary cables which run from the transformers to the switchboard. These secondary connections consist of three single-core lead covered 750 m.c.m. cables, each of which runs through a separate iron conduit to the board. These pipes are hot to the touch and great inconvenience has been

caused by the end-bell compound running out of the endbells on these cables at the switchboard. The transformers are hardly ever run at rated capacity and the power factor is about 85. Are the cables too small for the load carried or is there some other trouble? H. A. B.

Answer. — The trouble experienced above is one which occurs quite frequently if the design in any respect is at fault. The primary cause for the flowing of the end-bell compound is of course the heating in the cables, and the reason for the location of the trouble at the switchboard will in all probability be found in the difference in elevation between the two ends of the cable. While the material with which the cable is impregnated is very viscous and while the end-bell compound at normal temperatures is nearly in a solid state, yet given sufficient time and a sufficient temperature rise both will flow like any liquid though at a slower rate. End-bells are manufactured which are absolutely tight and are able to resist the head or pressure caused by the compound under similar conditions to the above.

The rise in temperature is not alone due to the resistance of the conductors but in this case is due to hysteresis in the iron conduit or pipe surrounding the single conductors.

When a current of electricity flows through a conductor a magnetic field is set up in the space surrounding the wire and when a single conductor is carried through an iron pipe the pipe is very strongly magnetized, given sufficient current. When the current reverses the magnetic flux also reverses. This reversal of magnetic flux requires a certain amount of energy for its accomplishment and this energy is dissipated in the form of heat. When the two sides of a single-phase circuit or the three leads of a three-phase circuit pass through the same pipe or conduit the resultant magnetic field due to the currents flowing is zero for the outgoing and return currents are equal in value and the direction of magnetic flux is opposite in each.

POLARITY INDICATOR

The query in last month's issue regarding the composition of the liquid used in a polarity indicator has reminded me of another solution which has been used with good results. If a few crystals of iodide of potassium are dissolved in water and then a little starch paste is added a very sensitive electrolyte is obtained which turns to a dark blue color at the anode when a very weak current is passed through it.

The decomposition of the iodide of potassium liberates iodine at the anode or positive pole which, acting on the starch in the solution, turns it a dark blue color at the anode.

Montreal. FRANK WILLIAMS.

PLATINUM is first recorded in Russia in the year 1821, when it was distinguished in the working of alluvial gold in the Ural mountains. Its value was not appreciated then, hence the discovery attracted little attention.

Torsion Meter for Power Transmitted by Propeller Shafts

The advent of the turbine introduced new problems in the measurement of power developed by marine engines. The conditions under which such apparatus is used on board ship demand simplicity of construction and reliability of operation. The apparatus described in the following article has proven satisfactory in actual service and is the result of efforts to combine extreme accuracy and lightness with the aforementioned features.

EXTREME accuracy, simplicity of construction, and lightness for unit length of shaft combine to insure the success of the Gary-Cummings torsion meter. This meter is the result of long experience with various power measuring instruments on board ship and the makers have been able, through their own efforts as well as through the experience of users with whom they have kept in close touch, to bring this instrument to a high state of prefection.

The personal equation is entirely eliminated from the readings on this type of torsion meter. These are recorded mechanically and form a permanent record for future reference if desired. All parts of the meter which are subjected to centrifugal action are made as light as possible and balanced perfectly. The instrument is largely housed within the shaft entirely out of the way. When space is limited, as on torpedo-boat destroyers, this feature is of great importance. All parts which might possibly get out of order are attached to the outside of the shaft flange where they can be readily inspected and removed or replaced in a very few minutes. The instrument contains no gears whatever. Another feature that contributes largely to its accuracy is the fact that it measures the torsion in one complete section of a shaft, making necessary but one multiplying device. There is but one part to wear and this is easily taken up, giving considerable advantage over those meters which attempt to measure the angular twist in a short section and require numerous multiplying devices all of which are a possible source of error in the reading.

Construction

The instrument is primarily a rigid steel tube extending for one complete shaft section and fastened rigidly at one end but free to move at the other. The fixed end of this tube is firmly attached to an arm which rests in a radial slot in the flange of the shaft where it is securely fastened. Along the steel tube at intervals are spider collars which fit loosely but are held from moving along the tube by long cotter pins placed through the tube on each side of the collar. These spiders eliminate all possibility of any whipping action. The free end of the steel tube is supported and centered in a ball bearing so that it is free to rotate with respect to the shaft. It is therefore free to transmit any angular displacement between the tube and the shaft to an arm which is secured across the end and extends radially through another slot in the shaft flange in which it is free to move angularly. In other words, any angular displacement between the two flanges on the shaft can be noted by the movement of this arm with respect to the flange. An umbrella, equipped with two recording points, is fastened securely to the outside of the shaft flange at the free end of the tube in such a way that it is capable of rotating in a plane at right angles to the shaft. Any movement between the arm and the flange is transmitted through a sliding ball joint to the umbrella, causing it to turn an amount which is directly proportional to the twist in the shaft. The two points on the periphery of the umbrella record on a specially prepared card placed in a holder at the side of the shaft as it revolves and are adjusted so as to cause a small negative reading when no power is being transmitted. When the shaft is transmitting power the distance between the two marks recorded on the card minus the zero reading is directly proportional to the twist in the shaft. From this measurement the actual torque transmitted by the shaft can be readily obtained from the calibration data. Using this and the revolutions per minute of the shaft the horsepower transmitted is easily calculated. If the record of the shaft revolutions is noted on the same card with the torsion meter reading, a permanent record is obtained which can be filed for future reference.

Torsion Member

In constructing this meter unusual care is exercised to secure an absolutely rigid fastening at the fixed end of the meter tube. The supporting spider is turned to fit the inside of the shaft with a tight fit. On the spider is a collar into which the steel tube fits and to which it is riveted solidly. The radial arm is secured to the spider head by machine screws prick-punched to prevent unscrewing. The arm itself fits tightly into the slot cut in the shaft flange and is secured by bolts through the flange. This construction eliminates the possibility of any play at this end of the tube.

The free end of the tube is riveted to a suitable collar which rests in a ball-

bearing within the spider which supports and centers this end of the tube. The spider is carefully made to fit within the shaft and is then secured there by tapered plugs in each spider leg which expand the four ears hard against the walls of the shaft. Further stability is added to the spider by two webs connecting opposite adjacent ears. The tube is thus supported and centered at this end but is free to rotate, or to move along the shaft as it expands or contracts. The position of the meter tube is therefore controlled entirely from its fixed end. The relative position of the two flanges is what the meter must measure and what is transmitted to the recording umbrella.

To understand the instrument it must be borne in mind that the tube is secured to one flange of the shaft only. It is free to rotate in the other flange; therefore the meter tube itself cannot possibly be subjected to any twisting action, but it is the shaft that twists about the meter tube, and it is this twist or difference in displacement between the shaft and the tube that is measured.

Recording Device

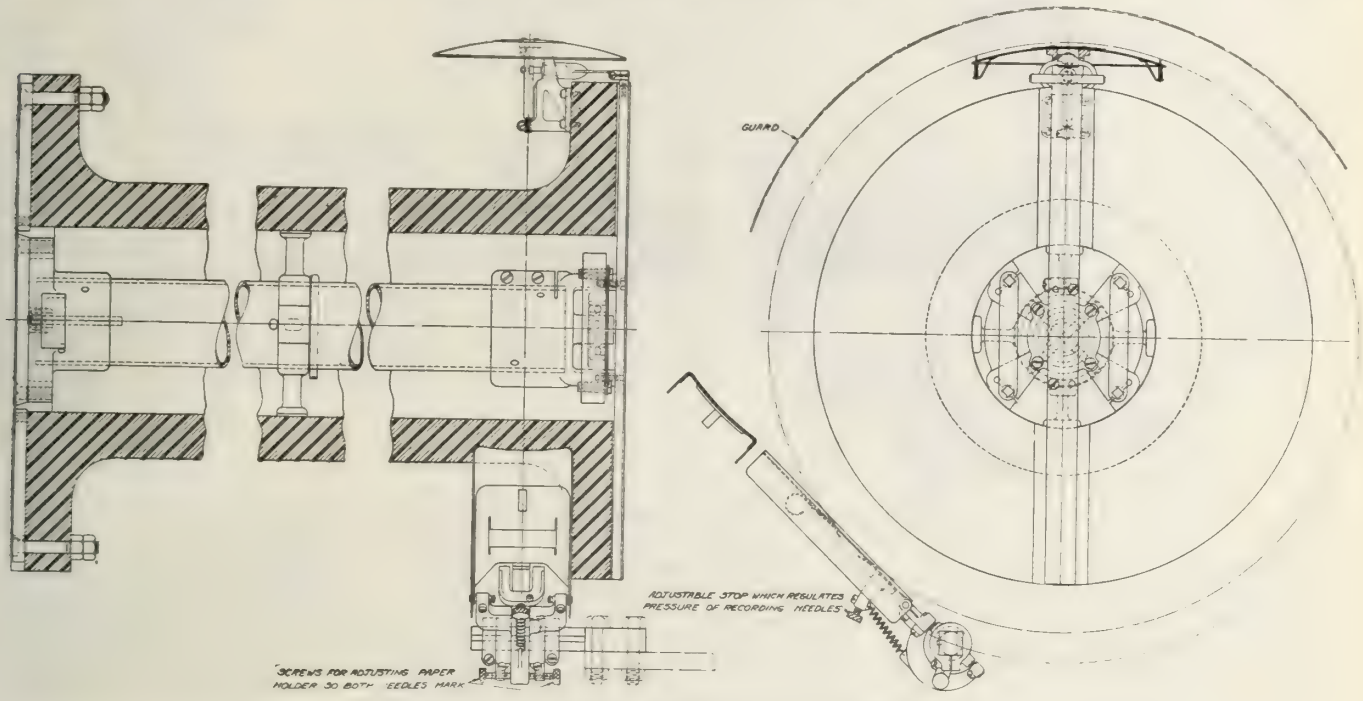
Probably the most interesting part of this torsion meter is the method of recording the twist of the shaft. A V-shaped or butterfly arm extends from the radial piece to the sliding ball joint which moves the umbrella. This butterfly piece is pivoted, as shown in the sketch, to the radial arm in order to provide for the very slight but positive movement of this arm in a plane vertical to the shaft axis. The pivoting joint can be easily adjusted for wear or for an approximate zero reading by the conical screws at each end. At the sliding ball joint provision also is made for taking up any possible wear. The ball is fastened to the supporting axis of the umbrella so that any angular movement of the radial arm attached to the free end of the meter tube causes a proportionate rotation of the umbrella. The recording points are set on opposite sides at the outer edge of the umbrella. When the shaft rotates these recording points move in a plane perpendicular to the shaft. As the shaft is twisted, the plane of rotation of one recording point moves aft and the other forward to correspond with the amount of twist in the shaft. The needles record on a card the exact distance between these planes. The prepared card is held in a holder supported from the hull or bearing foundation. The plane of the card must form practically a tangent with the circle described by the points of the needles when recording. When not taking readings a spring keeps the card away from the recording needles. All that is necessary to take a reading is to push the card-holder forward against an adjustable stop and the needles will record as the shaft rotates.

The card-holder itself has to be carefully constructed to obtain the best results. The opening for the needle record is only 3¼ inches wide by 2½ inches high, and in order that the needle readings may be properly centered on the card the holder contains a screw adjustment for moving the opening in the holder forward or aft parallel to the shaft axis a short distance. Provision is also made for adjusting the recording card so that both needles will mark properly. Ootherwise, only one needle would record. With these two adjustments the recording holder can take care of all variations due to temperature and the like.

Calibration

In order to obtain the best results, the shaft should be calibrated after the meter is installed in the section in which it is to be used aboard ship. The torsion meter is installed in the shaft exactly as aboard ship except for the card-holder. The shaft is placed on two suitable supports and the end containing the fixed end of the meter securely fastened to a heavy fixed girder. The opposite end of the shaft is supported by a bearing which allows it to turn in an angular direction with as little friction as possible. To this free end of the shaft another girder it attached for applying the test loads. Whatever apparatus is used it is necessary that the turning forces shall be balanced so that there will be no eccentric twist in the shaft. The usual method consists of applying known weights at one end of the beam and a turn-buckle or jack with a weighing scale at the other end. Suitable corrections are made for the weight pans and the turn-buckle with its attachments. The weights in the pan at one end act downward while the turnbuckle must act with equal force in an upward direction at the other end of the girder. The points at which the turn-buckle and the scale pan act upon the girder should be knife edges carefully measured from and on the same line with the axis of the shaft. For convenience these distances are usually made equal.

Of course the recording umbrella does not rotate around the shaft axis during this calibration test as it does when installed in the ship. Extra provision must, therefore, be made for properly recording the angular twist obtained during this test. The record card is placed in a small holder carried by an arm that rests on a special plate on the shaft itself. This supporting plate is fitted to the circumference of the shaft and when moved around the shaft causes the record card to describe a circle whose center is at the center line of the shaft.


GUARD
ADJUSTABLE STOP WHICH REGULATES PRESSURE OF RECORDING NEEDLES
SCREWS FOR ADJUSTING PAPER HOLDER SO BOTH NEEDLES MARK

DETAILS OF TORSION METER AND CARD HOLDER.

As the card passes the recording needle two parallel lines are traced. The distance between these lines is a measure of the twist or torque applied to the shaft.

Applying Load

In conducting a calibration test the needles should be adjusted so that the zero reading will be from ten to fifteen-hundredths of an inch, and a card taken. A known moment is applied to the shaft which is then rapped sharply with a lead hammer to remove any "set" that may have been caused by binding in its bearing, and a record taken from the recording points on the umbrella. Weights are then added in increments and the turn-buckle adjusted each time for the same upward thrust. The shaft should be thoroughly rapped each time with lead hammers before readings are taken. These operations are continued until the desired load has been reached. To check this, similar records are taken as the load is removed step by step. From these results, with proper corrections for zero readings of the instrument, the calibration curve for the meter is easily plotted. Torsion meter readings are plotted as abscissae and the torque, which is the equivalent load at one-foot radius, as ordinates. If the test has been properly conducted the resulting curve will be a straight line, indicating that the angular twist in the shaft is directly proportional to the load applied; this will, of course, be the case up to the elastic limit of the shaft. If the curve is a straight line it proves that the calibration is correct unless there was an error, such as friction, common to all points.

From the calibration readings the torque per one inch of meter reading is calculated. This will be found practically the same for all the loads applied to the shaft. Theroretically it should be exactly the same. The average of these gives a figure on which to base the horsepower constant for that meter in that particular shaft. To facilitate the ready calculation of the power transmitted, however, the constant used for each shaft contains the additional constants which enter into the calculation of the horsepower.

Calculations

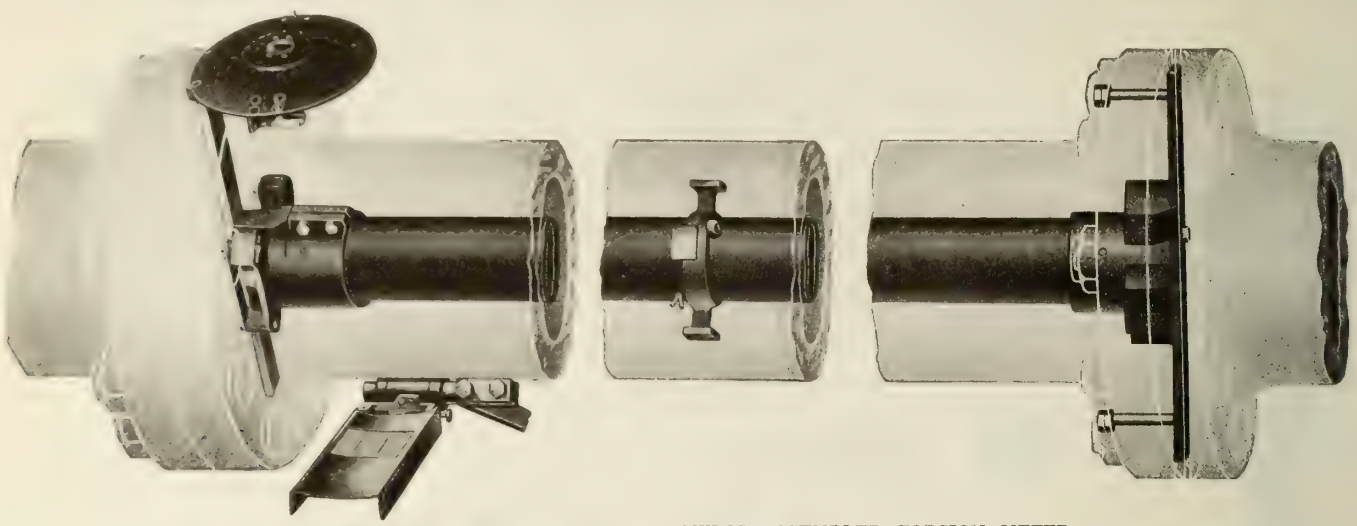
Algebraically, the calculations are as follows:

$$S.\ H.\ P. = K \times T \times RPM$$

R = radius on which load is applied in feet.

W = weight of load in pounds.

RPM = revolutions per minute.



PHANTOM VIEW OF SHAFT SHOWING ASSEMBLED TORSION METER.

M = torque or moment in foot pounds.

Q = foot pounds for 1 inch torsion meter reading.

T = torsion meter reading in inches.

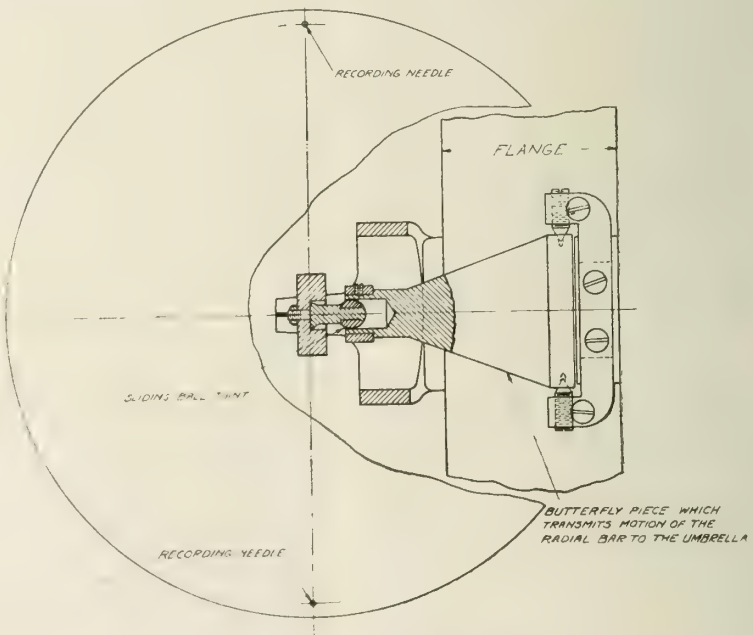
K = torsion meter constant.

From this equation the horsepower transmitted through each shaft in the ship is calculated, and when noted on the sheet containing the torsion meter reading becomes a part of a permanent record of the test.

In the use of this meter aboard ship it is essential that the needles record a small negative reading when the shaft is transmitting no power—that is, when the propellers are dragging, but still turning over. This zero reading is obtained by properly adjusting the set screws joining the butterfly piece with the radial arm when the meter is is installed. If the meter was set for no zero reading, that is, both points marking the same line on the card, it would not be possible to tell whether both needles were recording or not. With the small negative reading, however, it is easy to note that both needles are recording properly.

Setting Recording Needles

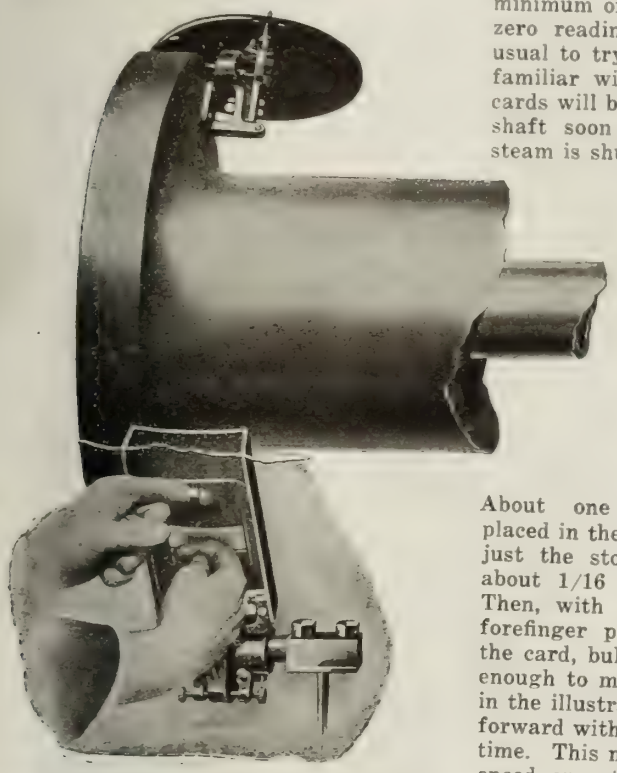
A gauge in the spare-part box fits the flange with a tongue projecting out to set the height of the recording needles.


RECORDING NEEDLE
FLANGE
SLIDING BALL JOINT
BUTTERFLY PIECE WHICH TRANSMITS MOTION OF THE RADIAL BAR TO THE UMBRELLA
RECORDING NEEDLE

SECTIONAL VIEW OF BUTTERFLY PIECE AND SLIDING BALL JOINT

These should be set with a watch key (No. 4 key in spare-part box) so that they just touch the gauge as it is moved around the flange. Then both recording

points are at the same distance from the centre of the shaft and will record when the card is brought in contact. By means of the centring screws on the block attached to the top of the bar the needles are set so that one is about ⅛ inch farther from the flange than the other. The mark on the gauge should be equidistant between the planes of the



THE MOST CONVENIENT WAY OF TAKING CARDS.

needles. This is the approximate zero reading.

The needles are set so tht their planes of rotation do not cross when the shaft twists in ahead direction, otherwise the zero reading would have to be added to the reading taken when under way instead of being subtracted as it should be.

Operation

In running a test the recording apparatus is attached to the shaft, care being taken to scrape the rust and dirt from the flange. The butterfly piece should be adjusted by the centring screws, so that it is freely movable without lost motion.

The Card-Holder

The card-holder is attached by two bolts to its support, which should be built out from the frame of the ship. By loosening the binding screws on the collars over the round bar the holder may be moved forward or aft, so that the centre of the opening is in the plane of the axis of the umbrella as it revolves with the shaft. Otherwise, when the shaft twists one needle would mark on the card and the other would be out of range.

Getting Zero Reading

After tightening all screws the torsion meter is ready for dragging the shaft. This should be done by getting some way on the ship, about one-third speed, then shutting off the steam to the turbine, including all auxiliary exhaust, and permitting the shafts to revolve partly by way of the ship and partly by its own inertia and that of the rotor. Cards should be taken at frequent intervals while the shaft gradually slows down and the minimum of these readings taken as the zero reading. Before dragging it is usual to try taking cards in order to be familiar with the operation so that no cards will be lost during the drag, as the shaft soon stops revolving after the steam is shut off. One man, experienced at taking cards, should be at each torsion meter while the shafts are dragging.

Taking Readings

Since the stop was set so that needles would not touch the card when the ship geats under way, the first thing to do is to adjust this stop so that the needles just make a mark without tearing the card. About one dozen cards should be placed in the holder. Some prefer to adjust the stop so that the needles are about 1/16 inch away from the card. Then, with a slight pressure with the forefinger placed horizontally back of the card, bulge it outward slightly, just enough to make needles work, as shown in the illustration. The holder is sprung forward with the other hand at the same time. This method is used by all experienced operators, because it lessens the danger of the needles striking metal and does not require such a fine adjustment of the stop screw. It is attended, however, with some danger of getting the fingers cut slightly by the revolving needles, so should not be attempted by careless operators. Should one needle mark before the other, the card should not be pushed farther in, but the side thumb screws should be adjusted, backing off one and tightening up the other. (Be sure holder is held tightly between these two adjusting screws before taking another record.) Keep trying this until both needles mark.

To calculate the horsepower a card is taken at the same time the revolutions per minute are being determined. Very often the torsion meter operator will take counter readings of each shaft on the minute, then go aft and take torsion meter cards, then counter readings again, say five minutes later. Each card should be marked with the shaft from which it was taken and also with the date and time. The revolutions per minute of each shaft are worked out for five minutes and noted on the cards also. The linear distance in inches between the two parallel marks on the cards minus the zero reading (in rare cases this is plus because planes of needles cross as shaft twistsis) is the corrected tersion meter reading. A convenient scale is furnished each ship for measuring cards. Multiply the corrected reading (in inches and fractions thereof) by the torsion meter constant and this result by the revolutions per minute of the shaft final result will be the horsepower being transmitted through the shaft. The torsion meter constant is worked out from the shop calibration of the shaft, as already described.

A NEW WOOD, THE LIGHTEST KNOWN

By D. Street.

A NEW wood, apparently little known and called balsa wood, is exceedingly light and promises to have an extended field of usefulness in connection with cold storage structures when heat insulation is important. It is a tropical wood, growing principally in the States of South and Central America.

The wood is remarkable—first, as to its lightness; second, as to its microscopical structure; third, for its absence of woody fibre; fourth, for its elasticity; and fifth, for its heat-insulating qualities. So far as investigation has disclosed, it is the lightest commercial wood known. It has also considerable structural strength, which makes it suitable for many cases. In general appearance balsa wood resembles bass wood.

Until recently Missouri cork wood, weighing 18 lb. per cubic foot, was believed to be the lightest, but recent investigations indicate that balsa wood is much lighter, having a net weight of 7.3 lbs. per cubic foot. The ordinary commercial balsa wood is seldom perfectly dry, and because of the moisture content its weight has been found to be between 8 lbs. and 13 lbs. per cubic foot.

The extreme lightness of this wood suggests its application as a buoyancy material in life-preservers and life-boats. When, however, it was attempted to apply the wood practically it was found to be of little value, because it absorbed water in great quantities, and also because it soon rotted, and also warped and checked when worked. After testing nearly every method that had been suggested, Colonel Marr's method of treating woods, which had been recently patented, was finally successful. In this method the wood is treated in a bath, of which the principal ingredient is paraffin, by a process which coats the interior cells without clogging up the porous system. The paraffin remains as a coating or varnish over the interior cell walls, preventing the absorption of moisture and the ill-effects as to change of volume and decay which would otherwise take place; it also prevents the bad effects of dry rot which follow the application of any surface treatment for preserving wood of the same type. The Marr process tends to drive out all water and makes the wood waterproof.

The North-Western Engineering and Supply Co. of Calgary are installing a 150 horse-power Babcock & Wilcox water tube boiler in their pumping and lighting plant at Drumheller, Alberta. This is the second Babcock & Wilcox boiler to be installed in this plant.

Exhibitors' Association Plans Representative Display

United Efforts of Manufacturers and Dealers Insure Interesting and Instructive Display—Industrial Power Conditions Impart Unusual Interest to Fuel and Labor-saving Appliances

AS in former years, a feature of the annual convention of the Association of Stationary Engineers will be the exhibition of power house apparatus, accessories and supplies which is organized by the Exhibitors' Association.

Events of the past year or eighteen months have served to convey with increasing seriousness the gravity of the present state of affairs regarding fuel supply and power resources. Taking place as it does in the midst of a district dependent almost entirely on outside sources of fuel and power, the convention and exhibition afford an admirable and timely opportunity for discussion of those questions which directly concern the welfare and prospects of stationary engineers along with inspection and investigation of the various appliances of which conduce toward the efficiency of the present day power house operator.

As indicated in a previous issue of POWER HOUSE the sessions will commence Tuesday, June 25, the opening ceremony in Hyman's Hall being performed by Mayor Summerville, following which, the appointment of the various committees will take place. The afternoon trip to Springbank Park will enable a close inspection of the pumping plant to be made, following which an entertainment by a select company of eminent artists will be offered the guests and members.

During the course of the convention addresses will be delivered by speakers on various subjects pertaining to the work of the members, including an address by Fred Raven, secretary of N.A.S.E., Chicago. In view of the organized efforts of power house engineers in the United States toward assisting in the national welfare the presence of Mr. Raven is looked forward to with considerable expectation.

Hyman's Hall is admirably suited for the double purpose of holding sessions and exhibition. Convenient of access from hotels, railroad depots and street car lines, it is located on a residential thoroughfare amidst pleasant surroundings, and much of the pleasure afforded members at the convention will be due to the conditions under which it will be held—the activities and labor of the local lodge under the secretaryship of Mr. W. G. Walters being worthy of due appreciation by all.

The Exhibitors' Association is under the presidency of Lieut. L. Archibald, of the Dart Union Co., who is at present overseas. As in former years, Mr. G. C. Keith, editor of the "Canadian Manufacturer," will discharge the duties of secretary, the other officers being E. F. Hetherington, Goldie-McCulloch Co., Galt, past president; C. N. Schrag, O. W. Meissner Co., Ltd., Toronto, first vice-president; Geo. E. Moll, hon. president, London; Jas. S. Mock, Jenkins Bros., Montreal, second vice-president; L. H. Dumage, V. D. Anderson Co., Cleveland, assistant-secretary; B. G. Newton, THE POWER HOUSE, Toronto, treasurer; C. B. Turner, Toronto; H. J. Ramshaw; Garlock Packing Co., Hamilton, chairman reception committee; Arthur Betton, Jas. Morrison Brass Mfg. Co., Toronto, chairman exhibition committee.

EXHIBITORS' COMMITTEE, C.A.S.S. CONVENTION, LONDON, JUNE 25-27.

NATIONAL ELECTRIC LIGHT ASSOCIATION CONVENTION

The thirty-fourth annual meeting of the National Electric Light Association was held at the Hotel Traymore, Atlantic City, June 13 and 14, and was devoted entirely to problems connected with the war.

No papers were read at this convention, and reports from committees and individuals and discussions were confined to matters of major importance. The brief time, two days, allowed no time to be taken up with the usual helpful discussions on general subjects relating to the progress of the art.

ANNUAL CONVENTION OF THE C. E. A.

The annual convention (28th year) of the Canadian Electrical Association will be held on Friday, June 21st, at the Chateau Laurier, Ottawa.

As this is a war-time convention, no entertainment will be provided, and the matters discussed will be principally confined to the effect of the war on the central station industry.

HYMAN'S HALL, LONDON, WHERE THE CANADIAN ASSOCIATION OF STATIONARY ENGINEERS AND THE EXHIBITORS' COMMITTEE HOLD THEIR 1918 CONVENTION AND EXHIBITION JUNE 25-27.

EDWARD CLARENCE MEIER, DECEASED

A large number of power house engineers and manufacturing firms learned with regret of the sudden death on May 7 of E. C. Meier, president of the Heine Safety Boiler Co. Mr. Meier was at Philadelphia attending a meeting of the district production division of the Emergency Fleet Corporation, and had made a short address regarding the speeding up of boiler construction. When he resumed his seat he was seen to fall forward in his chair, and was immediately removed to an ante-room, where a physician pronounced the body lifeless.

Edward Clarence Meier was born at Wyandotte, Kansas, in 1870, his father, Col. E. D. Meier having achieved distinction as founder of the Heine Safety Boiler Co., president of the American Society of Mechanical Engineers, and the leading spirit in the development of the present A.S.M.E. boiler code which is being rapidly adopted throughout the continent. Mr. Meier had worked through all the departments of the Heine Boiler Co., which was organized in 1884. The present plant at Phoenixville was established by the company in 1899 and Mr. Meier had been in charge of it up to his death. He was elected president of the company on the death of his father in 1916, and had been very active during the past year in designing a boiler for marine work.

M. C. Huyette, for 22 years with the Murphy Iron Works of Detroit, died at Buffalo, Friday, June 7, aged 75 years. The deceased was manager of the Buffalo office, and had charge of the Canadian business of the company. Despite failing health, due to heart trouble, he was active to the last, and had been in touch with the office the evening before his death.

Milton and Prentiss have formed a partnership in the business of engineering and machinery and power house

EDWARD CLARENCE MEIER

Late President of the Heine Safety Boiler Co., Phoenixville, Pa.

brokers, with offices in the Trader's Bank Building, Toronto. A. G. Milton was formerly of the Lincoln Electric Co. and later did business under the name of Archibald G. Milton, his special line being electricity. J. M. Prentiss, his partner in the new business, was for several years secretary of the Chartered Trust & Executors Co., for which concern he had charge of the winding up of the Interurban Electric Co., Ltd. He was also with the Power Plant Equipment Co., organized the Interurban Engineering Co., Ltd., and built and equipped an up-to-date machine shop on Vine Ave., West Toronto. The new firm have the agency of Schaeffer & Budenberg, for recording and pressure gauges and recording thermometers, also for steam jet ash conveyors, and other lines of interest to industrial plants.

W. H. Farrell, terminal superintendent of the Grand Trunk Railway in Toronto, has been offered and accepted the position of general manager of the Algoma Eastern Railway Co., with headquarters in Sudbury. Mr. Farrell will have charge of the line from Sudbury to Little Current, and will assume the duties of his new position on July 1st, Mr. Farrell has been in the Grand Trunk service thirty-four years, for twelve of which he has been superintendent of the Toronto terminals. The new general manager, like almost all successful railwaymen, started at the bottom, and by his untiring devotion to duty worked his way up to his present position.

P. O. D. Burke has been appointed inspector for the New Brunswick board of fire underwriters and will inspect sprinkler equipment and electrical installations throughout the province. He was formerly in the employ of the Nova Scotia Steel Company at Sydney Mines and came to New Brunswick as successor to Simon Skidmore, who was employed by the underwriters to inspect sprinkler installations, and who resigned to take up a position in Montreal on May 1. Mr. Burke, who is an expert electrician, will look after all special risks.

The MacLean Publishing Company
LIMITED
(ESTABLISHED 1888)

JOHN BAYNE MACLEAN - - - - - - - President
H. T. HUNTER - - - - - - - - - - Vice-President
H. V. TYRRELL - - - - - - - - - General Manager

PUBLISHERS OF

POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air, and Water Power, and to the design and operation of Refrigerating Machinery.

B. G. NEWTON, Manager.
J. M. WILSON, Editor. A. R. KENNEDY, Asst. Editor.
Associate Editors:
A. G. WEBSTER J. H. RODGERS (Montreal) W. F. SUTHERLAND

OFFICES

CANADA—
Montreal—Southam Building, 128 Bleury St., Telephone Main 1004.
Toronto—143-153 University Ave., Telephone Main 7324.
Winnipeg—1207 Union Trust Building, Telephone Main 3449.
Eastern Representative—E. M. Pattison.
Ontario Representative—S. S. Moore.

Toronto and Hamilton Representative, J. N. Robinson.

UNITED STATES—
New York—R. B. Huestis, 111 Broadway, New York, Telephone 8971 Rector.
Chicago—A. H. Byrne, 900 Lytton Bldg., 14 E. Jackson Street. Phone Harrison 1147.
Boston—C. L. Morton, Room 733, Old South Bldg., Telephone Main 1024.

GREAT BRITAIN—
London—The MacLean Company of Great Britain, Limited, 88 Fleet Street, E.C., E. J. Dodd, Director, Telephone Central 11960. Address: Atabek, London, England.

SUBSCRIPTION RATE

Canada, $1.00; United States, $1.50; Great Britain, Australia and other colonies, 4s. d., per year; other countries, $1.50. Advertising rates on request.

Subscribers, who are not receiving their paper regularly, will confer a favor by telling us. We should be notified at once of any change in address giving both old and new.

Office of Publication, 143-153 University Avenue, Toronto, Ontario.

Vol. XI. JUNE 1918 No. 6

PRINCIPAL CONTENTS

London, Ont., Scene of Annual Convention, C.A.S.E. 143-146
General 146-147
Training Essential to Conservation.
Sixty-ton Electrically Operated Raw Water Ice Machine 148-150
General 150-151
Progress in Power Plant Design....Large Gas Engines....Small Geared Turbines....The Economical Reconstruction of Belgium.
The McClary's Power House Installation, London, Ont. 152-157
General 157
Mechanical Economisers.
The Cultivation of Efficiency 158
General 159
Off Peak Use of Electric Energy for Heating....Development of Airplane Gun Ammunition.
The Ridout St. Station of the London Public Utilities Commission 160-167
General 167
Graphite in Oil....A Battleship of Pipe Fittings.
The Granby Auxiliary Steam Plant, II. 168-173
General 173
Boiler Service Maintenance.
Canadian Built Centrifugal Pumps of Modern Design 174-177
Electricity and Hydraulics 178-179
Principles and Operation of Modern Electrical Equipment, IV.
Torsion Meter for Power Transmitted by Propeller Shafts 180-183
Exhibitors' Association Plans Representative Display 184-185
Editorial 186
Twenty-ninth C.A.S.E. Convention....Practical Methods of Fuel Conservation.
The Operator's Point of View 187-190
Is Exhaust Steam Hotter Than Live Steam?....Syphon Starter....Key Puller....Everybody His Own Moulder....Repairs to Staybolt on Vertical Boiler....Comparative Areas ....Accident Prevention.
Progress in New Equipment 191-193
Why Cast Iron Protects Soot Cleaner Elements Against High Temperatures....Automatic Starters for Direct Current Motors....End Suction Centrifugal Pump....Large Exhaust Relief Valve.
Selected Market Quotations (Advtg. Section) 90
Trade Gossip—Catalogues (Advtg. Section) 92-94

TWENTY-NINTH C.A.S.E. CONVENTION

CIRCUMSTANCES affecting the practice and profession of power house engineering continue to be influenced by events of the day, and during the last year much has happened to impress upon our fellow workers the necessity of the most rigid economy—first, last and all the time.

The convention of the Canadian Association of Stationary Engineers which takes place at London this month is primarily devoted to the affairs of that body. The transaction of business relating to statutory affairs—the discussion of matters affecting the welfare and advancement of members and their work—the consideration of present policy and the formulating of new, in order that the work of the Association may be of greatest benefit to the country as well as individuals—these constitute an objective which can only be partially reached in the three days available.

The value of such occasions for strengthening the bond of friendship amongst the members is well known to executives, social events and plant visitations forming an attractive portion of the events.

Graded certificates have become the object of increasing discussion with each successive convention and this, the 29th occasion, will be marked by official recognition of the efforts put forth by members in furtherance of this desirable object. Dr. Riddell of the Public Works Department of the Ontario Legislature is expected to speak on the subject and his remarks, as indicating the attitude of the government towards graded certificates will be heard with more than ordinary interest.

Little more can be said at this time on the certificate question. Its ultimate consummation in Ontario will be a matter for mutual congratulation by all parties concerned, and will remove the stigma which has hitherto attached to this province, which, although the foremost in industrial activity, was the last to recognize the necessity and justice of classifying power house engineers according to their ability.

Should the immediate future witness the settlement of the graded certificate question in the manner desired by all progressive and ambitious engineers, the convention of 1918 will be noteworthy for that feature alone.

PRACTICAL METHODS OF FUEL CONSERVATION

FACTORY owners in the United States are being actively assisted by the Federal Fuel Administration in the matter of effecting fuel saving.

The question of how much coal a factory can get is not any more important than knowing how to get the most heat from the coal after it is receivel.

The mode of operations is on somewhat similar lines to the "greater production" propaganda recently carried out. A board of competent engineers is recommended to be attached to a conservation committee in each State, while a corps of lecturers will be employed to arouse public interest and disseminate engineering information.

A fifty-minute film of moving pictures will demonstrate good and bad methods of operating steam plants while methods of testing boilers, fuels, etc., will be similarly dealt with.

The prospect of possibly harder times regarding fuel will make all factory owners and power users approve of such missionary work. Despite the prevalence of electric power in most Canadian provinces, the consumption of coal is plenty high enough to make imperative every possible economy of fuel. Where the fuel is used for heating a few degrees less in temperature mean a large difference in the coal consumption.

Many factories are over-heated in winter, necessitating the discard of some clothing by employees. Such conditions are criminal and their continued existence is a betrayal of the country's welfare. Such propaganda as outlined above should bring all parties to a sterner realization of conditions as they will actually be in the coming winter.

Preparedness and Efficiency are indeed the watchwords of the hour.

The Operators' Point of View

IS EXHAUST STEAM HOTTER THAN LIVE STEAM?—READERS' DISCUSSION

In reply to J. W. Maxwell's question, 'Is exhaust steam hotter than live steam?' I would like to state my experience.

I had always, prior to a year ago, pooh-poohed the idea that less exhaust steam would be required to heat a building than would be the case if live steam were used, but the proof of the pudding is in the eating.

A year ago, whilst carrying on alterations in my boiler plant I shut down the engines and took outside power. I only had one boiler in service for laundry, cooking and sterilizing purposes, and also for any heating that might be required. The first day was decidedly cool and I found it impossible to carry more than 50 to 70 lbs. of steam pressure on account of the great demand for steam heat. That night certain connections were made which gave hot water for the boiler feed, so that the next day there was a slight improvement, but at no time during the entire two days did we get more than 80 lbs. pressure instead of 125 lbs.

The third day was still cool, and the laundry man was hot (under the collar), so in desperation it was decided to start up two engines and run them light. This was done, and the live steam shut off the buildings, with the result that we got steam to every room in the building, whereas previously only the centre of the buildings was heated, and then not the two top floors.

Not only that, but the steam pressure rose until within an hour or so the safety valves blew off, so that actually more work was done with less coal by using the exhaust steam from the engines for heating in place of live steam. The engines were not doing any work but were only running fast enough to give a dull red light in the pilot lamps.

I do not pretend to explain why this should be, but the above is actual experience.

According to all theories that I have heard expounded, live steam, allowed to expand through a reducing valve (not doing any work during its expansion) is slightly superheated and is therefore more valuable for heating than is exhaust steam.

If we take 100 lbs. of steam at 125.3 lbs. pressure we have a total heat above freezing point of $1192.2 \times 100 = 119.22$ b.t.u. If this is expanded through a reducing valve to a pressure of 3.3 lbs. we obtain 100 lbs. steam at a temperature of 222.4 degs. F., having a total heat of 1154.2×100, which equals 115.420 b.t.u. But there are 3,800 b.t.u. unaccounted for.

As the steam has done no work in expanding it is impossible to imagine there could be any loss due to condensation, therefore it follows that the steam must be superheated.

If on the other hand we take 100 lbs. steam at 125.3 lbs. pressure and use it in an engine, we find that the engine will extract a certain amount of heat from it. In a good non-condensing engine taking say 30 lbs. steam per h.p., we should obtain, assuming the 100 lbs. of steam were used in one minute:

$$100 \div \frac{30}{60} \text{ h.p.} = 200 \text{ h.p.}$$

The number of b.t.u. extracted by the engine in doing work would be $200 \times \frac{33{,}000}{788}$ b.t.u. $= 8484$—778 being the mechanical equivalent of one b.t.u., so that the engine extracts only about 7.7 per cent. of the heat supplied to it.

However, if we add to the heat extracted by the engine the heat losses in the pipe, and the heat lost by cylinder condensation and radiation which will be about another 2½ per cent. or a little over, we shall have about 90 per cent. of the heat contained in the steam as it left the boiler available for heating.

In the case of live steam we have 119,220 b.t.u., and in the case of exhaust steam we have 107.298 b.t.u. Now figures cannot lie, but it looks in this case as if they were taking liberties with the truth. According to this illustration, live steam should be far superior to exhaust steam for heating, but the facts are to the contrary.

My own opinion, but which I submit in great diffidence, is that the pulsation of the engine exhaust drives the steam farther than does the steady flow of live steam through a reducing valve. I should like to have the opinions of some other of your readers on this subject.

Toronto. S. BALMFIRTH.

* * *

The question raised by Mr. J. W. Maxwell regarding live and exhaust steam heating has often been placed before me, and I would like to state that live steam is hotter in temperature than exhaust steam. But when it comes down to the heating of buildings, the exhaust steam is more saturated and will deliver more units of heat more quickly to the atmosphere and will maintain the coils or radiators at constant temperature, effecting a saving of 7 per cent. over live steam.

If it is desired to use exhaust steam for heating it is desirable to instal an asbestos covered receiver equal in diameter to twice the diameter of steam engine cylinder. This tank should be installed on the exhaust line 8 to 10 ft. away from the engine. This will maintain a constant flow of steam and will do away with fluctuation caused by the stroke of the engines. A back pressure valve is to be placed over the receiver and should be set at eight pounds.

Montreal. H. V. Smith.

* * *

The question has been asked as to whether or not exhaust steam is hotter than live steam. Some engineers claim that it is hotter and others claim that it isn't so hot. These claims are made because it has been thought or has been actually experienced that exhaust steam heats better than live steam.

According to the steam tables there is no difference whatever. At atmospheric pressure the temperature of steam is given at 212 degrees F. regardless of whether it is live steam or exhaust.

However, there is such a thing as superheating, and the question therefore resolves itself into these two: Is the live steam superheated? Is the exhaust steam superheated?

It is easy enough to place a thermometer in a pipe and measure the temperature of the steam. It would be interesting and good practice if more engineers would put thermometers here and there in their steam pipes and learn more about the temperatures of the stuff as it whizzes to and fro—in and out. I'll wager that a great deal will be learned about your plant by yourself or your engineer if this practice would be adopted. Thermometers don't cost much and in the end they might lead to some very important economies.

As for the live steam, we quickly become "suspicious" or interested in it and we are more liable to purchase a thermometer for measuring its temperature. Live steam sounds more expensive. But when it comes to exhaust the owner or engineer generally says to himself:

"Sure that's just exhaust steam and isn't good for much anyway, so why waste any money on a thermometer for measuring its temperature." That, in a nutshell, is the reason why so many of us overlook the value of exhaust steam. Too little is known about the heat contained in exhaust.

Is it likely that exhaust steam is superheated? Yes, and no. It all "depends." I have searched through voluminous treatises labelled Thermodynamics but didn't find the subject discussed, so will just point out a few probable reasons why exhaust steam is often or sometimes superheated.

In the first place steam enters a steam engine at high or fairly high pressure. The temperature is such as to correspond with the pressure as per our well known steam tables. As it enters the cylinder it heats the cylinder walls to about the temperature of the steam itself. Condensation occurs within the cylinder due to the imparting of this heat to the walls. During the expansion stroke some and perhaps all of this condensate is re-evaporated. Then dur ing the exhaust stroke the steam is pushed out past the hotter cylinder walls and through the hot exhaust ports which are kept hot by condensation and in the writer's mind it is quite possible that the exhaust steam is superheated. Where condensation is excessive perhaps the exhaust is not superheated. Never having made any tests it would be folly for me to declare that all exhaust steam is superheated.

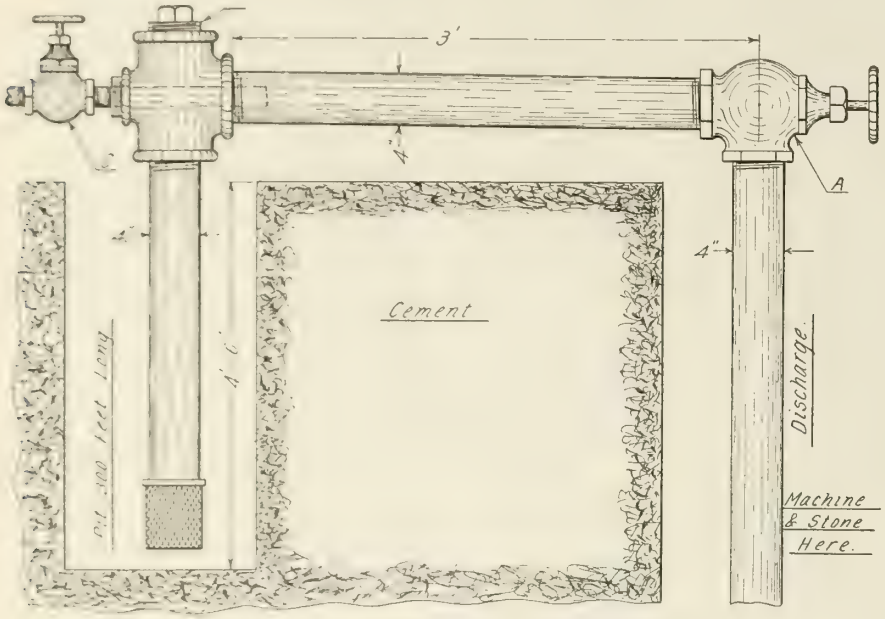
If the steam initially admitted into the cylinder is highly superheated, does it not seem quite probable that the exhaust may be superheated? True, again, much depends upon the point of cut-off.

Further, if the cylinder is steam jacketed and kept hot by live steam does it not seem quite probable that the exhaust will be superheated? I did find in the treatises through which I searched that one objection to steam jacketing is that a great share of the heat given to the jacketing is lost through the exhaust. If that is the case there must be a rise in temperature somewhere especially if the cylinder walls are kept so hot at all times that no condensation is formed.

It is well known that when live steam expands through an orifice as in a throttling calorimeter the steam on the low pressure side is superheated. It usually superheats to such an extent that the moisture contained in the initial is itself evaporated into steam and superheated. For the same reasons, to some extent at least, the exhaust steam from a steam engine or from a non-condensing steam turbine may be slightly superheated. If such is the case the suspicions of the engineers who believe exhaust steam to be better than live steam may be better founded than is generally believed.

This is a question that the writer has never seen discussed and he would like to read about some engineer's actual experiences. Or, he would like to be directed to some actual tests that have been made along this line.

W. F. SCHAPHORST.



SKETCH OF ARRANGEMENT FOR STARTING SYPHON.

SYPHON STARTER

By J. E. Noble

At the plant where the writer is employed there is a pit 300 ft. long and 4 ft. 6 in. deep, which receives a constant supply of strained sewage. After being treated with chloride of lime the sewage is syphoned into a machine, which travels back and forth the length of the building, i.e., 300 ft., being operated entirely by the syphoned water.

During its travel the machine discharges the sewage in the form of a spray over a stone-filter bed, 5 ft. deep, which covers the entire floor of the building, 60 ft. wide.

About once a week the machine has to be stopped for flushing out with clean water, etc, and the syphon breaks when the pit is emptied. To start the syphon again the valve A (see sketch) would be closed and the air extracted by a hand air pump placed on the tee at B.

In time the valve A leaked; it was refaced, but soon started leaking again. This was repeated until the valve could not be refaced again. By this time the air pump was almost worn out. Even when valve A and the air pump were both new it required from 15 to 20 minutes quick pumping to get the syphon started.

A plug was therefore placed in the tee at B, and a hole drilled in the back of the tee to take in a ½ in. high-pressure steam pipe having a valve outside at C. The 4 in. leaking angle valve was left on at A.

When the pit became full of water the valve C was opened and the valve A nearly closed, and inside of two minutes the syphon would start. The steam valve would then be closed and A opened wide.

KEY PULLER

By John Port

THE accompanying sketch shows a key puller which will prove satisfactory. When used with a suitable key drift and hammer the tightest keys will start.

Three pullers from light to heavy will handle about all the different sized keys to be found in any plant. The legs A and B can be lengthened or shortened to suit requirements by the nuts on the ends. The bolt C holds the puller leg against the key. Fig. 2 shows the centre leg or puller of different design. The puller is placed over the key head and bolt A is turned up, pulling the piece C over as far as the space at B will allow.

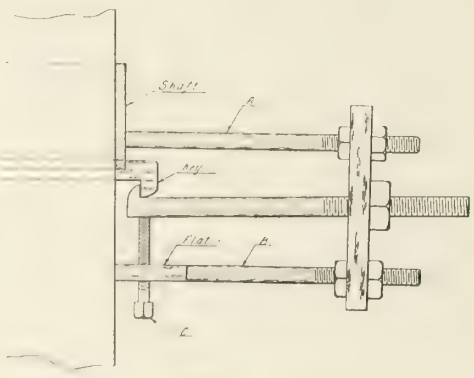


FIG. 1.

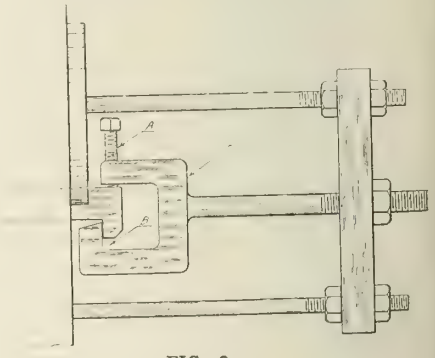


FIG. 2.

SETTING VALVES ON DUPLEX PUMP—READER'S QUERY

Replying to your correspondent's inquiry regarding the setting of valves on a duplex pump, it is only necessary to get everything central—that is, to set all the moving parts in mid-position.

To do this proceed as follows:

Remove both steam chest covers.

Push one piston to the extreme end of its stroke, and mark the rod where it enters the stuffing box, say, at the steam end. Push it to the other end of the stroke, and mark again at the steam end. Divide the distance between these two marks and mark the rod again at this point. This is the mid-stroke mark, which is to be set at the edge of the steam cylinder stuffing box.

Do the same with the other rod. Then with both piston rods set at mid-stroke, set the rocker arms in a vertical position. If necessary use a plumb bob.

Then set the slide valves in mid-position—that is, just covering the steam ports. If the lost motion between the nut on the valve rods and the lugs on the valves is not the same on both sides of the nut make it so by screwing the rod in or out of the nut as required. This is all that is to do to set the valves of a duplex pump.

In case of excessive wear in the valve gear some of the lost motion on the valve rod may be taken up by placing a washer on the rod next the nut until the valve gear is repaired or renewed.

Toronto. S. BALMFIRTH.

EVERYBODY HIS OWN MOULDER

By J. E.

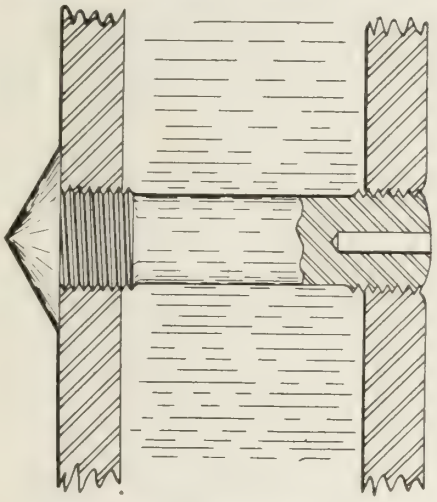
While conversing with a brass moulder a short time ago, I was given some valuable information, likely to be of considerable help to most mechanics. He described to me a method for making castings of brass or copper as easy to melt and run as lead. In special places the plumber can have brass or copper tacks to solder on his waste. I confess there are very few lead tacks used now, but I remember the time when I used hundreds of them. The jobber can run copper or brass name plates in the ordinary brass mold, such as is used to run lead tacks. The engineer can make plumb bobs from the metal, castings with holes can be filled with the metal and look as solid as a rock, and hundreds of other uses can be found for it. Here are the details.

Secure a quantity of brass or copper filings, dissolve a quantity of sheet zinc in about a cupful of muriatic acid, and add about a cupful of water. Place a quantity of either of the filings in this dilute zinc chloride to clean them. As a binder, melt nine parts of lead to one part block tin; remove the filings from the acid mixture, and place them somewhere so that they will dry out fairly quickly without getting hot enough to burn or tarnish. Now stir the filings into the lead and tin in about the same proportions as the former—that is, nine parts of filings to one part of the binder. Sprinkle a little rosin in with it. It will become one complete mixture, which will run as freely when heated as a pot of lead on a gasoline furnace or even over a wood fire. This metal can be made into castings and turned in a lathe, and it will require close examination to detect the counterfeit. When made into such things as plumb bobs, etc., a brass or copper surface can be secured by a slight rubbing over with fine emery cloth or sandpaper and polishing with whiting or any other polishing agent. Of course, this metal can not be used on anything which will be subject to a strong heat, as its temperature of fusion is about the same as lead.

REPAIRS TO STAYBOLTS ON VERTICAL BOILER

By A. Rodgers

A recent repair on a small vertical boiler reminded me of a job that was successfully accomplished by the writer a number of years ago. The work required was the stopping of several leaky staybolts. Several attempts had been



REPAIR TO STAYBOLT.

made to stop the leak by caulking, but with very little result. The writer was then placed on the job, and the method adopted was as follows. As illustrated in the sketch, the fire end of the staybolt had been so badly burnt that nothing remained of the riveted section; in fact, the portion near the thread had been destroyed below the level of the main plate. As the two shells were of cylindrical form it seemed to me that there was little need of staybolts anyway, so decided to leave the old bolt in position and remedy the trouble by expanding the thread of the bolt into the thread in the plate. By means of a ratchet and a ¼ inch drill the small hole shown was made in the center of the bolt, after which a small slightly tapered drift was inserted and the metal of the bolt gradually expanded until the leak was entirely stopped. When this was attained a small steel plug was driven into the hole and locked by slightly riveting over the end of the bolt. The repair proved very satisfactory and showed no signs of leaking even under excessive pressure.

READER'S QUERY

Question.—I have been given several samples of oil to test and would like to be given a simple method of determining which is the best.

Toronto. G. M.

Answer.—The most important qualities which permit of easy comparison are vicosity, low coefficient of friction and wearing powers. As a means of determining these properties the following test is recommended:

Take a piece of glass, preferably plate glass, about fifteen or eighteen inches long whichever happens to be handy, and also a disc of glass about 10 sq. ins. in area. Load this small disc with sufficient weight, determined by trial, to insure its sliding on the large glass when the latter is tilted and covered with the lubricant.

In testing out the oils take a small definite quantity of each oil and test these quantities out in rotation by thoroughly spreading the oil on the disc and on the glass slide. Then slowly tilt the glass until the loaded weight begins to slide and observe this angle for each sample. Then tilt the glass farther and let the disc travel to the bottom and repeat until the disc refuses to travel further. Be sure after each oil is thus tested to clean off both disc and plate thoroughly before trying out another sample.

The different angles at which ahe disc starts to slide for different oils will give a comparative measure of viscosity and coefficient of friction, and the number of times that the disc travels down the plate before it sticks gives an indication of its wearing and lasting powers.

BOILER SERVICE MAINTENANCE

A boiler is in a dangerous condition when the plates, bolts, braces, or rivets of which it is constructed become weakened to such an extent that the internal force or pressure equals the tensile strength of the material at the weakest section or sections. In this condition, strains due to varying temperature will cause rupture and an explosion, the volume and destructiveness of which would be in accordance with the size of the boiler and the pressure carried therein.

The moment a boiler is placed in service it gradually becomes weaker, due to the destroying forces continually acting upon it. These forces are of both a chemical and mechanical nature. Corrosion and oxidation are continually acting on the material from which a boiler is constructed, and take place both internally and externally, these processes being the two most serious and subtle causes of weakening to which a boiler is subjected. Evidences of these are most noticeable in the grooving and pitting of plate, and more especially at locations most subject to deposits of mud, scale, and organic substances.

Expansion and contraction also play a very important part in the destruction and weakening of a boiler, more especially when concentrated at any one point, such as at sharp bends or flanges in the plates where the inner and outer

sheets are subjected to different temperatures. Constant working or bending of bolts, flanges, or angles, however slight, will sooner or later destroy the fibres in the material at points subjected to it, causing crystallization, cracking, and leaving same more susceptible to the chemical action of the feed water.

It is, therefore, obvious that only thorough examination by competent inspectors who understand the construction, nature of defects, and remedies to be applied, will maintain a steam boiler in safe working condition.—"Cheap Steam."

ACCIDENT PREVENTION

By J. Hamilton

Industrial accidents must always be recognized as one of the possible factors in any mechanical development or enterprise. Much has been done during the past, particularly in recent years, to minimize the casualties resulting from inexperience, carelessness or accidental causes. It is safe to say that the greater proportion of accidents to industrial workers has resulted from individual carelessness or thoughtlessness, either on the part of the injured workman or some other party. Close study on the part of officials and safety supervisors —relative to the causes and prevention of accidents—has resulted in the adoption of many appliances that have assisted in reducing the size of the casualty lists in industrial establishments.

The efficiency of the majority of these devices, however, depends very largely on whether the same are acceptable to the workmen, who are required to adapt themselves to the changed conditions. It is invariably true that the application of a safety device will, for a time at least, prevent the operator from maintaining his accustomed production, and should he be working on a piece-work basis, the loss very often develops an antagonistic feeling towards the appliance indirectly responsible, so that it will not receive the just trial it is reasonably entitled to. Frequently the device is discarded as an obstruction to production until another mishap demands its further application.

When guards are mentioned as a means of reducing or preventing accidents we naturally think of some tangible appliance for the purpose intended, but the most efficient guard for permanent results has been acknowledged as the better education of the workmen respecting the serious possibilities that may arise through careless or thoughtless performance of their respective duties. This does not imply that instruction should take the place of safety appliances, but rather that the adoption of such devices should be preceded by personal consultation with the workman upon whose machine the method is to be applied. The conversation should be such as to impress the operator with the need of the device, and at the same time make him feel that his interests are being considered; obtaining, if possible, any suggestions he has to offer in connection with the design or installation of the attachment. His constant operation of the machine may result in a suggestion that may have been overlooked by the designer, and a slight change made to meet the suggestion of the workman may not only remove an antagonistic tendency but would undoubtedly act as a stimulus for the operator to give the device every opportunity to prove its effectiveness.

ENGINE ROOM RULES

Employees should be strictly forbidden to enter the engine room except for a special mission, and then should remain only as long as necessary. The engineer should not be permitted to leave the engine room until some other attendant who is thoroughly familiar with the engine, valves and signals is present to take charge.

No person other than those responsible for the operation of the engines should be allowed to touch any valves or other part of the mechanism or approach any moving part.

The safe speed for each flywheel should be known, and in no case should this be exceeded. Flywheel revolutions should be recorded every day in order to make sure that the engine is not running over the speed limit.

All parts of engines and accessories should be frequently and thoroughly inspected, and daily tests should be made of the governor mechanism and automatic engine stops.

Under no circumstances should engines be started until they are thoroughly cleared by alternately blowing live steam through each end of the cylinders, and the steam pipe and cylinders thoroughly drained of all water. The drip should be left open until the load is put on and then closed. Be sure to warm the engine cylinder at both ends.

In shutting down, the drip valve should be left closed until the engine is stopped. If the throttle is equipped with a bypass valve, the throttle should be closed and engine stopped with the bypass. This gradually stops the engine, avoids the pumping effect of the piston and prevents water being drawn into the cylinder.

Never attempt to "bar" a flywheel around, nor pull it off centre by grasping the belt when the steam pressure is on.

Never start to take cylinder head off or piston out of cylinder without making sure that the throttle and exhaust valves are shut tight and locked and the drains wide open; nor without trying the indicator cocks to see whether there is any pressure on.

Never stop the air pump before stopping the engine (condensing), as the condenser and exhaust pipe may be flooded and overflow into the cylinder.

All steam traps should be kept clean and in working order. Should a trap get out of order, and it be impossible to repair it at once, the bypass should be opened sufficiently to pass off all water which might collect.

Leaks in pipes, flanges or gaskets should be repaired at the earliest possible time.

In opening up a cold line, all available drips should be opened. The line should be warmed by opening the bypass where possible or by opening the stop valve sufficiently to warm very slowly. Never open the main valve until certain that the line is thoroughly heated. An inexperienced attendant should not be allowed to turn steam into a cold line until properly instructed.

Automatic valves should be frequently examined to insure their proper action in emergency.

Under no circumstances should vacuum breakers, governors, engine stops or other safety devices be blocked or otherwise made ineffective. If such apparatus is out of order, it should be repaired at once.

Do not stand in front of cylinder head of engines.

Do not place any material, tools, etc., on platforms or stairs around engine. They might fall off and injure someone below.

Never work in a gas-engine room alone; always have a helper with you.

If you find a man overcome with gas, get him into the open air at once, send for the doctor and notify the foreman.

Smoking and open lights should be forbidden around gas machinery and gas pipes; otherwise an explosion might occur.—The National Safety Council.

A NORWEGIAN engineer has devised an ingenious method of reducing the cost of paper manufacture by utilizing the residue from the mills, which produces a fuel to run the plant. The paper pulp obtained from wood constitutes only 45 per cent. of the wood, and the residual 55 per cent. has hitherto been found useful chiefly for the wood alcohol and acetic acid obtained from it by distillation. This engineer has recently patented and perfected a new process by which the residue furnishes a fuel in the form of a powdered coal, or charcoal, which evolves great heat in commbustion. The first plants have been erected at Greaker, on the Christiana fojrd, and it is estimated that they will shortly be able to yield an annual output of 6,000 tons of this new fuel. This will suffice to supply all the cellulose plants in Greaker with an inexpensive fuel, and at the same time it rids them of a burdensome encumbrance. Since the total production of paper pulp in Norway is estimated at 1,000,000 tons yearly, doubtless other plants throughout the country will soon be similarly equipped.—M.L.

THE task of the power plant engineer can be materially lightened by the use of an electric recorder which records the level of the boiler water at all times. This instrument indicates where the water is, where it has been and the time in each instance. It is provided with high and low alarms in the form of lights and bells. A light burns continuously when the boiler water is on the economical line.—C. T.

Progress in New Equipment

WHY CAST IRON PROTECTS SOOT CLEANER ELEMENTS AGAINST HIGH TEMPERATURES

Although steel, wrought and cast iron are used more than other metals in engineering works, there are few engineers who can tell what effect high temperatures have on them as regards strength.

Tests have been made mostly in Europe, but the results of those tests have been buried in dry, voluminous reports or in foreign language literature. These tests have recently been sought and collected by the Vulcan Soot Cleaner Co., of Du Bois, Pa.

Permanently installed soot cleaners must often be placed in temperatures that are comparatively high and for that reason the above manufacturers have investigated the matter with thoroughness. Their study, experience and conclusions will doubtless prove of interest to all who have anything to do with steam boiler operation.

Most laymen are aware of the fact that when metal is heated to a high temperature it bends easily. When "red hot" they know it is forged easily. And when still hotter it becomes liquid. But these phenomena are not associated with decrease in tensile strength. Yet it is this decrease in tensile strength that permits the metal rod or pipe to be bent or broken easily and that is why tensile strength tests are so important in this discussion.

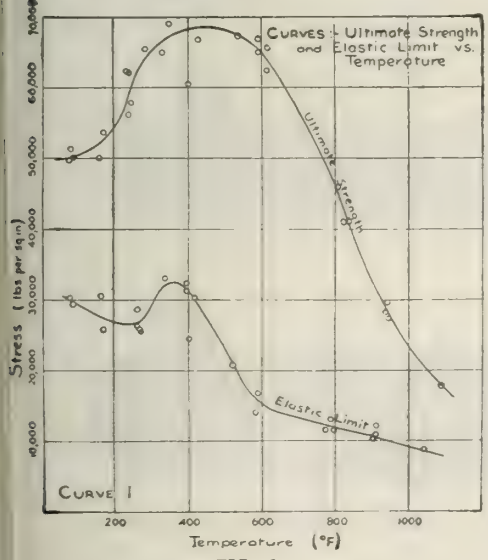


FIG. 1.

On the other hand, it is commonly believed by engineers who have given more thought to the subject that steel and wrought iron become weaker with increase in temperature. But that is not strictly true, and therein lies a point of considerable interest.

Steel and cast iron both grow stronger up to a certain point as shown by the ultimate strength curves in Figs. 1 and 2. Thus the maximum strength of wrought iron occurs at a temperature of 50 degrees F. whereas the corresponding temperature for steel is about 525 degrees F. However, with further increase in temperature the curves show that ultimate strength decreases rapidly. These figures also give the elastic limits of wrought iron and steel at high temperatures and the curve relation between elastic limit and ultimate strength.

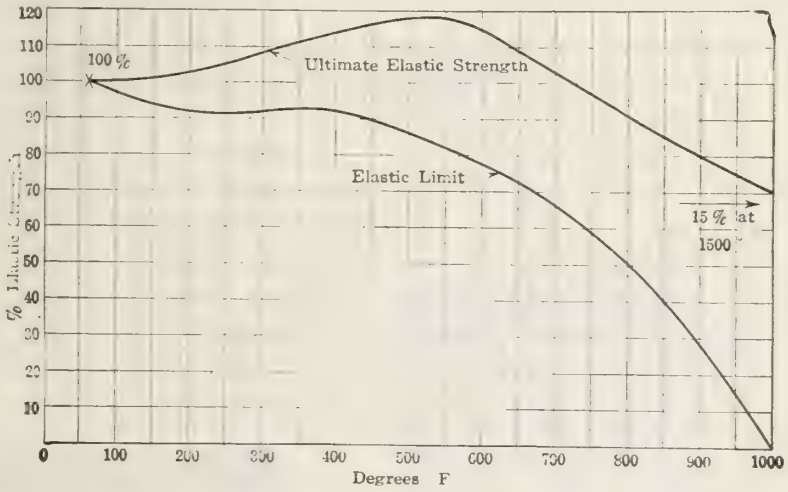


FIG. 2.

Fig. 1 shows that the ultimate strength of wrought iron drops very rapidly when the temperature is in the neighborhood of 1000 degrees F. and Fig. 2 shows that at the same temperature, steel no longer has an elastic limit. In other words, if soot cleaner elements are made of steel alone, and if they are heated to a temperature of 1000 degrees F. they are liable to sag due to their own weight and become inoperative in a short time.

The maximum temperature to which soot cleaner elements are subjected is not definitely known, but it is doubtful if the temperature of the metal itself ever passes 1000 degrees F. even though the temperature of the hot gases is 1500 degrees F. For example, a test made by A. W. Conklin shows the temperature at the top of the first pass in a hand-blown boiler to be 954 degrees F. In the same boiler, cleaned by a permanently installed cleaner, the temperature at the same place was reduced to 934 degrees or a difference of 20 degrees in favor of the mechanically cleaned boiler. Thus the mechanical cleaner protects itself in providing for itself a minimum temperature. Even at points close to the fire near the bottom of the first pass, there was a temperature difference which favored the mechanical cleaning method. Although it may sometimes be necessary to place soot cleaner elements in gases having a temperature of 1500 degrees F. as for instance in the first pass of a B. & W. boiler, it has not been found difficult to maintain a temperature in the cleaner elements of less than 1000 degrees F. by means of dead gas pockets, baffle screens, etc. Convection currents are thus warded off and by placing the elements in close proximity with the boiler tubes, which seldom if ever have a temperature higher than 380 degrees F., the temperature of the element is kept well within the bounds of safety by radiation.

It has been stated by such authorities as Kreisinger and Barkley that in taking temperatures of gases, surrounded by colder or hotter surfaces, there is usually an error of some 3 to 25 per cent. in temperature. This error is due to radiation. Quoting from "Finding and Stopping Wastes in Mod-

ern Boiler Rooms Vol. II" by the Harrison Safety Boiler Works:

"If a temperature measuring instrument is immersed in hot gases surrounded by cooler surfaces, it absorbs heat by convection, and its temperature rises. Gases are permeable to radiation and as soon as the temperature instrument exceeds that of the surrounding surfaces, heat passes from it to them through the gases by radiation. The temperature of the instrument continues to rise with a decreasing rate until the quantity of heat it gives off by radiation is equal to the quantity is received by convection. The temperature then remains constant, but is below the temperature of the gases. The magnitude of the error depends mainly on:

(1) The size of the part of the instrument exposed to the gases and the radiation.

(2) The difference between the temperature of the gases and that of the surrounding surfaces.

"The smaller the exposed part and the smaller the difference of temperature, the smaller the radiation error."

Rules 1 and 2 are applicable to a soot cleaner element as well as to a thermometer. Thus according to rule 1 it is advantageous to make the element large. And according to rule 2 the difference in temperature, perhaps 600 degrees or 700 degrees F. at times, serves as a further protection.

Thus it has been found that the elements are seldom if ever subjected to a higher temperature than 1000 degrees F. However, to make assurance doubly sure, the manufacturers decided to make the Vulcan cleaner safer and longer lived by reinforcing the element with a metal sheath that is not easily influenced by heat.

A study of pages 543, 544 and 545 of Marks' Mechanical Engineers' Handbook will soon convince anybody that there is no better metal for this purpose than cast iron. Among the various metals listed are alumnnum, bronze, phosphor bronze, cast manganese bronze, malleable iron, cast steel, cast nickel, Monel metal, machining steel, metal vanadium steel and rolled Monel metal. All of these metals lose their strength very rapidly when the temperature is in the neighborhood of 1000 degrees F., but it is shown that soft cast iron and strong cast iron both retain their strength remarkably well.

Fig. 3 is plotted from the test data given in Marks' Mechanical Engineers' Handbook for strong and soft cast iron. These curves tend to show that cast iron grows stronger up to a temperature of about 450 degrees F. and from that point on the strength reduces slightly. The strength of soft cast iron, it will be noted, is practically constant all the way from 100 degs. to 1,000 degs. Fahr.

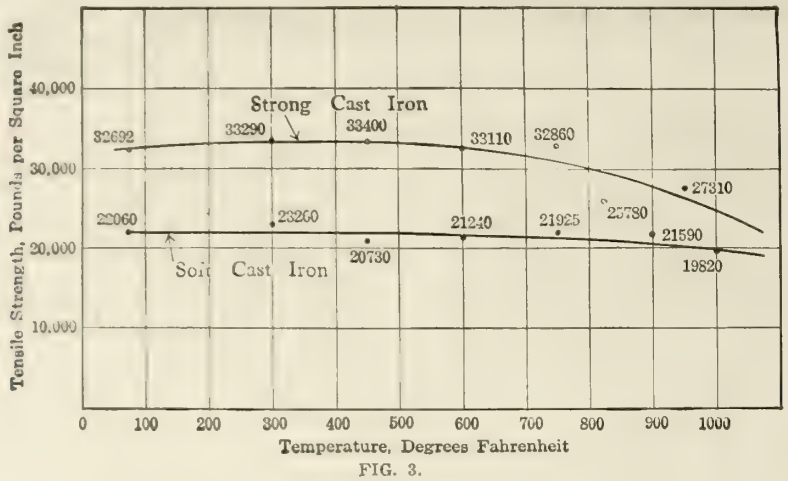


FIG. 3.

From these curves the conclusion may be drawn that cast iron of almost any good composition will protect soot cleaner elements sufficiently. But a specially uniform grade of cast iron has been decided upon and is now being used.

Also, inasmuch as the cast iron sheath placed over the soot cleaner element makes the element somewhat larger, it is evident that the rate of radiation will be greater, according to one of the rules quoted above. The greater size, therefore, insures lower temperature.

Cast iron also has a high heat radiating factor. Marks' handbook gives the following factors for the several substances: Cast iron, rough, oxidized, 1570; lamp black, 1540; wrought iron, dull, oxidized, 1540; lime plaster, rough white, 1510; water, 1120; wrought iron, highly polished, 467; brass, dull, 362; copper, slightly polished, 278.

To further emphasize the value of cast iron for retaining its strength at high temperatures take for example the well known comfortable, red hot, cast iron stove. Have you ever stopped to consider the strength retained by the metal, even at the high temperature of a good cherry red (1,500 degs. Fahr)? Moreover, you recall that the top of the stove does not scale or burn.

All engineers are quite familiar with the use of cast iron in grates where temperatures go very high.

In the field of steam engineering we are all familiar with super-heaters that have cast iron rings placed upon the inner tubes of steel, these being used principally to strengthen the structure at high temperatures which prevent overheating and warping. These superheater rings do not scale or burn.

We are also told of a case in a steel foundry where certain cast steel parts for furnace cage which was used to transfer the part to be annealed in and out of the furnace fell down repeatedly. The foundry was employed in making castings of steel only and the parts that were failing were finally sent out to be made of cast iron, and thereafter proved entirely satisfactory and resisted warping under the high temperatures to which they were necessarily exposed.

An editor of "Metallurgical and Chemical Engineering" wrote the following:

"Cast iron is better than wrought iron or steel for purposes where the material is subjected to considerable heat. Most steel is heat treated, and if subjected to considerable heat in practice it will lose to some extent the properties which were given it by the heat treating. Cast iron contains a much larger percentage or carbon than either wrought iron or steel and retains its properties up to quite high temperatures."

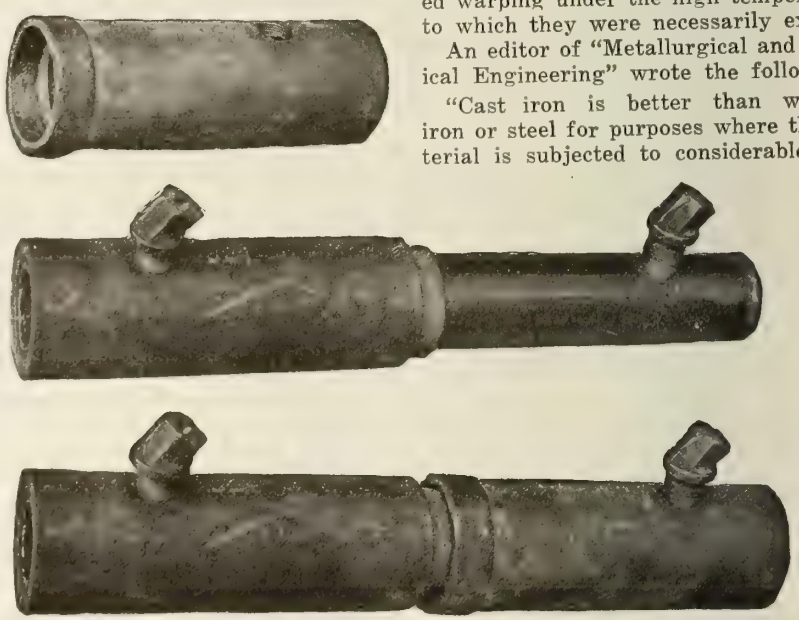


FIG. 4—SOOT CLEANER ELEMENT AND CAST IRON PROTECTING SLEEVE.

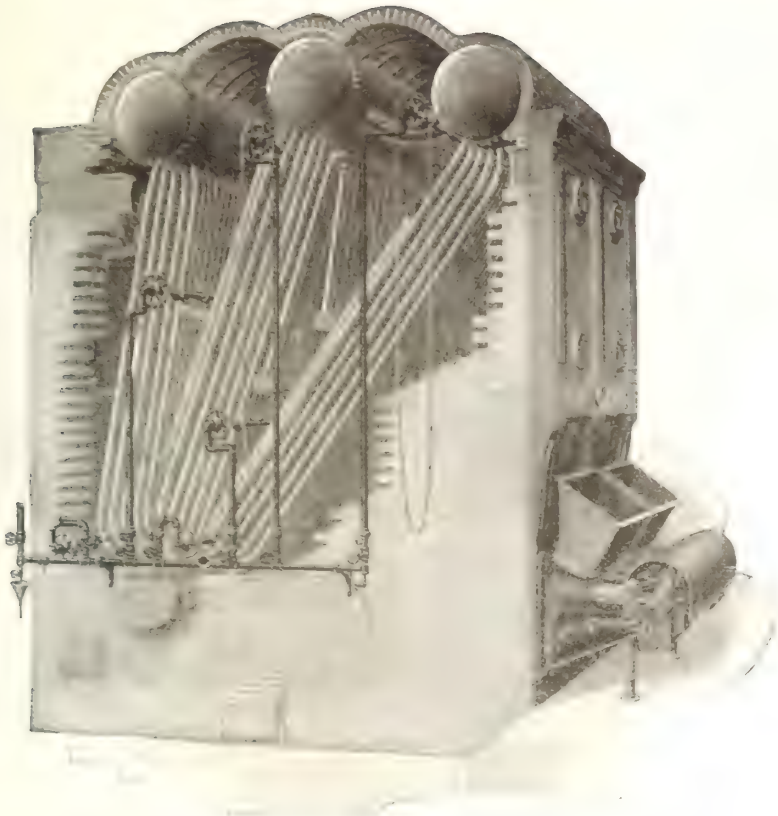


FIG. 5—SOOT CLEANERS INSTALLED IN BOILER SETTING.

Cast iron is used in Diesel engine cylinders, for example, where steel would not stand the strain.

Cast iron has an additional important advantage because of its resistance to corrosion. It is well known, for instance, that there are a great many cast iron economizers which have been in successful operation for fifty years. Cast iron is used for pipes under all sorts of conditions, in underground work, in water, in out-door exposures, subject to acid fumes, etc. We are all familiar with the cast iron pipe advertisements showing examples of pipes that have been in active service for some 100 to 200 years without evidence of serious corrosion. Cast iron forms a scale on its outer surface which seems to act in a protective manner, and besides, the crystal construction of cast iron itself is effective in resisting corrosion.

Fig. 4 illustrates how the problems of designing these non-warping sheathed elements was approached. The steel inner pipes in the element are wholly encased in the heavy cast iron sheaths with a loose fit. Fig. 4 is a short length of a standard element for horizontal tube boilers. Above the assembled view is shown the same element with part of the sheath removed exposing the inner steel tube. This photograph also shows the arrangement of nozzles for blowing down obliquely.

Fig. 5 shows a soot cleaner installation adapted for vertical tube boilers. It is similar to Fig. 4 except that its nozzles are at right angles to the element and not oblique. This element is located between the circulating tubes above the first pass in boilers of the type illustrated in Fig. 6 where the tube arrangement is such that the nozzles discharge at right angles to the element.

AUTOMATIC STARTERS FOR DIRECT CURRENT MOTORS

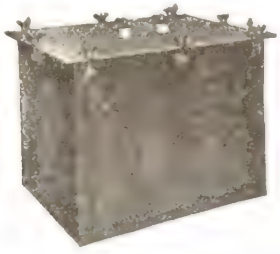
A SIMPLE and reliable means of controlling direct current motors from remote points is offered in the automatic starters manufactured by the Canadian General Electric Co. and illustrated herewith. These starters are particularly advantageous when used with motors

OIL TANK PARTIALLY REMOVED FROM AUTOMATIC STARTER FOR INSPECTION.

which are required to start and stop frequently, and may be applied to either shunt or compound wound motors.

All contactors are designed for heavy duty. The operating coils of the line contactors ,as well as the coils of the smaller accelerating contactors are wound with enameled wire and impregnated for moisture proofing. On the larger sizes coils are wound edgewise with heavy copper ribbon.

The main circuit is made and broken on solid copper contacts provided with magnetic blow out and arc chutes. The starters provide current-limiting acceleration which always starts the motor



OIL IMMERSED AUTOMATIC STARTER

quickly on light loads and slowly on heavy loads.

The terminals are plainly marked and the line, motor and control connections are made on the front of the panel, thus facilitating installation.

These automatic controllers are recommended for use with motors driving centrifugal or rotating machinery, air compressers, blowers, etc., or any machinery where automatic starting is desired and

A MODIFICATION OF THE STANDARD REMOTE CONTROL STARTER HAVING THE LINE SWITCH FUSES AND OVERLOAD RELAY MOUNTED ON THE PANEL.

may be operated by a float switch pressure governor or other switch.

Where fire hazard is prevalent these controllers are supplied of the oil immersed type.

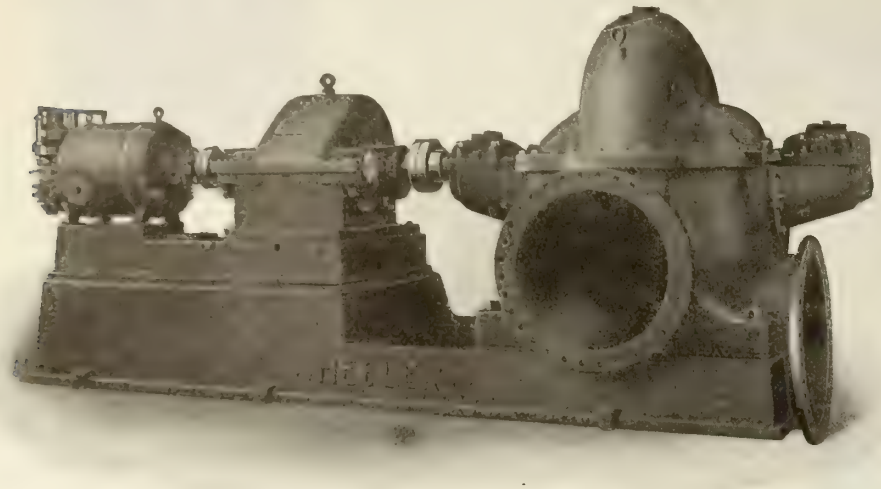
All starters are provided with either under-voltage release or under-voltage protection. The under-voltage release provides that in case of failure of voltage the motor will automatically restart on return of voltage. Under-voltage protection provides that in case of failure of voltage the motor will not start upon return of voltage until the starting button is pressed. Overload protection is supplied by an instantaneous hand reset overload relay which opens the closed circuit on overload. An electrically reset relay can be supplied if desired.

A NEW END SUCTION CENTRIFUGAL PUMP

A NEW design of pump manufactured by the Wheeler Condenser and Engineering Co., Carteret, N.J., is illustrated herewith. This pump is of unusual interest because of the unusual position of the suction opening which is directly

beneath and parallel to the end bearing. In this position it is out of the way, yet in a convenient place for the erection man for inspection and for upkeep.

This arrangement makes it possible to place a pumping unit in a room of small ground area—considerably smaller than where the suction end is opposite the outlet end as is the most common practice. In many cases this also facilitates the making of pipe connections, sometimes saving elbows and reducing the length of piping more or less.



STEAM TURBINE DRIVEN CENTRIFUGAL PUMP WITH END SUCTION ADAPTED TO CONDENSER PRACTICE

The capacity of the particular pump shown is 45,000 gals. per min. against a head of 20 ft. The diameter of the outlet pipe is 36 inches. The speed of the pump is 240 r.p.m., and it is coupled by a 10 to 1 reduction gear to a steam turbine whose speed is 2,400 r.p.m.

LARGE EXHAUST RELIEF VALVE

ONE of the largest relief valves ever manufactured is illustrated herewith. The illustration gives a good idea of its relative size. It is a 48-inch horizontal exhaust relief valve, and is hydraulically operated, and serves as a safety relief for the condenser on a turbine unit.

The complete valve weighs 4,000 pounds and measures 7 feet 5 inches from face to face of flanges. The valve disc, 48 inches in diameter, is made of cast iron, and has a bearing metal face which seats on a brass ring. It is water sealed, and is double cushioned with brass-lined dash pots above and below the disc. The valve stem is 3½ inches diameter. This valve is the latest addition to the valves built for the Detroit Edison Co. by the G. M. Davis Regulator Co., Chicago.

IMPORTANT RADIUM DEVELOPMENT

More than $180,000 worth of radium for use in the sciences has been delivered to the Bureau of Mines at Washington under an agreement between it and the National Radium Institute to develop a more efficient process for the manufacture of radium out of the carnotite ores of Colorado and Utah. It is stated that the amount of radium in question was procured for an expenditure of less than the amount of radium in question was $38,000. In addition, under the agreement, the bureau has turned over to the National Radium Institute about 6½ grams of radium, and has given to the country a method for producing pure radium compound from the ore for one-third the current price of radium.

When the Bureau of Mines began this work in 1912, it found that the precious carnotite ores, constituting the largest known supply of radium ore in the world, was going to Europe, mainly to Germany where it was being turned into radium and sold back to the United States at fabulous prices.

THE question of the most advantageous way of cooling a car is surrounded with a number of considerations due to the circumstances underwhich the car is employed, and consequently it is impossible to say what would be the best course to adopt until all the qualifying conditions are examined. In South Africa it was found most convenient to cool brine at the termini and run this brine into coils on the top of the cars. For Russia, with the long journeys from Siberia to the capital, it was ultimately decided as the result of long and careful tests that iced cars were the most suitable. On the Eastern Bengal State Railways a similar conclusion has been arrived at, provided the character of the insulation were suitable. Experimental vans were built to deal with the fish traffic from Sara and Goalunda to Calcutta, and at the same time the carriage of fruit was considered. In connection with the latter it was found that the carbon dioxide given off by the fruit hastens its decomposition, necessitating special means of ventilation.

Cork slab insulation was tried, but after using it and other materials the consideration of effectiveness, weight, and cost, resulted in the use of "Sunsul" (*Bombox Malabarium*) which is a variety of cotton tree common in India. It is said also to be only slightly absorbent of moisture. The insulation consists of 12-in. to 8-in. of non-conducting material, with ice compartments at one or both ends. Electric fans circulated the air previous to loading as well as on the journey, the temperature being reduced from 90 deg. Fahr. to 48 deg. or 42 deg. Fahr. in twenty-four hours. It was found that the temperature rose practically one degree in four hours.

Arrangements have been made to run the railway cars with various types of refrigerating machine either direct driven, or by means of electric motors taking current from a generator driven from the axle, and in some cases whole trains have been cooled from one of the cars fitted with the necessary machinery. —*Refrigerating World.*

LARGE EXHAUST RELIEF VALVE.

The Lack of a Grease Extractor Cost Them $5,000.00

We can't give the actual name of the college power plant at which this neglect took place.

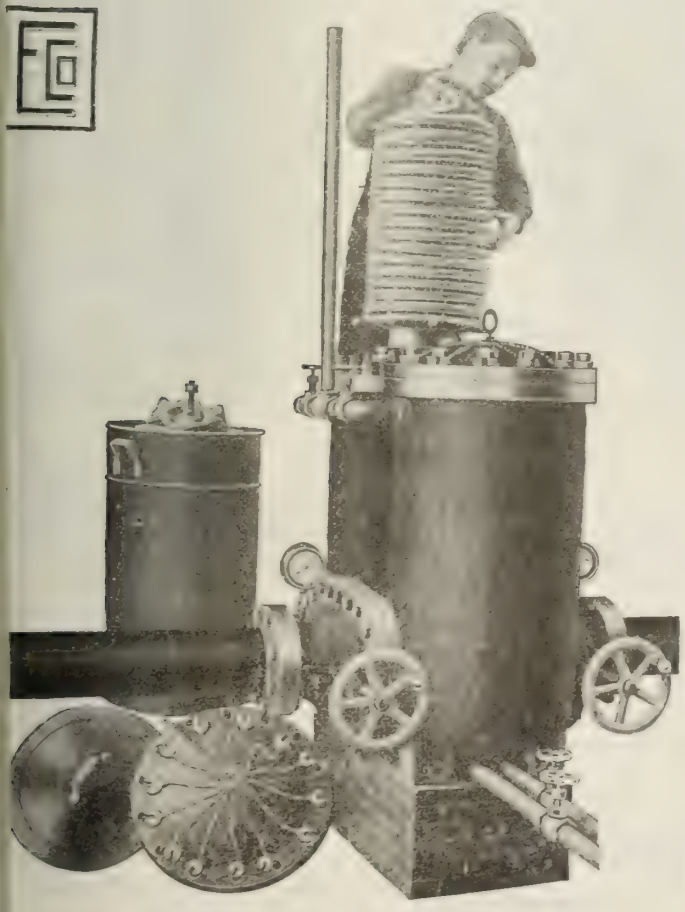
Naturally no plant wants to be connected with a true story like this.

But here are the facts:

Oil was allowed to get into the boilers and four of them were ruined by sagging—it cost $5,000—get that, five thousand in cold cash to reset these boilers.

With the reset boilers, a Twin Grease Extractor was installed and—

They have had no trouble since.



The Twin Filter and Grease Extractor

Avoid the Danger of This—Install a Twin Grease Extractor

This actual case proves again how much better it is to use the ounce of prevention. Keep oil out of your boilers thoroughly, efficiently, safely, with a Twin Grease Extractor.

You'll find unusually good features in the "Twin." For instance, you can clean it easily—a very important point. But more important, the twin idea; two separate filtering chambers—while one is in service, the other can be cleaned without by-passing or interrupting the flow of water.

You'll find a complete description in our Bulletin B. Send for a copy.

ELLIOTT COMPANY

6902 Susquehanna St., Pittsburgh, Pa.

SELECTED MARKET QUOTATIONS

A Record of Prices Current on Raw, Semi-finished, and Finished Materials Entering Into the Manufacture and Operation of Power Plant Equipment

BOILER TUBES

Size	Seamless	Lapwelded
1 in.	$36 00	$.....
1¼ in.	40 00	.....
1½ in.	43 00	36 00
1¾ in.	43 00	36 00
2 in.	50 00	36 00
2¼ in.	53 00	38 00
2½ in.	55 00	42 00
3 in.	64 00	50 00
3¼ in.	.....	58 00
3½ in.	77 00	60 00
4 in.	90 00	75 00

Prices per 100 feet, Montreal and Toronto.

PLATES

	Montreal	Toronto
Plates, ¼ to ½	$10 00	$10 00
Heads	10 30	10 25
Tank plates, 3-16 in..	10 50	10 10

WROUGHT PIPE

Effective Jan. 7, 1918.
Standard Buttweld.

Size.	Black Per 100 feet	Galvanized Per 100 feet
⅛ in.	$ 6 00	$ 8 00
¼ in.	5 16	7 29
⅜ in.	5 16	7 29
½ in.	6 55	8 12
¾ in.	8 28	10 41
1 in.	12 24	15 39
1¼ in.	16 56	20 82
1½ in.	19 80	24 89
2 in.	26 64	33 49
2½ in.	42 72	53 53
3 in.	55 85	70 00
3½ in.	70 84	87 86
4 in.	83 93	104 10
	Standard	Lapweld
2 in.	29 60	36 08
2½ in.	44 46	54 70
3 in.	58 14	71 53
3½ in.	72 68	90 62
4 in.	86 11	107 37
4½ in.	97 79	122 56
5 in.	114 00	142 82
6 in.	147 80	185 28
7 in.	192 80	241 57
8L in.	202 50	253 75
8 in.	233 30	292 32
9 in.	279 50	350 18
10L in.	259 20	324 80
10 in.	333 70	418 18

Prices—Ontario, Quebec and Maritime Provinces

WROUGHT NIPPLES

4" and under, 45%.
4½" and larger, 40%.
4" and under, running thread, 25%.
Standard couplings, 4" and under, 35%.
4½" and larger, 15%.

IRON PIPE FITTINGS

Malleable fittings, class A, 20% on list; class B and C, net list. Cast iron fittings, 25% off list. Malleable bushings, 25 and 7½%; cast bushings, 25%; unions, 45%; plugs, 20% off list. Net prices malleable fittings: Class B black, 24½c lb.; Class C black, 15¾c lb.; galvanized, Class B, 34c lb.; Class C, 24½c lb. F.O.B. Toronto.

COLD ROLLED SHAFTING.

At mill ..... list plus 40%
At warehouse ..... list plus 50%
Discounts off new list. Warehouse price at Montreal and Toronto.

FINISHED IRON AND STEEL

Per lb. to Large Buyers	Cents
Iron bars, base, Toronto....	$5 25
Steel bars, base, Toronto....	5 50
Steel bars, 2" to 4" base...	6 00
Iron bars, base, Montreal...	5 25
Steel bars, base, Montreal..	5 50
Reinforcing bars, base ...	5 25
Small shapes	5 75

SHEETS

	Montreal	Toronto
Sheets, Black, No. 28.	$ 8 00	$ 8 25
Sheets, Black, No. 10.	10 00	9 50
Canada plates, dull, 52 sheets	9 00	8 65
Canada plates, all bright	9 50	9 50
Apollo brand, 10¾ oz. galvanized	....	....
Queen's Head, 28 B.W.G.	....	....
Fleur-de-Lis, 28 B.W.G.		
Gorbal"s Best, No. 28.		
Colborne Crown, No. 28	....	....
Premier, No. 28 U.S.	....	9 20
Premier, 10¾ oz. ...	....	9 50

PROOF COIL CHAIN B

¼ in.	$12 35
5-16 in.	11 85
⅜ in.	11 50
7-16 in.	10 90
½ in.	11 20
9-16 in.	10 70
⅝ in.	10 50
¾ in.	10 40
⅞ in.	10 90
1 in.	10 65
Extra for B.B. Chain	1 20
Extra for B.B.B. Chain	1 80

ELECTRIC WELD COIL CHAIN B.B.

¼ in.	$13 00
3-16 in.	12 50
¼ in.	11 75
5-16 in.	11 40
⅜ in.	11 00
7-16 in.	10 60
½ in.	10 40
⅝ in.	10 00
¾ in.	9 90

Prices per 100 lbs.

FILES AND RASPS

	Per Cent.
Great Western, American	50
Kearney & Foot, Arcade	50
J. Barton Smith, Eagle	50
McClelland, Globe	50
Whitman & Barnes	50
Black Diamond	37½
Delta Files	37½
Nicholson	37½
Globe	50
Vulcan	50
Disston	50
P.H. and Imperial	50

OILS AND COMPOUNDS

Castor oil, per lb.	....
Royalite, per gal., bulk	18
Palacine	21
Machine oil, per gal.....	26½
Black oil, per gal.	15
Cylinder oil, Capital	49½
Cylinder oil, Acme	39½
Standard cutting compound, per lb.	06
Lard oil, per gal. 2	60
Union thread cutting oil antiseptic	88
Acme cutting oil, antiseptic	37½
Imperial quenching oil.....	39½
Petroleum fuel oil	13½

BELTING—No. 1 OAK TANNED.

Extra heavy, single and double	30-5%
Standard	40%
Cut leather lacing, No. 1....	$1 95
Leather in sides	1 75

COAL AND COKE.

Solvay Foundry Coke	.....
Connelsville Foundry Coke...	.....
Steam Lump Coal	.....
Best Slack	.....

Net ton f.o.b. Toronto.

BOLTS, NUTS AND SCREWS

	Per Cent.
Coach and lag screws.....	25
Stove bolts	55
Plate washers.....list plus	20
Machine bolts, 7-16 and over	net
Machine bolts, ⅜ and less...	10
Blank bolts	net
Bolt ends	net
Machine screws, fl. and rd. hd., steel	27½
Machine screws, o. and fil. hd., steel	10
Machine screws, fl. and rd. hd., brass .....add	20
Machine screws, o. and fil. hd., brass .....add	25
Nuts, square blank .....add	$1 50
Nuts, square, tapped.....add	1 75
Nuts, hex. blank .....add	1 75
Nuts, hex. tapped .....add	2 00
Copper rivets and burrs, list plus	30
Burrs only list plus	50
Iron rivets and burrs	15
Boiler rivets, base ¾" and larger $8	50
Structural rivets, as above.. 8	40
Wood screws, flat, bright..	72½
Wood screws, O. & R., bright	67½
Wood screws, flat, brass....	37½
Wood screws, O. & R., brass	32½
Wood screws, flat, bronze..	27½
Wood screws, O. & R., bronze	25

MISCELLANEOUS.

Solder, strictly 0	60
Solder, guaranteed 0	70
Babbitt metals .....18 to 1	00
Soldering coppers, 3 to 6 lbs. 0	64
Putty, 100-lb. drums 5	20
White lead, pure, cwt..... 15	20
Red dry lead, 100-lb kegs, per cwt. 15	50
Glue, English 0	35
Gasoline, per gal., bulk.... 0	31½
Benzine, per gal., bulk.... 0	30½
Pure turpentine, single bbls., gal. 0	74
Linseed oil, raw, single bbls. 1	36
Linseed oil, boiled, single bbls. 1	39
Lead wool, per lb. 0	15
Plumbers' oakum, per cwt. 9	00
Sandpaper, B. & A....list plus	20
Emery Cloth.....list plus	20
Sal Soda 0	03½
Sulphur, rolls 0	05
Sulphur, commercial 0	04½
Rosin "D," per lb..... 0	03
Rosin "G," per lb..... 0	03½
Borax crystal and granula. 0	14
Wood alcohol, per gallon... 1	80
Whiting, plain, per 100 lbs.. 2	20

COPPER PRODUCTS

	Montreal	Toronto
Bars, ½ to 2 in. ..	$42 50	$43 00
Plain sheets, base 16 oz. and heavier ..	46 00	44 00
Copper sheet, tinned, 14x60 in., 14 oz. ..	48 00	48 00
Copper sheet, planished, base 16 oz. and heavier	57 00	45 00
Braziers' in. sheets, 6x4 base	45 00	44 00
Tubing T.P.S., base ¾ in. up to 3 in.	60 00	60 00

Above prices are full sheets and bars. Cut sheets and bars are 5c per lb. higher.

BRASS PRODUCTS.

Brass rods, base ½" to 1" rd..	$0 43
Sheets 24 oz. and heavier base	0 48
Brass tubing, seamless.....	0 55
Tubin, I.P.S., 1" base.....	0 55

POLISHED DRILL ROD.

Discount off list, Montreal and Toronto ..... Net

RUBBER BELTING

Standard	10%
Best grades	15%

WASTE

White.	Cents per lb.
XXX Extra	21
Peerless	21
Grand	19¾
Superior	19¾
X L C R	18½
Atlas	18½
X Empire	17¼
Ideal	17¼
X press	16
Colored.	
Lion	15
Standard	13½
No. 1	13½
Popular	12
Keen	10½
Wool Packing	
Arrow	25
Axle	20
Anvil	15
Anchor	11
Washed Wipers	
Select White	11
Mixed colored	10
Dark colored	09

This list subject to trade discount for quantity

MILLED PRODUCTS

	Per Cent.
Set screws .....%	25
Sq. & Hex., Head Cap Screws	20
Rd. & Fil Head Cap Screws	Net
Flat & But. Hd. Cap Screws plus	Net
Fin. & Semi-fin. nuts up to 1 in.	25
Fin. and semi-fin. nuts, over 1 in., up to 1½ in.....	20
Fin. and semi-fin. nuts, over 1½ in., up to 2 in., list plus	10
Studs	20
Taper pins	40
Coupling bolts, pins	10
Planer head bolts, without fillets .....list plus	10
Planer head bolts, with fillet list plus 10 and	10
Planer head bolt nuts, same as finished nuts.	
Planer bolt washers	net
Hollow set screws..list plus	20
Collar screws...list plus 30,	10
Thumb screws	20
Thumb nuts	65
Patch bolts .....add 40,	10
Cold pressed nuts to 1½ in. ..... add	$4 50
Cold pressed nuts over 1½ in. .....add	$7 00

METALS

	Montreal	Toronto
Lake copper $30 00		$28 00
Electro copper 30 00		28 50
Castings, copper ... 29 00		28 00
Tin 125 00		125 00
Spelter 10 50		10 00
Lead 10 00		9 00
Antimony 17 50		16 00
Aluminum 55 00		50 00

Prices per 100 lbs...

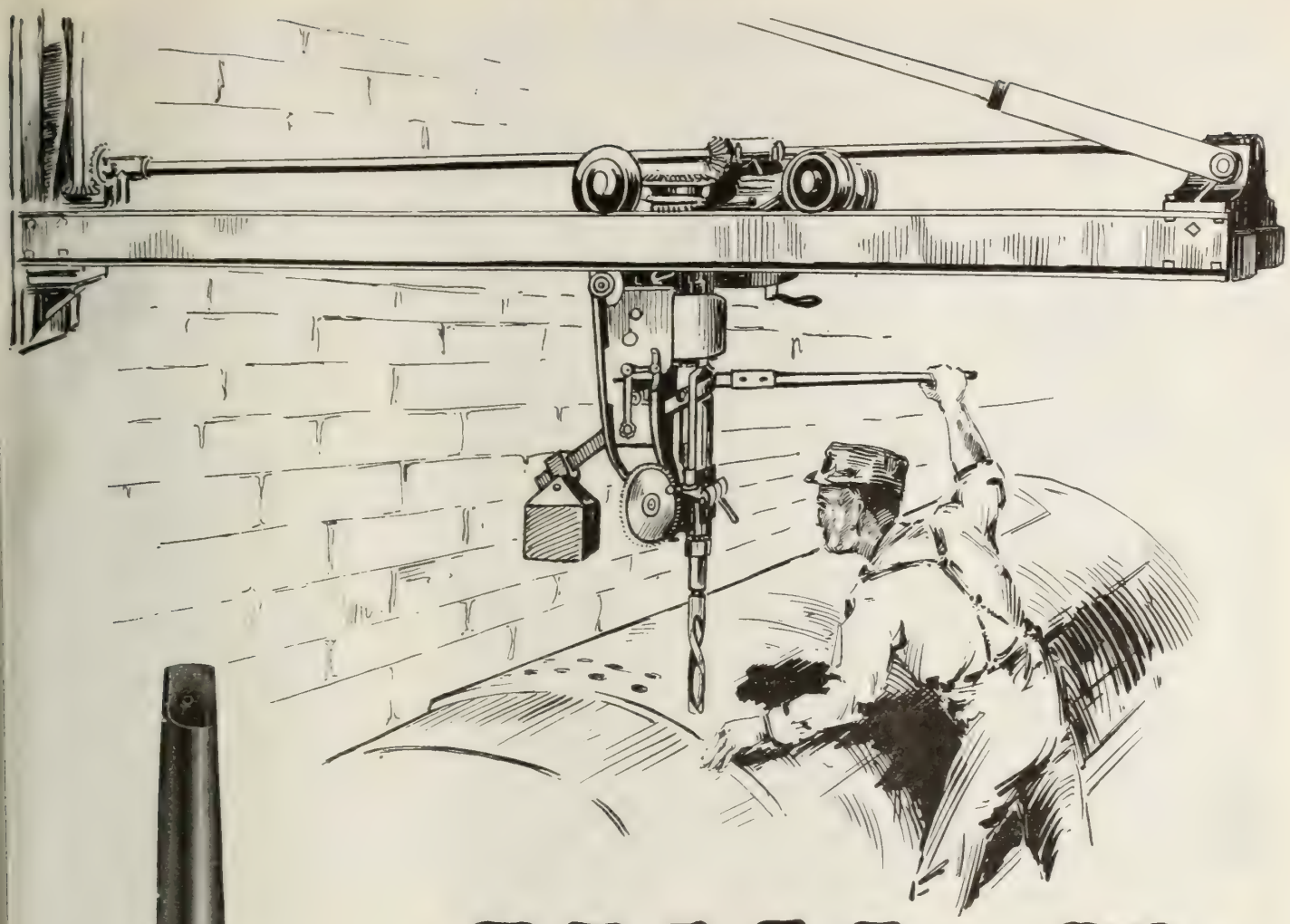
ROPES AND PACKING

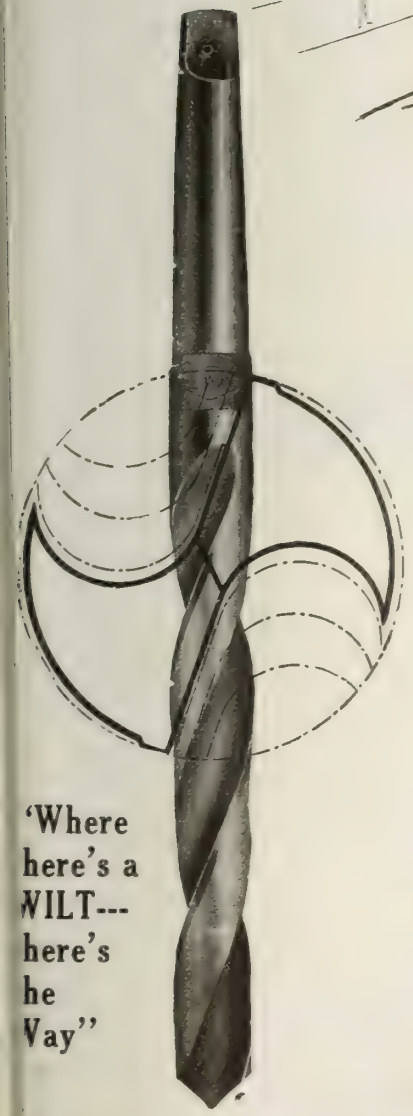
Packing, square braided.... 0	34
Packing, No. 1 Italian..... 0	40
Packing, No. 2 Italian..... 0	32
Pure Manila rope 0	39
Transmission rope, Manila.. 0	45
Drilling cables, Manila..... 0	41

LEAD SHEETS

	Montreal	Toronto
Sheets, 3 lbs. sq. ft. lb. $12 00		$13 25
Sheets, 3½ lbs..... 12 00		13 25
Sheets, 4 to 6 lbs... 13 00		12 50

Cut sheets, ¾c per lb. extra.
Cuts sheets to size, 1c per lb. extra.





'Where here's a WILT--- here's the Way"

WILT

High Speed and Carbon

TWIST DRILLS

Industrial requirements were never so exacting as now. The utmost in SPEED and EFFICIENCY is demanded in production. Wilt High Speed and Carbon Twist Drills fill the bill. They combine ACCURACY, QUALITY, SERVICE and ECONOMY in the highest degree.

Equipped for Quick Deliveries

WILT TWIST DRILL CO.

OF CANADA, LIMITED

Walkerville - Ontario

London Office, Wilt Twist Drill Agency
Moorgate Hall, Finsbury Pavement, London, E.C. 2, England

If any advertisement interests you, tear it out now and place with letters to be answered.

TRADE GOSSIP

Chicago.—A portable track welding outfit weighing less than 200 pounds which takes its power from trolley wires has been invented for small street railways that do not require elaborate equipment.

Renfrew.—The town council, through the waterworks' committee, has decided to purchase a twin horizontal enclosed turbine waterwheel, and a 12-inch two-stage pump. It is practically a duplicate of the present outfit. Some idea of the way prices are increasing can be gained from the fact that the present price quoted is $1,244 over the quotation of October 23, 1917, and $1,640 over that of July, 1917.

To Build Briquette Plant.—It is announced that the federal government has sanctioned the plan whereby a plant for the manufacture of briquettes from lignite coal will be established in the Estevan district. The federal government will provide $200,000, and Manitoba and Saskatchewan each $100,000. This plant will be erected as soon as possible, and may prove a factor in the solution of the pressing fuel problem.

Detroit.—Henry Ford has this to say of the much-discussed Liberty motor; "It is a wonderful creation. It is undeniably the finest mechanism of the kind the world has ever seen. It represents about the maximum of power possibilities in aeroplane motors, inasmuch as it develops about two horsepower for each pound of weight. The men who have worked out this extraordinary motor deserve the thanks and heartfelt appreciation of the nation."

Manufacturers Protest.—At a general meeting held in the Kerby House at Brantford of the manufacturers of the Counties of Brant, Elgin, Oxford, Norfolk, Haldimand, Welland, Lincoln and Wentworth, it was decided to send a delegation to Toronto to arrange for a meeting in regard to the order for the curtailment of the gas supply of manufacturers in this district. There was a representative attendance of about forty manufacturers present, many of whom were entirely dependent upon gas to operate their respective plants.

New Equipment.—The Otis Fensom Elevator Co. have purchased a 50 h.p. motor-driven De Laval 3-in. three stage centrifugal pump for use in connection with a hydraulic elevator, which they will install in the Bell Telephone Building. The Hydro-Electric Power Commission of Ontario have purchased six De Laval single and multi-stage pumps for the Ontario Power Company. These range in sizes from 100 to 150 h.p., and all will be motor driven. Sales were made by the Turbine Equipment Co., Ltd., Toronto.

Increased Output.—Efforts are already under way to relieve the coal situation in the Canadian West. In Alberta a large increase is noted in the amount of coal mined and exported. A report just issued states that the total amount of domestic coal mined in 1918 during January, February and March amounted to 810,972 tons, as compared with 744,700 tons mined last year during the same period. In the bituminous field the amounts were 712,313, as compared with 650,319 tons mined last year. Anthracite was 39,409 tons in 1918, as compared with 37,817 last year.

Coal Mixing Plant.—A coal mixing plant is to be installed by the Grand Trunk Pacific Railway at Edson, and contracts for the construction work are now being awarded. The purpose of the works will be to combine three different grades of Alberta coal into a standard fuel, which will be used on all locomotives of the system between Winnipeg and Prince George ,and the consumption of home mined coal will thereby be increased to the extent of 200,000 tons a year. The plant will be in operation about the 1st of August, and employment will be given to some fifty men.

Winnipeg.—One result of the decision to make the West dependent on Alberta for a coal supply this winter has been a move for an investigation into the price that is to be paid. One of the Winnipeg papers has gone into the matter at some length, pointing out that the price of the coal at the mines is from four to four and a half dollars. The same article delivered to the consumer is paid for at the rate of $12.50 per ton, and it is held that the spread is too great. The Winnipeg Board of Control are also taking action in regard to the same matter.

Montreal.—Sir Herbert S. Holt, presiding at the annual meeting of Montreal Light, Heat and Power Company, Consolidated, stated that while the new La Salle gas plant had been considered sufficient for five years' growth, enlargement would be necessary to meet the growing demand. The directors were not inclined to go ahead with extensions just now, because of the high cost of machinery, etc., but an extension in this case was virtually forced on the company by conditions. Sir Herbert referred to the rates for gas and electricity in Montreal being the lowest in America, and reaffirmed the company's intention to make no change unless further increases in cost of operation, taxes, etc., compelled such action.

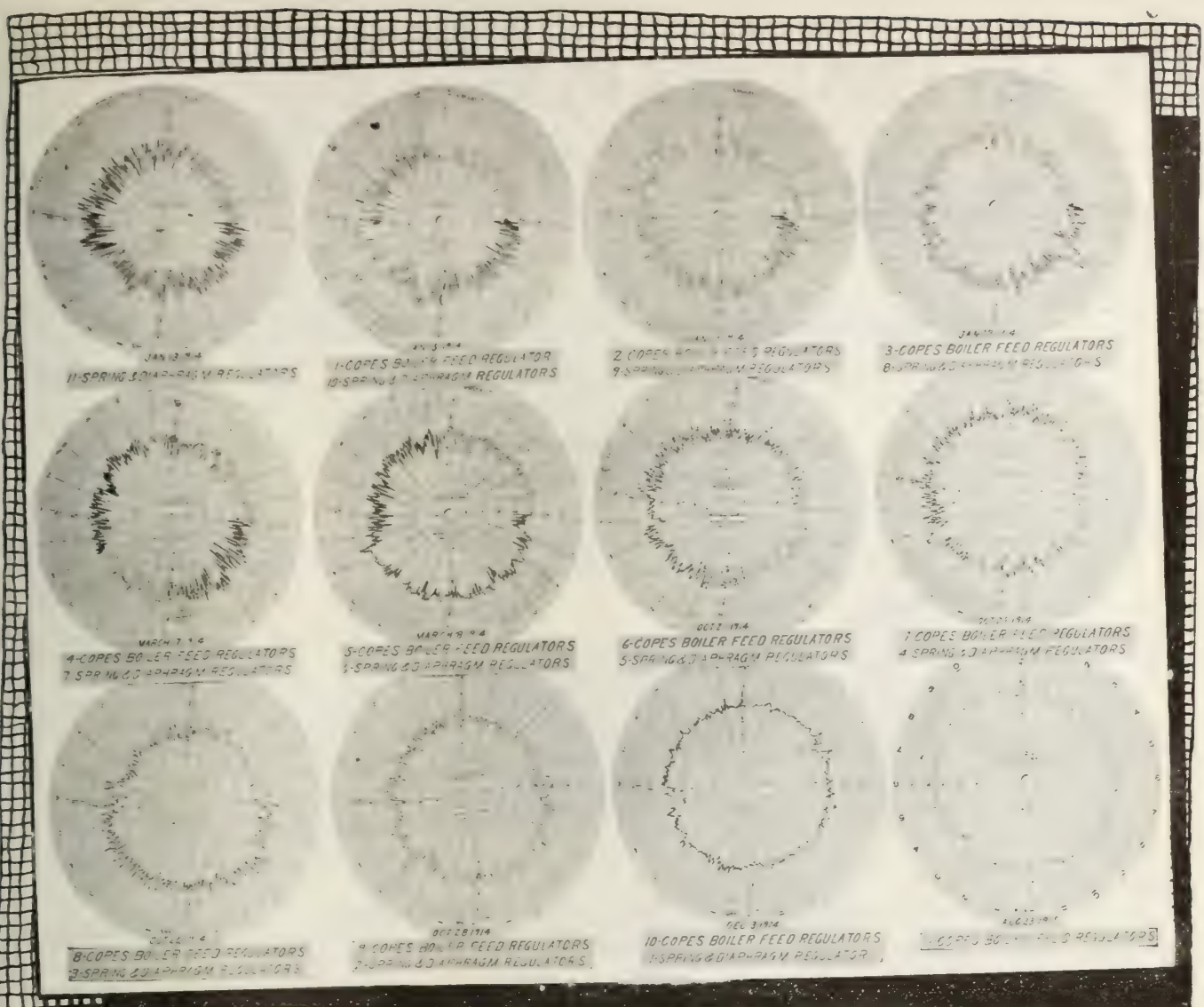
Patents Issued.—The following is a list of Canadian patents recently issued through the agency of Messrs. Ridout & Maybee, 59 Yonge Street, Toronto, from whom further particulars may be obtained. H. E. Angold and Wm. Duddell, distance operated mechanisms and signals connected to electric supply systems; Wm. T. Bell, Leonard W. Jones and Wm. H. Watson, motor plow; Wm. J. P. Cloakey, dust collector; Wm. Hooker, atmospheric gas burner; H. and A. Saunders, safety catches for brooches and the like; Henry P. Baird, air moistening and filtering attachment for radiators; Shurly-Dietrich Co., Limited,

MacKINNON, HOLMES & Co.
Limited
MacKinnon Steel Co., Ltd.
SHERBROOKE QUEBEC
Engineers, Manufacturers and Erectors of Steel Structures
We Specialize in
Bridges, Buildings, Towers, Tanks, Penstocks, Roof Trusses, Columns, Smoke Flues and Stacks, Coal Bins, Ore Bins, Buckets, Refuse Burners, Stills, Air Receivers, etc.
WRITE FOR PRICES.

R.D. Wood & Co.
Philadelphia, Pa., U.S.A.
Water and Gas Work Supplies,
Cast Iron Pipe and Castings,
Mathews Hydrants and Valves,
Hydraulic Presses and Accumulators,
Operating Valves,
Mechanically Operated Gas Producers.

WALTER J. FRANCIS, C.E. M. Can. Soc. C.E. M. Am. Soc. C.E. M. Inst. C.E.
FREDERICK B. BROWN, M.Sc. M. Can. Soc. C.E. Mem. Am. Soc. M.E. Mem. A.I.E.E.
WALTER J. FRANCIS & COMPANY
CONSULTING ENGINEERS
Head Office, 232 St. James St., Montreal
Cable Address "Walfran, Montreal"—W.U. Code.
Long Distance Telephone, Main 5643.

MONCRIEFF'S "UNIFIC" WATER GAUGE GLASSES
Stand in a Class by Themselves for Quality, Efficiency and Economy
A trial will convince you. Write for Catalog
W. J. WALL, 134-136 BLEURY ST., MONTREAL
(Canadian Representative)



AN EVOLUTION IN BOILER OPERATION

These Venturi Meter Charts show how the gradual addition of

COPES BOILER FEED REGULATORS

changed an inefficient fuel-wasting system of boiler feed regulation into a highly economical one.

Let us tell you something about the savings that the "Copes" can make for you. Write for Catalog "D."

Northern Equipment Co., Erie, Penn.

CANADIAN REPRESENTATIVES:—Allen General Supplies Co., Bank of Toronto Chambers, Toronto, Ont. Mr. H. N. Brown, P.O. 620, New Glasgow, Nova Scotia.

STEAM TRAP "SARCO"

Superior in Three Respects

1—*Its Cost, compared with the Bucket Trap*

BUCKET

SARCO

2—*Its Size, compared with the Bucket Trap*

BUCKET

SARCO

3—*Its Capacity, compared with the Bucket Trap*

BUCKET

SARCO

WHY not use the "SARCO?" It is made in all sizes from ⅜-in. up to 3-in. and for Vacuum lines or for any given pressure between, up to 200 lbs.

Send for Bulletin J-6.

Sarco Co., Inc.

Woolworth Building, New York City

Elliott Square, Buffalo
New Telegraph Bldg., Detroit
Williamson Bldg., Cleveland
Monadnock Block, Chicago
Drexel Bldg., Philadelphia
And representatives in all principal cities
Canada, Peacock Brothers, Montreal

CLASSIFIED ADVERTISEMENTS

FOR SALE

FOR SALE CHEAP—ONE 30 K.W. GENERATOR Set 220 Volt D.C. Ideal Engine—Westinghouse Generator on sub-base—Switchboard; one 20 K.W. Generator Set on sub-base, same as above. These two sets are in perfect condition and we offer decided bargain for quick sale. Winnipeg Machinery Exchange, Sutherland and Gladstone Sts., Winnipeg.

Engines For Sale

pound Engine, 13 x 23 x 30. Run condensing at 90 lbs. steam. Wheel 13′ x 20″

12 x 30, 8′ x 8″ Fly Wheel 100 R.P.M. 80

1—Inglis Simple Corliss Valve, L.H. Crank Engine, 13″ x 30″. 12′ x 16′ belt wheel. 100 R.P.M. 93 H.P. at 90 lbs. steam arranged

1—Skinner 8″ x 12″ Center Crank, 60″ x 8″ belt

Class B Automatic Center Crank, 36″ x 8″ belt wheel. 360 R.P.M. 42 H.P. at 100 lbs. steam.

100 x 125 H.P. Boilers suitable for 90 lbs.

Ogilvie Flour Mills Co., Ltd.

WINNIPEG

POSITION WANTED

SUCCESSFUL SALESMAN, MARRIED, 27 years old, catering to hardware trade east of Toronto to the Sydney's, desires connection with reliable concern. Have A1 connection and thorough knowledge of modern salesmanship. William Baldwin, 752 St. Valier St., Montreal, Que.

STATIONARY ENGINEER, AT PRESENT WITH large power company, desires change. British born, married, ten years' experience in Canada, five years with previous employers. Have had considerable experience in electrical equipment operation and can furnish excellent references. Am looking for a more congenial locality than where now employed. If you need a first-class engineer now or will need one shortly, let me write you further. Box 428, Power House. (p6h)

CHIEF ENGINEER

Wanted by large manufacturing plant in Ontario; must be competent to take charge of Boiler House and several repair gangs; free house, good salary, and permanent position. Address, stating age, past experience, and full details to Vice-President, P.O. Box 360, Montreal, P.Q.

saw blade; G. & J. Weir, Limited, control device for rotary pumps; Gutta Percha & Rubber, Limited, the manufacture of sheet rubber; the Williams, Greene & Rome Co., Limited, reversible cuffs.

CATALOGUES

"The Proper Care of Belts," is the title of a booklet gotten out by the Joseph Dixon Crucible Company. We suggest that engineers obtain a copy for their files. As long as the original condition of life and pliability of a belt is preserved it is worth its cost price. To neglect belts will result in a two-fold loss; a waste of power due to the inefficiency of the belts and increased cost due to frequent belt renewals. Just now as never before it is essential that belting be given careful attention. The booklet contains helpful suggestions for getting maximum results from belts and in addition has several pages devoted to useful information of a general character.

Hydraulic Valves and Fittings.—A new catalogue of hydraulic valves and fittings has just been issued by the Hydraulic Press Mfg. Co., of Mount Gilead, Ohio. The book is quite elaborate in make up and presents the complete H.P.M. line very attractively. The four general classes of hydraulic valves are clearly illustrated and described. These are operating, check, knock-out and safety. Every standard type of hydraulic fitting is also listed, also accumulator controls, pressure gauges, hydraulic pipes, etc. Many of these hydraulic devices are of improved design and are here published for the first time. Interested parties may obtain copies from the above address.

The Collapse of Short Thin Tubes.—Professor A. P. Carman of the Department of Physics, University of Illinois, has completed a series of experiments on the Collapse of Short Thin Tubes. The purpose of these tests was to find an equation by the application of which the pressure required to collapse a tube can be calculated when the dimensions of the tube and the elastic properties of the material are known. The results of tests of longer tubes were published by the Engineering Experiment Station in 1905 and the present report contains a brief summary of these earlier tests. Seamless steel, seamless brass, aluminum, glass, and rubber tubes mere used in the new tests. Bulletin 99 of the Engineering Experiment Station contains the results of these tests. Copies may be obtained gratis by addressing the Engineering Experiment Station, Urbana, Ill.

ALLOYS of from 57 to 63 parts of copper and the balance of zinc are used in the extruding process for making rods, tubes and shapes and a mixture of approximately 50 parts of copper and 50 parts of zinc has the highest content of zinc the alloy may contain and be workable.

Murphy AUTOMATIC Furnace

Murphy Stokers

A few longtime constant users, and there are others!

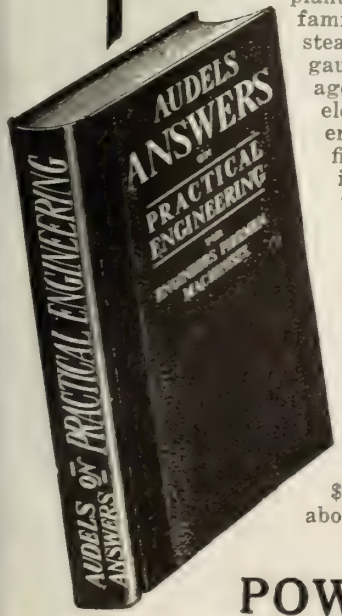
Lockport Paper Co.,	Lockport, N.Y.	33 years constant use
Hartje Paper Co.,	Steubenville, Ohio	24 years constant use
Sherwin-Williams Co. 12 contracts 20 Stokers	Montreal, P.Q. Cleveland, Ohio Kensington, Ill.	16 years constant use
Laurentide Co., Ltd.,	Grand Mere, P.Q.	13 years constant use
Ford Motor Co., " " " " " "	Detroit, Mich. Des Moines, Iowa New York, N.Y.	18 years constant use
Ohio Traction Co., 16 Repeat Orders	Cincinnati, Ohio	28 years constant use 74 Murphy Stokers

For printed matter address

MURPHY IRON WORKS

DETROIT, MICH. BUFFALO, N.Y.

Audel's Answers on *Practical Engineering*



GIVES you the everyday practice and simple laws relating to the care and management of a steam plant. Its 250 pages make you familiar with steam boilers, steam, fuel, heat, steam gauge, installation and management of boilers, pumps, elevators, heating, refrigeration, engineers' and firemen's law, turbines, injectors, valves, steam traps, belts, gears, pulleys, electricity, etc., etc.

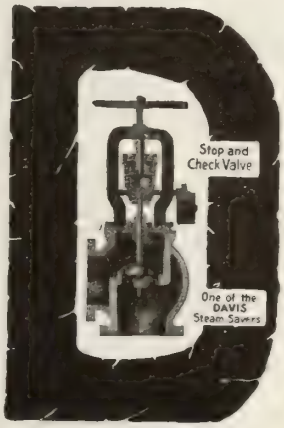
Price, One Dollar.

To subscribers to Power House who send us two new subscriptions, above book will be mailed, postage paid, for 35c. To subscribers who send three new subscriptions, together with $3.00 to pay for same, above book will be sent free.

Address:

POWER HOUSE

153 University Avenue, TORONTO, ONT.



DAVIS SAFETY

protects you and your plant from the possible boiler explosion that may happen next year, next week or *tomorrow.*

Not only does the Davis Stop and Check Valve protect, but it equalizes the load by making each boiler do its share. Automatieally it will prevent a reserve flow of steam caused by sudden drop of pressure; will equalize the loss by cutting out the laggards; and will close tight when the fire is drawn. Reliable, efficient and absolutely dependable. Visible action—will not stick.

For your free copy of the new Davis Catalog, write the G. M. Davis Regulator Co., 434 Milwaukee Ave., Chicago.

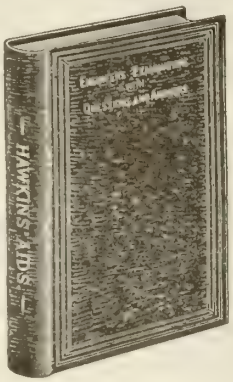
DAVIS VALVE SPECIALTIES
STEAM SAVERS SINCE 1875

If any advertisement interests you, tear it out now and place with letters to be answered.

Books for the Engineer's Library

Hawkins' New Catechism of Electricity

It contains 550 pages with 300 illustrations of electrical appliances; it is bound in heavy red leather, with full gold edges and is a most attractive handbook for electricians and engineers. One-third of the book is devoted to the explanation and illustrations of the dynamo, with particular directions relating to its care and management—$2.10 post paid.



Engineers' Examinations

By N. Hawkins, M.E.

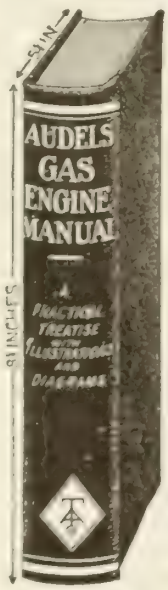
It presents in a condensed form the most approved practice in the care and operation of boilers, engines, pumps, condensers and refrigerating machinery, and covers the work in the problems relating to the safety valve, strength of boilers and horse power of engine and steam boiler.—$2.10 post paid.

Steam Turbines

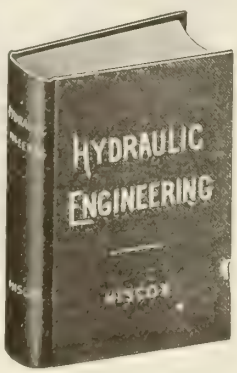
By Leland.

A reference work on the development, advantages and disadvantages of the steam turbine; the design, selection, operation and efficiency of steam turbine plants and turbo-generators. 135 pages. Illustrated.—$1.00.

Audel's Gas Engine Manual



A practical treatise relating to the theory and management of gas, gasoline and oil engines, including chapters on producer gas plants, marine motors and automobile engines.—$2.00.



Hydraulic Engineering

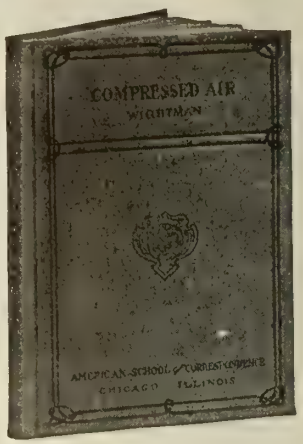
By G. D. Hiscox.

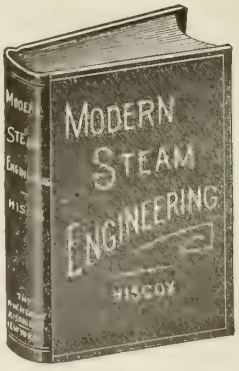
This comprehensive book of Hydraulics written by an experienced engineer, is a practical treatise on the properties, power and resources of water for all purposes, including the measurement of streams, the flow of water in pipes or conduits; the horse-power of falling water; turbine and impact water wheels; wave motors, etc. All who are interested in Water Works Development should have a copy. 320 pages, 305 illustrations. Price $4.15 post paid.

Compressed Air

By L. I. Wightman, E.E.

A reference work on the production, transmission and application of compressed air; the selection, operation and maintenance of compressed air machinery; and the design of air power plants. Illustrated.—$1.10.





Modern Steam Engineering in Theory and Practice

By Hiscox.

This book has been specially prepared for the use of the modern steam engineer, the technical students, and all who desire the latest and most reliable information on steam and steam boilers, the machinery of power, the steam turbine, electric power and lighting plants, etc. 450 pages. 400 detailed engravings.—$3.15 post paid.

Boiler Construction

By Kleinhans.

The only book showing how locomotive boilers are built in modern shops. Shows all types of boilers used; gives details of construction; practical facts, such as line of riveting punches and dies, work done per day, allowance for bending and flanging sheets and other data that means dollars to any railroad man. 421 pages, 324 illustrations, six folding plates.—$3.00.

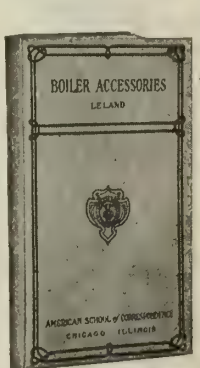
Compressed Air, Its Production, Uses and Application. *By G. D. Hiscox, M.E.*

Comprising the physical properties of air from a vacuum to its liquid state, its thermodynamics, compression, transmission and uses as a motive power in the operation of stationary and portable machinery, in mining, air tools, air lifts, pumping of water, acids and oils and the numerous applicances in which compressed air is a most convenient and economical transmitter of power.—Price $5.15 post paid.

Boiler Accessories

By Walter S. Leland, S.B.

Assistant Professor of Naval Architecture, Mass. Institute of Technology, American Society Naval Architects and Marine Engineers. 144 pp., 80 illus. Cloth binding. A treatise giving complete descriptions of the various accessories of the boiler room and engine room essential to economical operation, such as evaporators, pumps, feed-water heaters, injectors, mechanical stokers, etc., with practical instruction in their use.—Price $1.10 post paid.



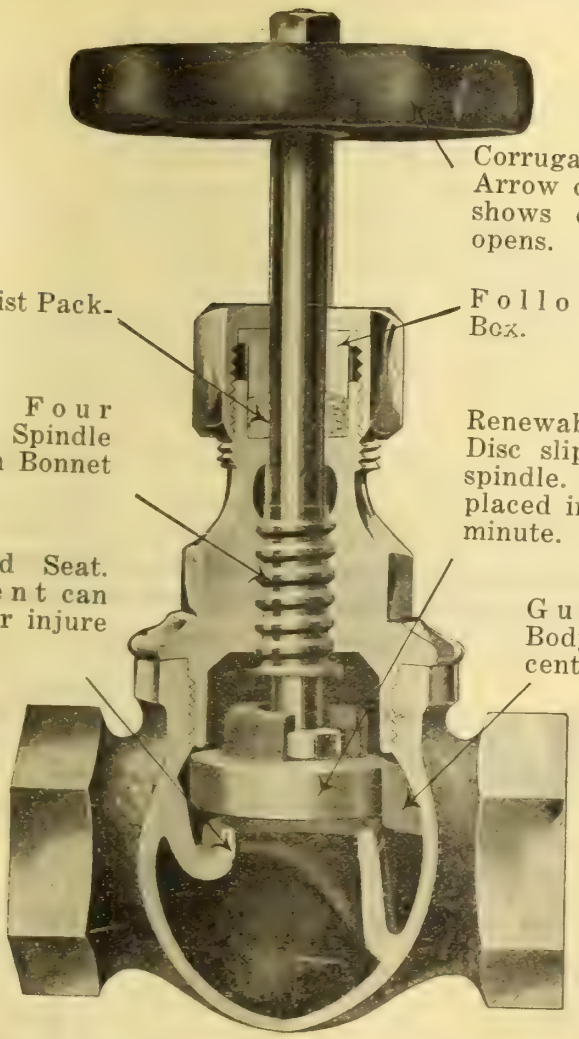
Technical Book Department

MacLean Publishing Company 143 University Ave., Toronto

THE CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED

Fairbanks Valves

with *Renewable Disc*


Corrugated Iron Wheel. Arrow cast on wheel shows direction Valve opens.
Palmetto Twist Packing.
Follower in Stuffing Box.
At least Four Threads of Spindle engaged with Bonnet at all times.
Renewable Bakelite Disc slips over end of spindle. Can be replaced in less than one minute.
Raised round Seat. No sediment can lodge on it or injure Disc.
Guides Cast on Body hold Disc centrally over seat.

—avoid shut downs

A valve, like a piece of belt, must be renewed with the least possible delay in order to avoid expensive shut-downs.

Fairbanks Renewable Disc Globe and Angle Valves can be renewed right on the job. No tools are required, except a wrench to remove and replace the bonnet. In less than a minute the job is done. Fairbanks and Pratt and Cady Valves are made in all sizes and styles for every requirement.

Let us quote on your specifications for all Valves, Pipe, Fittings and Specialties.

THE CANADIAN FAIRBANKS-MORSE CO., Limited

"Canada's Departmental House for Mechanical Goods"

ST. JOHN QUEBEC WINNIPEG MONTREAL SASKATOON OTTAWA CALGARY TORONTO VANCOUVER HAMILTON VICTORIA WINDSOR

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

one can be too canny

EXPERIENCE is a thorough teacher, to be sure. But it is unwise to reason that all products advertised to solve the scale problem are inefficient—"no good." Don't let an unfortunate "affair" with a "compound" or "cure-all" keep you from learning about

METLSKIN
BOILER PRESERVATIVE
Neither "Compound" nor "Cure-all"

METLSKIN is a boiler-metal treatment, pure and simple. Not only does it remove old scale, but it also prevents further scale-formation. It preserves boiler-metal, and prolongs the boiler's span of life.

The annual fuel-saving alone will pay for a year's supply, and many times over.

But you need not take our word for this. Send a post card for details of the 60-day trial offer. Let us mail the latest booklet. It will prove interesting reading.

The Canadian Fairbanks-Morse Company, Limited

St. John, Quebec, Montreal, Ottawa, Hamilton, Toronto, Windsor, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria

III IMPORTANT THINGS

TO CONSIDER ABOUT A SEPARATOR.

I. THE PLAN—Is it sensible, will it work, no matter how large the Separator or how well made?

II. THE SIZE—Is it big enough regardless of plan, will it hold a good dose of water?

III. THE CONSTRUCTION—Is it strong enough, are flanges heavy, how will it look by the side of a nicely finished engine? Send for catalog and note these points in

Sweet's Separators

DIRECT SEPARATOR COMPANY

820 Geddes Street - SYRACUSE, N.Y.

General Sales Agents:

Canadian Fairbanks-Morse Company, Limited

St. John, Montreal, Quebec, Ottawa, Toronto, Hamilton, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria

FOR Steam or Air Drill, Pneumatic Tools, Boiler Flue Cleaning, Syphon Connections, Suction Lines.

For all kinds of Oil, Gasoline, Paints, Hydraulics, Gas.

"PENFLEX" METAL HOSE

INTERLOCKING

An all Metal Flexible Hose. Manufactured in Bronze or Galvanized Steel. Will withstand highest pressures. Is unsurpassed for durability and pressure resisting qualities.

Large Stock Carried in Canada

Pennsylvania Flexible Metallic Tubing Co.

Philadelphia, Pa.

Canadian Agents:

The Canadian Fairbanks-Morse Co., Limited

St. John, Quebec, Montreal, Ottawa, Toronto, Hamilton, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria

THE CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED

GRATON & KNIGHT

Standardized Series

LEATHER BELTING

Tanned by us for belting use

14-in Graton & Knight Spartan Leather Belting on difficult quarter-turn drive. Standard Box Co., Baton Rouge, La.

Here is Economy

MAKE every ton of coal yield the maximum production." That's the peremptory command of America to manufacturers.

The importance of economical transmission of power cannot be exaggerated.

Economy of transmission is fundamental. It means efficient service. It is the basis of "Standardization" in belting.

Mills that have kept Belt Service records know that the use of Graton & Knight Standardized Series Leather Belts means economy in production. (And to-day they are even more economical, because while they have increased in price, their percentage of increase is **much less** than that of substitutes.)

Talk over the selection of belts with your practical production men, superintendents, and foremen. Ask them these questions: What belts give the longest service? transmit most power? are easiest to repair? have the proper elasticity with firmness? best stand mauling of shifters and flanges? when damaged can be cut down for use on narrower pulleys? when worn out bring the best price for scrap?

If you have kept suitable records, you know how to answer these questions. If not, you are only guessing. Start a belt record immediately. Write us for the necessary cards. An accurate record of belting service is as profitable as a record of a workman's service. Tell us the number of drives in your plant and we will mail record cards gratis.

The Graton & Knight Mfg., Company

Worcester, Massachusetts, U. S. A.

Oak Leather Tanners, Makers of Leather Belting, Lace Leather Packings and Specialties

The Canadian Graton & Knight Ltd., Montreal.

Canadian Representatives: The Canadian Fairbanks-Morse Co., Ltd., St., John, Montreal, Ottawa, Toronto, Hamilton, Quebec, Calgary, Saskatoon, Vancouver, Windsor, Winnipeg, Victoria.

GRATON AND KNIGHT

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

DURABLA

DURABLA
TRADE MARK REGISTERED

Durabla is a Giant in Strength

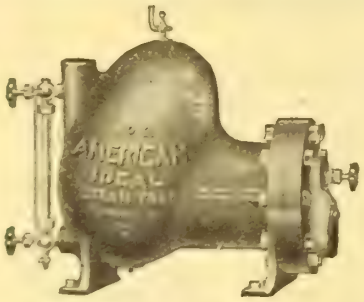
Many of the largest industries have adopted Durabla Gasket Material as a Standard for all new Construction Work and Repairs, using it on Steam, Air, Oil, Ammonia, Benzol and Alkalies at various temperatures and pressures, on All Flanges where a Permanently Tight Joint is required.

Claims of Superiority are easily made—comparative tests establish facts.

Durabla Manufacturing Company
NEW YORK

Distributors for Canada:

The Canadian Fairbanks-Morse Co., Limited
Montreal, Toronto, St. John, Quebec, Ottawa, Hamilton, Winnipeg, Saskatoon, Calgary, Edmonton, Vancouver, Victoria



During the Warm Weather Plan for the Winter

STEAM MUST BE SAVED

Keep Steam Lines free from condensation by using

AMERICAN IDEAL STEAM TRAPS

Large Capacity
Tight Valve
Powerful Valve Leverage

Let us help you save Steam, Coal, Money

Canadian Agents: CANADIAN FAIRBANKS-MORSE CO., Ltd. Montreal, Quebec

AMERICAN STEAM GAUGE & VALVE MANUFACTURING COMPANY

NEW YORK CHICAGO BOSTON ATLANTA PITTSBURGH

P&C CO

Valves—Asbestos Packed Cocks

for Every Purpose and Pressure

Pratt & Cady valves and cocks make good where others fail because they remain leak-proof under the most severe strains. Put your toughest job up to Pratt & Cady valves and cocks. Get our catalog and full information.

Pratt & Cady Co., Inc., Hartford, Conn.

Canadian Agents:

Can. Fairbanks-Morse Co., Ltd., Toronto, Montreal

St. John, Quebec, Ottawa, Hamilton, Windsor, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria.

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

High quality is being maintained in spite of war conditions

Quality is Being Maintained in "Palmetto" Packing

in spite of the difficulties of a world war, and for that reason "Palmetto" can be depended upon to give the same long satisfactory service for which it has always been noted.

"Palmetto" comes in two forms--Braided for rods ; twist for valve stems

Let us send you a working sample to prove quality.

Greene, Tweed & Co.

Sole Manufacturers

109 Duane Street, New York

Canadian Agents :
The Canadian Fairbanks-Morse Co., Limited, St. John, Toronto, Quebec, Hamilton, Montreal, Ottawa, Vancouver, Victoria.

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

50% More Heat

from no more steam. In your own plant prove that this Alberger Heater will transmit 50% more heat than any plain tube heater of equal size. We are positive you can, because we have made demonstrations with results claimed something like a thousand times.

In this Alberger the tubes are small and corrugated. Scale does not form; nothing collects. Heater trouble is not and cannot develop in this

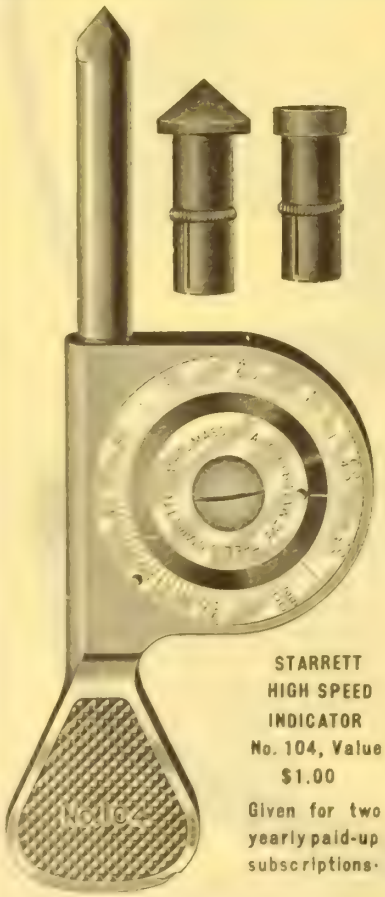
ALBERGER
Multi-Head
Water Heater

The tubes never split—they're pure copper. They expand into floating heads independent of the cast iron shell. Trouble from contraction and expansion strains is unknown.

Ask for Catalog.

ALBERGER HEATER COMPANY, BUFFALO, N.Y.

GENERAL SALES AGENT:
CANADIAN FAIRBANKS-MORSE COMPANY, Limited
St. John Montreal Ottawa Toronto Hamilton Quebec Calgary
Windsor Vancouver Winnipeg Victoria



STARRETT
HIGH SPEED
INDICATOR
No. 104, Value
$1.00
Given for two
yearly paid-up
subscriptions.

You May Have This Speed Indicator without Spending a Cent

if you are a subscriber to "POWER HOUSE." If you are not a subscriber, send in your own subscription together with two others, and the indicator you are entitled to will be mailed to you immediately.

To subscribers who send us two NEW yearly paid-up subscriptions we will send this $1.00 indicator.

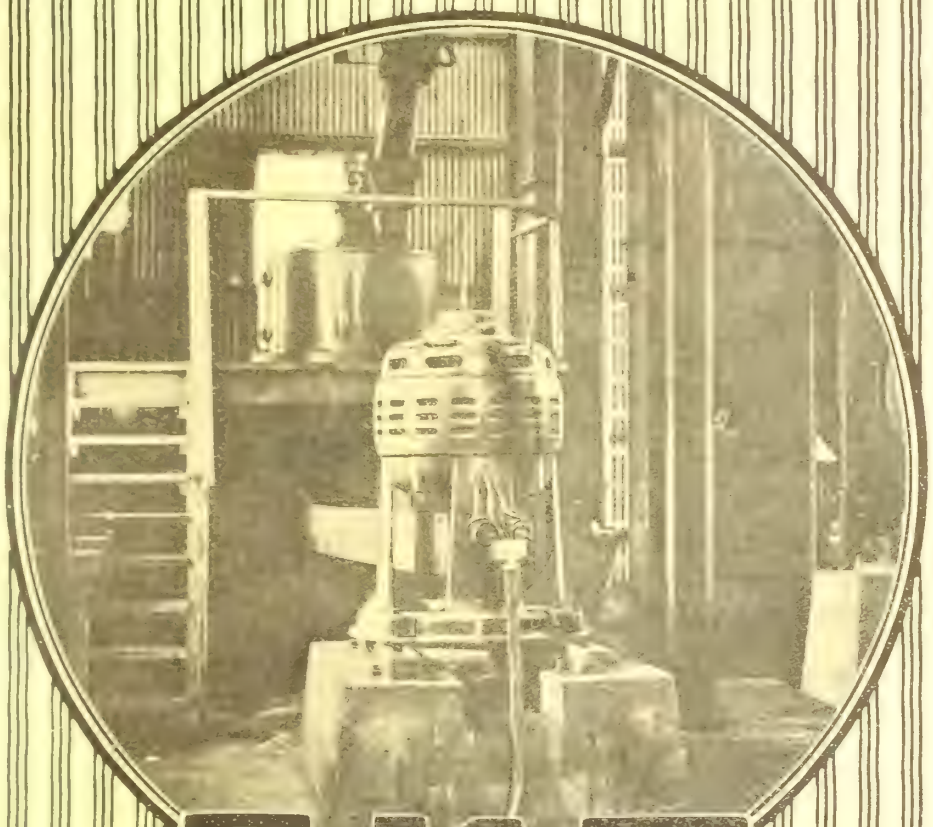
"POWER HOUSE" is designed to give Canadian Engineers, Superintendents and Power Users all the latest and best information in the engineering field. A little work among your engineer friends and acquaintances will earn for you this handy indicator without any trouble. Try it and see how easy it will be.

PUBLISHED MONTHLY AT $1.00 PER YEAR
Start in TO-DAY to earn one of these Handy Tools

POWER HOUSE 143 University Ave., **Toronto**

THE CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED.

CANADA'S



SKF
BALL BEARINGS

Sealed Against Coal Dust

Flying particles of fine coal dust soon play havoc with plain or bronze bearings. That is why the Pulverized Coal Plant of the Atchison, Topeka and Santa Fe Railway use S K F equipped Fairbanks-Morse Motors. Sealed housings prevent the intrusion of grit, dust and moisture. And more too, S K F equipped motors require much less lubricant. No handy man required to constantly oil these motors and guard against hot boxes. Many other advantages are enumerated in Bulletin No. 70. Send for it to-day.

CANADIAN SKF COMPANY, Limited

TORONTO, Ont., 128 Coristine Bldg., Montreal, Quebec

Agents for S K F Transmission Bearings

THE CANADIAN FAIRBANKS-MORSE CO., Limited

St. John, Quebec, Montreal, Ottawa, Toronto, Hamilton, Windsor, Winnipeg, Saskatoon Calgary Vancouver Victoria

385

LIEUT.-COLONEL ———, the writer of the following letter, abandoned a lucrative business and joined the Canadian forces in August, 1914. He has never been out of uniform since. He has been in some of the heaviest fighting; has been wounded several times; was given up by the doctors; recovered and is again at the Front; was offered command of a brigade. He is regarded as a man of so much importance that he has been guaranteed a sure seat in the House of Commons and will be one of the chiefs, if not the leader, in the returned soldiers' movements in Canada.

Lt.-Col. John Bayne Maclean,
Toronto, Canada.

France, April 5th, 1918.

Dear Colonel Maclean:-

Yesterday I had handed to me by Captain———a copy of MacLean's Magazine with your article on "WHY WE ARE LOSING THE WAR," which has been sent to him by a lady from Edmonton because of the reference made in it, no doubt, to . . . . . I have read the article over carefully and so have many of my officers and I thought I ought to let you know how deeply impressed we all are with your array of facts and arguments and the manner in which you have marshalled them together in a brief that should bring envy from the best legal minds in Canada.

For a long time I have been filled with the same ideas with reference to the infantile handling of the great affairs of State by the big men of our country and as one who has been brought up in the greatest awe and respect for those high in authority in England I tried to fight against the gradual turn my mind and heart was taking towards these great leaders. Furthermore, being a soldier, I felt it would not be in keeping with my duty to make comment or criticize those in authority and perhaps also I lacked the courage lest I might bring about my ears criticism which must always follow attacks upon big men. I believe there are many others who have shared the same views and for the same reasons refrained from "Talking out in Meetings." You have stepped into the breach and taken upon your own shoulders the burden of a whole people and in doing so I realize what it will mean to you and the courage and fearlessness which you must have in order to have taken this step. I know of no other man who has so boldly set before us Britishers our own case. You will, no doubt, having attacked these great leaders, find yourself in a maelstrom of criticism. You will be called disloyal and you will be vilified and abused, but the truth of your statements cannot be gainsaid and you must eventually stand out as a great and fearless citizen who was not afraid to place himself in jeopardy, that EVEN YET A ROTTEN SITUATION MIGHT BE TURNED INTO VICTORY BY PROPER HANDLING.

The history of this war has been a history of bungling on the part of the higher ups, interwoven with a history of devotion, loyalty and doggedness on the part of men in the ranks, which can never be excelled. It has been one continual panorama of "light brigade" episodes and our brave men still go on fighting knowing that "someone has blundered," yet feeling that blunder or no blunder, we must fight and fight on that civilization may be preserved and British traditions maintained.

Some sections of the public here abuse Northcliffe, Lloyd George and Beaverbrook but having watched things closely for a few months I have come to the conclusion that in these three men and their associates lies the future of the British Empire. The old regime is fighting and dying hard. Incompetency is also tenacious and hangs on doggedly to the high positions where it has been entrenched for so many years in British public life. A few brilliant charges like yours will start such an onrush of public opinion throughout the Empire that sooner or later he will be dislodged, and brains having taken his place, we may look for results. Until that time comes, we need not hope for a change in the present state of affairs.

OUR MEN MUST HANG ON FOR THE TURN OF THE TIDE IN THE BRITISH PUBLIC LIFE FOR AT THE SAME TIME THERE WILL BE THE TURN OF THE TIDE TOWARDS VICTORY IN FRANCE.

Faithfully

Signed.....

Commanding.....

This letter was not marked "private," but for good reasons the name is temporarily withheld. If desired it will be given in confidence to Sir Robert Borden or Sir Wilfrid Laurier. MACLEAN'S MAGAZINE and THE FINANCIAL POST have outstripped all other Canadian newspapers and magazines in information on the big war and political problems of special interest to business men. Address MacLean Publishing Company, University Avenue, Toronto, Canada.

The "COLE" Return Trap for Handling Condensation

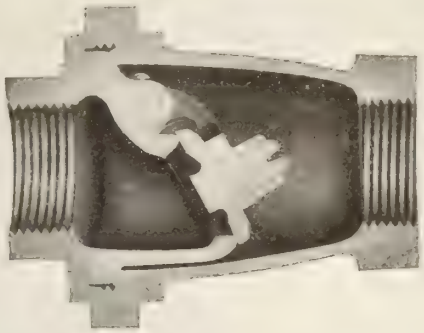
Coal Saved is Money Made

The first steam trap approved by the Steam Boiler Branch of the Department of Public Works of Ontario.

The Cole Trap System returns condensation back to the boiler at such a high temperature that you cannot help but show a saving.

We can cite instances where users have cut their coal bill almost in half. Think of what that means. Others have done it, so can you. Our book, "Steam Condensation," tells how this fuel saving can be accomplished.

You are under no obligation when writing us for advice. Our engineers are at your disposal at any time.



"COLE" Check Valves

Altogether different; there is nothing just like it. It eliminates the troubles that go hand in hand with ordinary check valves.

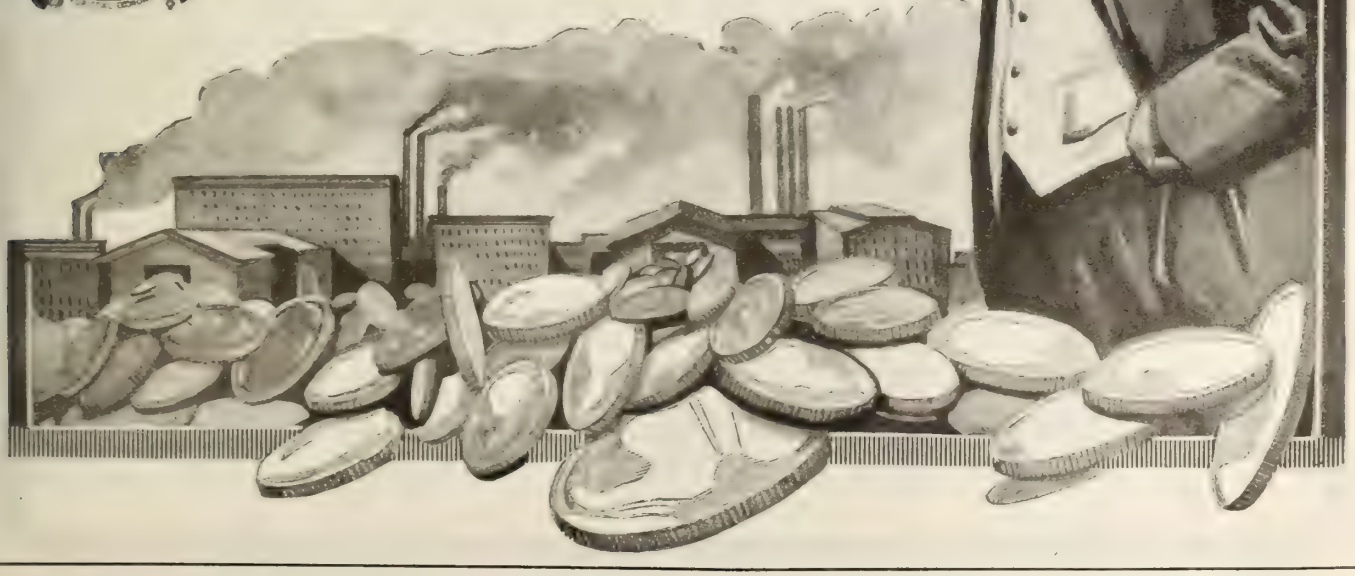
It's a combination of union and check valve. Made right to hold tight. All brass and fully guaranteed.

Away ahead in everything but price.

DON'T forget to send for our new ***Lightning Calculator.*** It shows steam and fuel losses at a glance. Every engineer should have one.

Geo. W. Cole, Limited

2002 Dundas St. W., Toronto



"Can I have another black belt?"

LEATHER TRADE VIM MARK BELT

"Why do you want a black belt?"
"Because I can turn out more work."
"You had one before?"
"Yes, sir."
"What happened to it?"
"One of the night shift stole it."
"How much more work can you turn out with the Black Belt than with the other kind?"
"I was making about $5.00 a day with the old belt. Since I got the Black Belt I've been making $6.50 to $7.00."
"What is the name of the Black Belt?"
"VIM!"
"You get a Black Belt!"

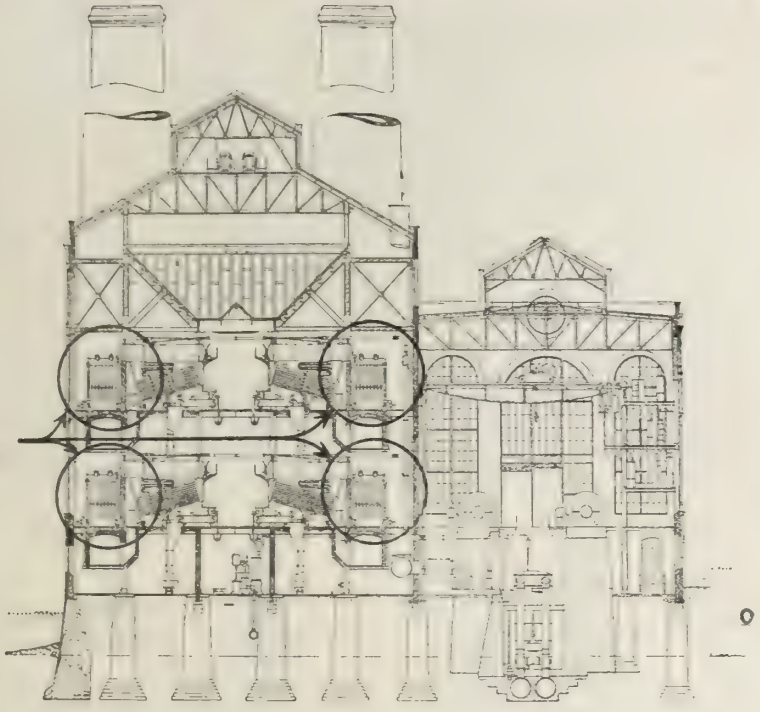
It's 100 per cent. Leather.

Made and Sold by

The Canuck Supply Company, Limited

MONTREAL TORONTO WINNIPEG

Universally Used —



Chelsea Station, Underground Electric Railways Co., London, Eng.

The value of, and the advantages of installing,

GREEN'S ECONOMISERS

are not only recognized and made use of in Canada and the United States, but are as well known in every part of the world where steam is generated by stationary boilers.

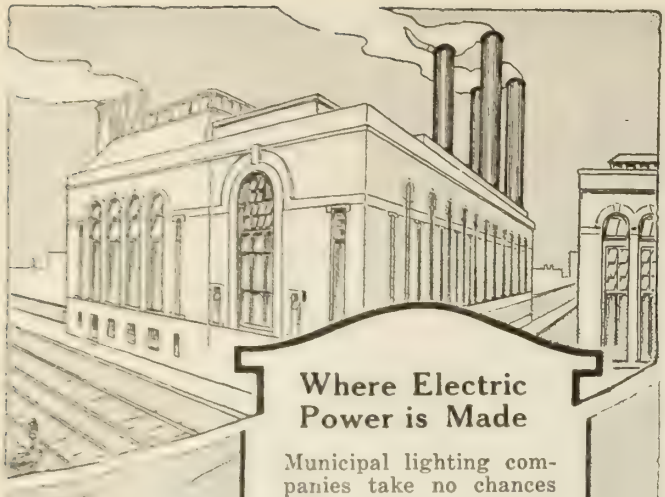
They are extensively used all over Great Britain and the Continent of Europe, especially in the great industrial centers. South America, Japan and China can also bear witness of their merit as savers of fuel.

The above installation, about 15,000 tubes, is the largest in the world—but whether your plant is large or small our engineers will be glad to submit data showing the saving possible by installing economisers.

Also
STORERS
CHIMNEYS
FORCED DRAFT FANS
INDUCED DRAFT FANS
BOILER ROOM SPECIALTIES

GREEN'S ECONOMISER, LTD.
TORONTO
Branches in
MONTREAL
WINNIPEG
NEW YORK

Associated with
E. GREEN & SON, LTD.
Wakefield, Eng.
THE GREEN FUEL ECONOMIZER CO.
Beacon, N.Y.



Where Electric Power is Made

Municipal lighting companies take no chances when buying equipment. As current must be supplied uninterruptedly, every precaution is taken against shut-downs.

Take corporations such as

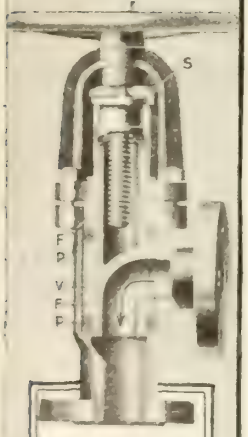
Montreal Light, Heat & Power Co., using 24.
Cleveland Elec. Ill'g. Co., using 178.
Edison Elec. Ill'g. Co., Brooklyn, using 100.
Potomac Elec. Lgt. & Pr. Co., Washington, D.C., using 24.
Duquesne Lgt. Co., Pittsburgh, using 34.
Omaha Elec. Lgt. & Pr. Co., using 97.
Worcester Elec. Lgt. Co., Worcester, Mass., using 36.

Each has its boilers equipped with from 24 to 178 YARWAY (formerly Simplex) "Seatless" Blow-off Valves—a choice that in effect, becomes a recommendation of the very highest character.

In the YARWAY (formerly Simplex) there are no seats or discs to cut, clog or grind down. There are no pockets to gather sediment—no obstructions of any kind. The port is free and wide open. Packing is protected and will last for years.

Other good points may be learned by trying a YARWAY for 60 days. It may be returned if not satisfactory.

Write for one to-day, stating size of line and whether screw or flange, angle or straightway.



Operation:

In closing valve, shoulder "S" on plunger "V" engages the loose follower gland "F," compressing packing "P" above and below the port, making an absolutely tight valve.

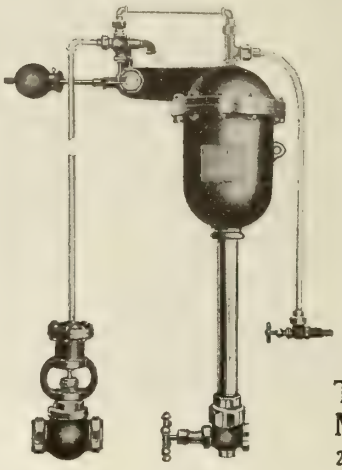
Yarnall-Waring Co.
7604 20 Queen Street
Chestnut Hill, Philadelphia, Pa.
Canadian Representatives
A. McLELLAN,
301 Read Bldg., Montreal.
Stock also carried by
James Robertson Co., Montreal
Cunningham Hdwe. Co.,
New Westminster, B.C.

YARWAY
Seatless Blow Off Valve
formerly the
SIMPLEX

VIGILANT
Automatic Feed Water Regulator

100% Protection

3 to 17% Fuel Saving



Keeps the water within ¼" of middle gauge, regardless of the load or firing. Works automatically, perfectly — an absolute protection from high and low water accidents. Because proven an absolute protection and a fuel saver too, the Vigilant is used by nearly all the iron and steel producers in the States.

Ask for Catalog.

The Chaplin-Fulton Manufacturing Co.
28 Penn Ave., Pittsburgh, Pa.

ADVERTISING to be successful does not necessarily have to produce a basketful of inquiries every day.

The best advertising is the kind that leaves an indelible, ineffaceable impression of the goods advertised on the minds of the greatest possible number of probable buyers, present and future.

MANUFACTURERS OF

BOILERS, ENGINES, STACKS

Complete Portable and Stationary Sawmills, Heaters, Retorts, Tanks

We have a large stock of boilers to conform to the Provincial Inspection Laws, and can make prompt shipment. We also build boilers to your own specifications.

Get prices on our second-hand boilers and engines for all purposes.

OVER 84 YEARS IN BUSINESS

ST. JOHN, N.B. — MONTREAL, P.Q. — **E. LEONARD & SONS, LIMITED** — LONDON - . ONTARIO — CALGARY, ALTA. — VANCOUVER, B.C.

WE MAKE EVERYTHING WE SELL

NON-CORROSIVE

CYLINDER OIL

MANUFACTURED ONLY BY

E. H. KELLOGG & CO.

NOS. 242 & 244 SOUTH ST. NEW YORK, U.S.A.

FRICTION LOSS

An overload is often a necessity. But it is hard on an engine. To successfully carry an overload so that there will be no after effects on the engine a very careful selection of your oil should be made. An oil that is not free from impurities will cause a greater wearing on the bearings, a great friction loss will occur. You will need to fire the boiler more often because the engine will be harder to run. In this manner you lose out. You work harder, have larger operating costs, and less power all because of your oil. Do as a great many Canadian engineers have done — give Kellogg's "Non-Corrosive Cylinder Oil" a trial. Absolutely pure. Write us regarding it.

E. H. KELLOGG & CO.,
New York, U.S.A.

A Slipping Belt is a Lazy Belt

Lazy belts and lazy men put a drag on production; they are misfits in a well-managed plant. Neither should be tolerated, for their moral effect on efficient operators is bad.

Belt slippage is preventable.

DIXON'S SOLID BELT DRESSING

does the trick and it is absolutely harmless to the belt itself—whether of leather, rubber or fabric.

Ask for a booklet 222-O and free sample.

Made in Jersey City, N.J., by the

JOSEPH DIXON CRUCIBLE COMPANY

ESTABLISHED 1827

Sole Canadian Representative:
CANADIAN ASBESTOS CO.
Montreal, Que.

"Belmont" 1903 Special Hydraulic Packing. For Hot or Cold Water Boiler Feed Pumps (Inside or Outside Packed) and for Hydraulic Work It Has No Equal.

Pressures up to 10,000 lbs.

Cannot Split, Swell or Pinch

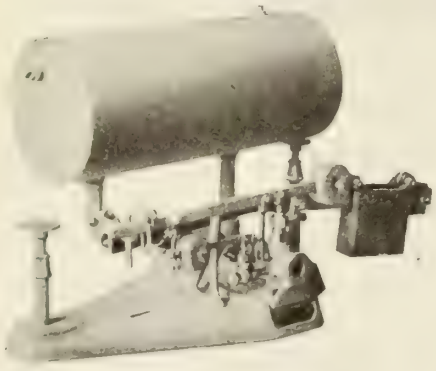
We guarantee Belmont Special Hydraulic Packing to give absolute satisfaction under the heaviest pressures, and when exposed to acid or alkaline waters. We know that it is made right, and from the best material, and that "Belmont" is absolutely the "last word" in packing arguments.

William C. Wilson & Co.
21 Camden St. TORONTO

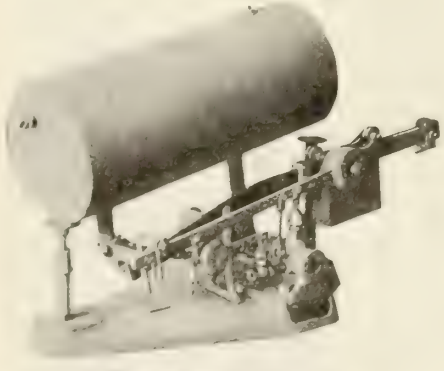
We Must Knock Down Our Fuel Consumption

Manager and Engineer discuss a serious problem.

WILL DO IT



Showing machine in filling position.



Showing machine in discharging position

CONSERVE and SAVE every pound of coal possible. It is imperative. Fuel of all kinds will be higher in price and more difficult to procure.

Is your Steam Plant Equipment 100% Efficient? That is the question you have confronted repeatedly. You will have to confront it again and again. The Morehead Back-to-Boiler System is the satisfactory answer and solution.

The present improved equipment is the result of 28 years' use and experience in thousands of heating and steam plants throughout the world.

THE MOREHEAD is the **original** and has at all times been the standard by which the comparative values of other Steam Traps have been measured.

It is a system of steam coil drainage and boiler feed by which the condensed water is delivered back into the boiler as pure hot feed water without pumps or complex equipment of any kind.

Morehead Machines fill every time and discharge every drop of condensation contained in the tank into the boiler at each operation. This is an advantage not obtained in other machines. As a result the maximum heat unit is thereby conserved.

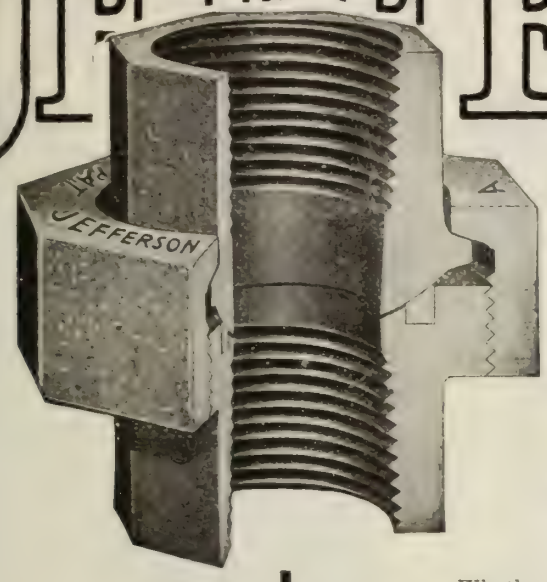
Morehead capacity is greatly in excess of any filtering return machine in existence.

Send for Booklet, "Morehead Back-to-Boiler System." Read what other users say. Consider the saving this system has effected.

Canadian Morehead Manufacturing Co.

Woodstock, Ontario

JEFFERSON



Test a Jefferson Union on your Toughest Job

Whether your idea of severe union service is superheat or heavy pressure or corrosive action, you must actually try out a Jefferson before you can realize perfect union service.

Built by specialists, Jefferson Unions embody all qualities necessary for 100% efficiency on pipe line and power plant service. The Jefferson Union is unique in construction because we have protected ourselves with basic patents covering the essential features.

Take the drawn brass seat ring for instance. Now of course, every practical engineer knows that a brass-to-iron joint will not corrode (Point No. 1). But with an all-brass seat the expansion and contraction would be excessive, so in the Jefferson Union we embed the brass seat ring into the malleable iron by exerting enormous pressures—up to 40 tons. The seat ring cannot become dislodged under any conditions. (Point No. 2). Finally the seat ring is ground accurately to fit the spherical face of the other part of the union. This insures a tight joint even though the pipe is slightly out of line. Point No. 3).

And so we could go right along with each Jefferson strong point, but these are all covered in detail in our new Catalog. Send for your copy to-day—we'll tell you where to find the nearest Jefferson Dealer.

JEFFERSON UNION COMPANY
Lexington, Massachusetts

Jefferson Swing Union. Allows connections, ranging from a slight offset up to 90 degrees, and many angle connections.

Union Elbow, all female. Takes the place of a straight union, nipple and an elbow. Also made male and female.

All Male Union. Saves two pipe joints between two female threaded parts.

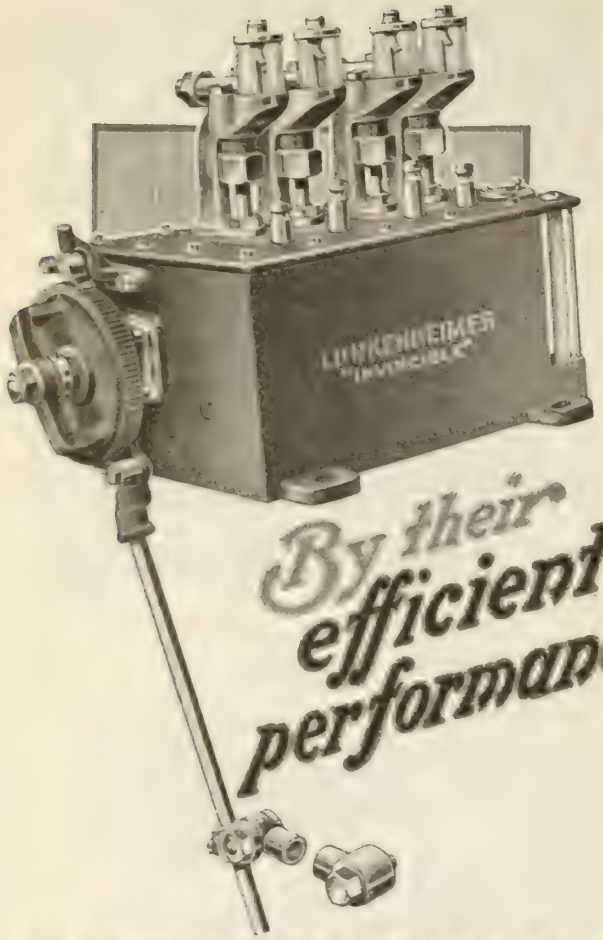
MAIL THIS HANDY COUPON FOR THE JEFFERSON BOOK "UNIONS"

Jefferson Union Co.,
Lexington, Mass.
Please send me without obligation on my part, copy of your New Catalog.

Name .....
Firm Name .....
Address .....

P.H. 5-18

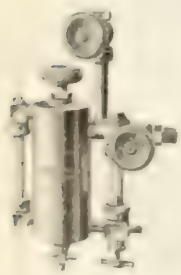
If any advertisement interests you, tear it out now and place with letters to be answered.



By their efficient performance

LUNKENHEIMER
CYLINDER
LUBRICATORS

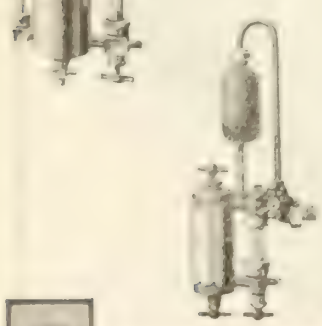
contribute to maximum production and the conservation of the power generated by reducing frictional waste to a minimum. Absence of friction prolongs the life of the generating unit and insures the highest efficiency in plant operation.
Lunkenheimer Cylinder Lubricators are very durable and all parts being made to gauge are easily renewable. Users are requested to repair rather than discard a Lunkenheimer Lubricator on which a part becomes worn or broken. This tends toward economy—a practice advocated by the Government.
CONSERVE and ECONOMIZE—both are necessary to win the war.



Our "WAR-PERIOD" Appeal
Engineering Appliances are Prime War Essentials

Stocks of distributors and facilities of manufacturers must be conserved to care for essential needs.

Lunkenheimer patrons are earnestly requested to assist in the conservation of materials by including their War Period specifications to essential plants, craft, vehicles



THE LUNKENHEIMER CO.
"QUALITY"

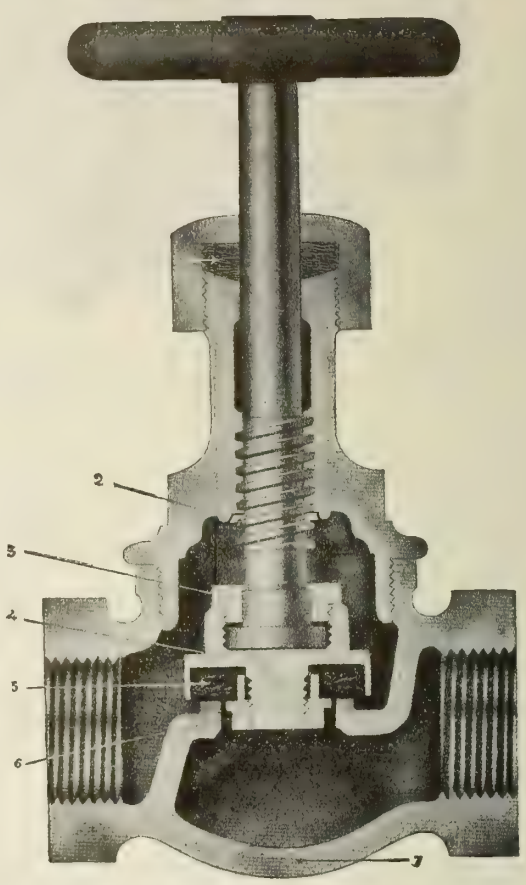
Largest Manufacturers of High Grade Engineering Specialties in the World,

CINCINNATI, O., U.S.A.

New York Boston
Chicago London

22-11-43

"VICTOR 200"
Hard Metal
GLOBE VALVES
SECTIONAL VIEW



Suitable for Working Pressure of 200 lbs.
Tested 800 lbs. Hydraulic

Fitted with special Copper-covered Discs. Guaranteed to have four times the life of the ordinary Composition Disc.

CAN BE USED FOR
High or Low Pressure Steam.
Hot or Cold Water. Gas or Air.

Send for Victor Catalog

T. McAvity & Sons
LIMITED

St. John, N.B., Canada

Montreal **Winnipeg**

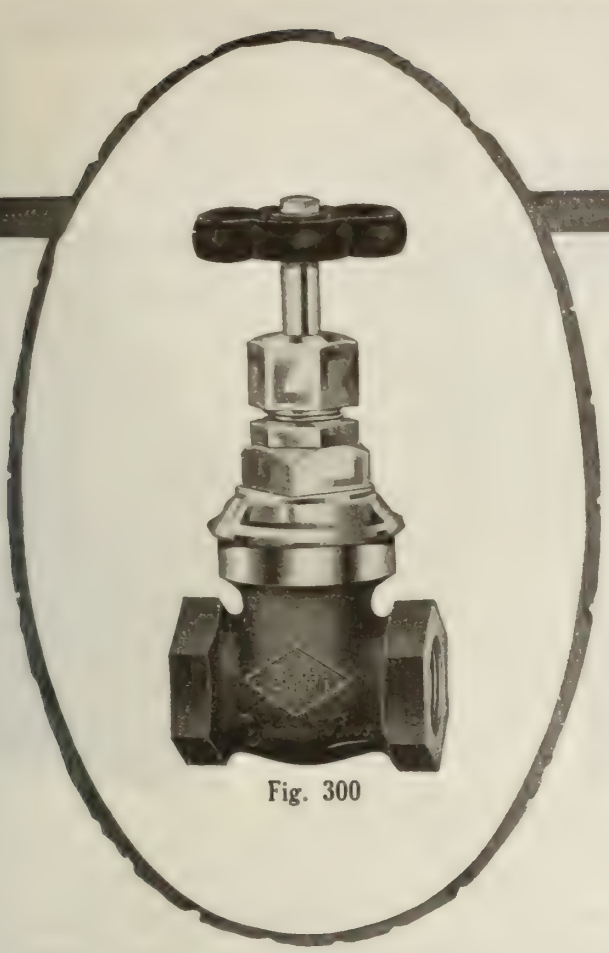


Fig. 300

TRADE JENKINS MARK

Jenkins Bros

Type "K" Brass and Iron Body Gate Valves

IF you are anxious to be "dead certain" of dependable valve service, install Jenkins Bros.' Type "K" Gate Valves—the valves with the DIAMOND Trade-Mark cast on body.

Type "K" Brass Gates are made of a superior grade of new metal. They excel in design and construction.

The body, trimmings and all the working parts are strong and well proportioned. Type "K" Iron Gates are "Leaders" in their class.

Jenkins Bros.' Type "K" Gate Valves are approved for use in Ontario and the Western Provinces by the Depts. of Public Works. Stocked by first-class dealers in all parts of the World.

Write for Catalogue No. 8. It's free for the asking.

TRADE JENKINS MARK Jenkins Bros

Jenkins Bros. LIMITED

Head Office and Works: 103 St. Remi Street, Montreal, Canada

Agencies in all Principal Countries of the World

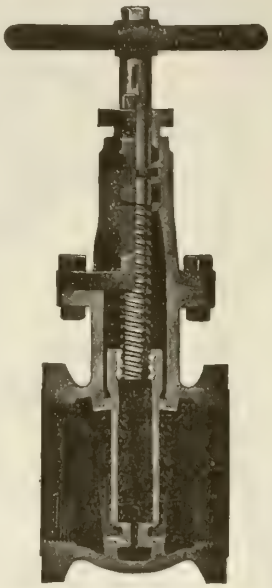
European Branch: 95 Queen Victoria Street, London, E.C. 4, England

TRADE JENKINS MARK Jenkins Bros

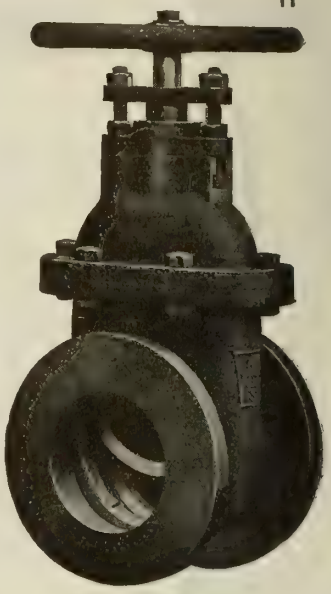
If any advertisement interests you, tear it out now and place with letters to be answered.

KERR
("New KEYSTONE" Pattern) GATE VALVES

If you have not used any of these New Pattern Valves, specify "KERR" in your next order. We want you to get acquainted with the most reliable valve on the market.



If you have been using them, we are confident that our satisfaction will bring us your repeat orders. These valves will never cause you or your customer the slightest trouble. Their high quality is consistent.



When you buy a "KERR" Valve you get a guaranteed article that is backed by a reliable firm. Many of the largest distributers of valves in Canada have sold "KERR" Valves for over 25 years, and are still recommending them as the "Best Valve." Write us for particulars.

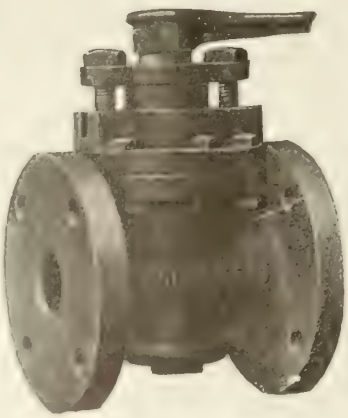
Kerr Engine Co., Ltd., Valve Specialists **Walkerville, Ont.**

Save Yourself

from many expensive break-downs by adopting

Homestead
Quarter-Turn
Valves

They not only give perfect service, even under the most severe conditions, but records show them to possess an unequalled long life.



Homestead Valves are all constructed with the patent Homestead Principle which makes them seatless while the pressure is passing through, and which permits their being operated easily and safely.

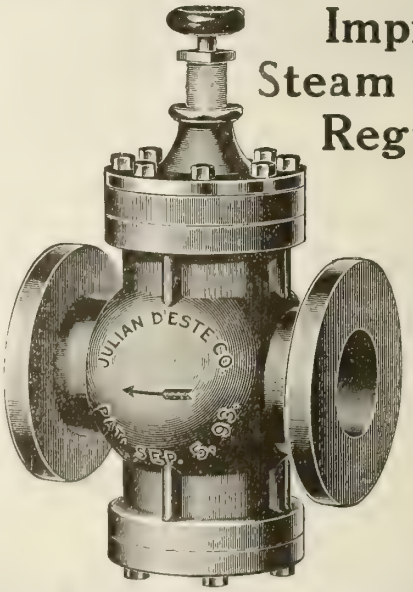
Made in Straightway, Threeway and Fourway patterns, for all conditions of service.

Send for Catalog

Homestead Valve Mfg. Co.
Homestead, Pa.

CURTIS Engineering Specialties

Improved Steam Pressure Regulator



For Universal Application to all the varied and various conditions under which a reduced pressure of steam, water or other fluid is required, this Regulator (see illustration) has no equal. It is compact and self-contained, without levers, weights or projections.

No glands or packing; no drip or leak of steam or water. Suitable for any boiler pressure; made entirely of metal; is a lock valve, very simple and sensitive.

The universality of use of this Regulator is one of its best features, but it is in **Steam Heating** that its use is most common and obvious. Send for leaflet fully descriptive of this Regulator (contains price list) to the manufacturers.

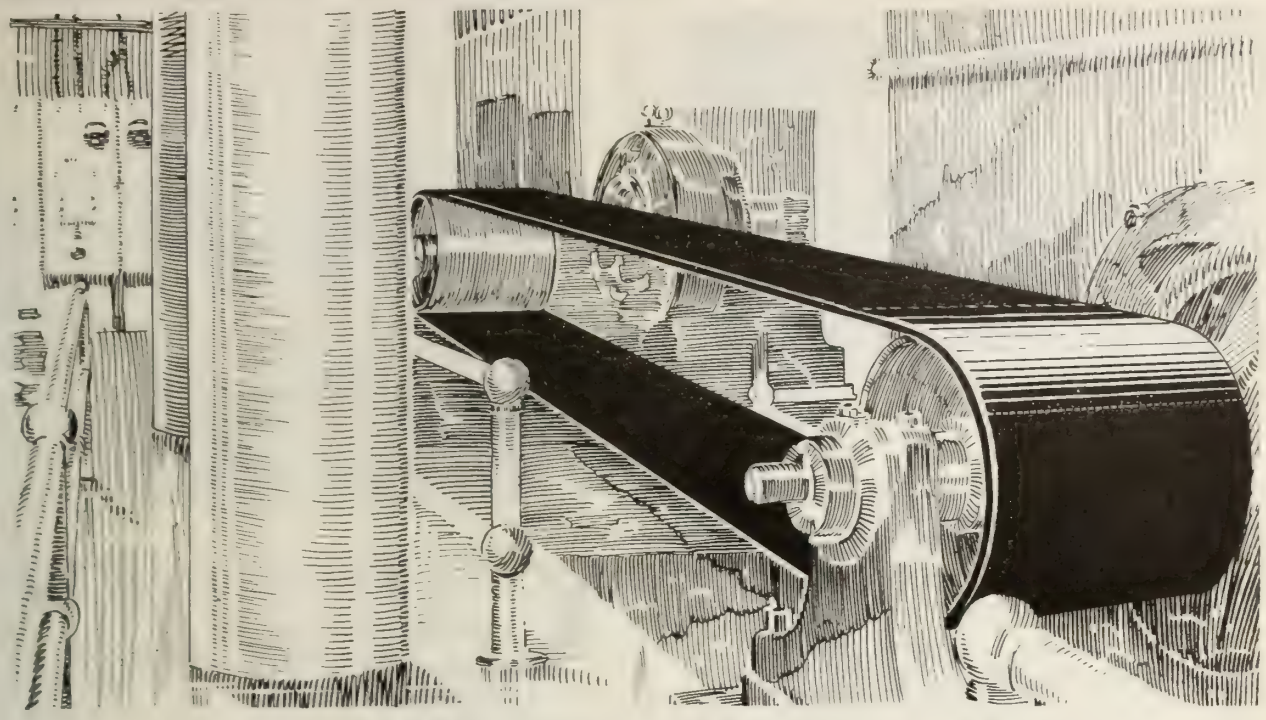
MANUFACTURED BY THE

JULIAN D'ESTE COMPANY

Main Office, 26 Canal St., Boston, Mass.

Agencies: 216 FULTON ST., NEW YORK CITY; 174 N. MARKET, ST., CHICAGO, ILL.

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.



It Ends the Troublesome Drive

Extra power belt on motor generator in Coristine Building, Montreal. Belt is 26 in. x 6 ply, endless. Distance center to center 16 ft. 2 in. Pulleys 24 in. diameter. Speed 4172 F.P.M. Statement of Engineer Hutchinson: "No trouble—a smooth-running belt—steady readings of volt-meter, even with load varying from one to nine elevators—no slippage."

WHEN factory foremen make a point of asking for a specific piece of equipment it must have merits worthy of your consideration at least.

Above is a letter typical of the reputation Extra Power belting is earning in many up-to-date shops throughout Canada.

Particularly in those plants that have a *troublesome, hard, bugbear* of a drive do the super-belt qualities of Extra Power win fast friends.

It is scientifically constructed to ensure those features you expect from a belt—lasting service, economy, flexibility, freedom from trouble.

Its construction guarantees great strength and even balance, without power-squandering weight.

"Extra Power" is flexible—it is long-lasting—it is trouble-proof—free from stretch, shrinkage, ply-separation and pulling loose from the fasteners.

Add to its natural flexibility its gripping surface and you have a belt that hugs the pulleys for the last ounce of power—

—on every drive, light loads or heavy, steady or intermittent.

—but especially on *hard* drives.

Write or telephone the nearest Goodyear Branch. No obligation is involved in getting the trained and expert advice of Goodyear belting men.

The Goodyear Tire & Rubber Co. of Canada, Limited

Branches—Halifax, St. John, Montreal, Ottawa, Toronto, Hamilton, London, Winnipeg, Regina, Calgary, Edmonton, Vancouver.

Service Stocks in smaller cities.

EXTRA POWER BELTING

"CLING-SURFACE! Why I heard of that twenty years ago! Never took much stock in it, George"
"Well, Uncle, I couldn't get along without it"

Back in '96 and '97, when "Uncle" ran an engine, people took more for granted.

For instance: power lost between engine and machines. With shafting true and bearings oiled, they still lost a lot of power because the belts slipped.

Their belts were run tight. When stretched they were taken up again. This caused friction, which ate up coal and kept the shop busy filling oil cups and cooling hot bearings. So between slipping belts and this friction, 5 to 30 per cent. of the power was lost.

Yet no belt, unaided, could run under full load **without** slipping. If the belts were heavy enough, and the pulleys large enough, a good deal of slip was avoided, but larger equipment required more power to move it.

And sticky belt dressings were as harmful then as to-day. They stopped belt slip for a time, but gummed up both belt and pulley faces; they tore the belts and, often containing rosin or other injurious materials, eventually destroyed them.

It was about this time CLING-SURFACE was discovered. A small beginning: its name did not stare at you in the [illegible]

Yet CLING-SURFACE soon became well known. People heard of it because it accomplished things.

For tension was doing by **main force** what could better be done by **"persuasion."** And the men behind CLING-SURFACE had found this better way.

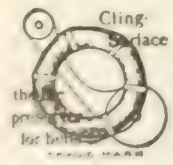
CLING-SURFACE stopped the slipping. Since this was [illegible] power cause for tension, with slipping already stopped, why use it at all?

The Cling-Surface Company preached **slack** belts. Manufacturers who tried CLING-SURFACE discovered a great [illegible] No take-up was necessary, there was no slipping, belts lasted longer, and more power was delivered to the machines with less oil, coal, time and money required than when the belts were run tight.

CLING-SURFACE has grown for twenty years because it has kept on accomplishing things. And it will do the same for you.

We have many interesting booklets; one may describe your conditions. Let us send it to you—with the plan 10,000 firms have found successful. All free.

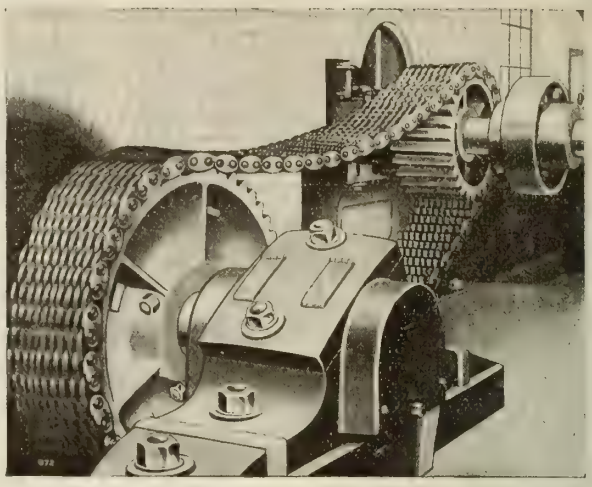
Remember, use CLING-SURFACE and you won't need belt [illegible]



Cling-Surface Co

1057 Niagara Street
Buffalo New York

Copyright, 1917, by CLING-SURFACE CO.



COVENTRY NOISELESS CHAINS

For all kinds of power transmission — Main and Countershaft Drives, Pumps, Fans, Air Compressors, and at all times 98 per cent. of power being transmitted.

Write for our handbook C-3 on chain gearing, post free for the asking.

Head Office and Works:

"THE COVENTRY" CHAIN CO., LTD.
COVENTRY, ENGLAND

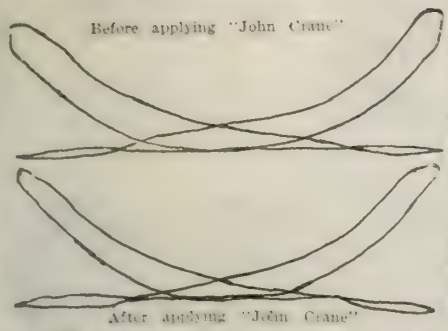
Cables: Chains, Coventry.

Codes: A.B.C., 4th and 5th editions. Western Union.

London Office: 47 Victoria St., S.W. 1.

Agencies in all the principal countries in the World.

Before and After Applying "John Crane" Metallic Packing

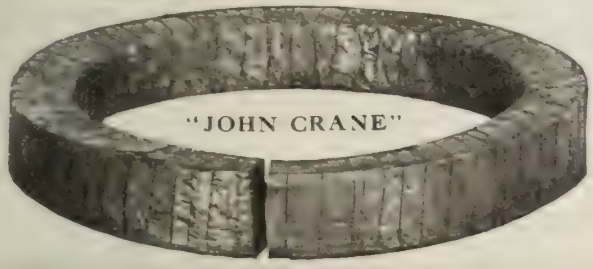


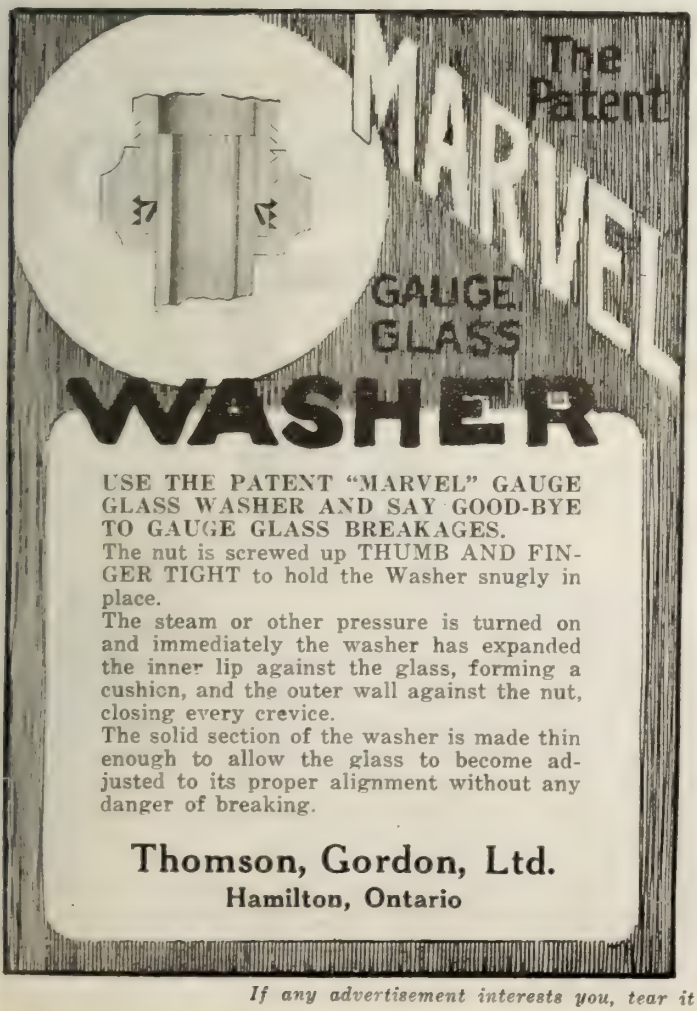
The best way to prove to your own satisfaction that John Crane Flexible Metallic Packing saves power is to take indicator diagrams before and after "John Crane" has been put in place. The diagrams at the left are typical friction cards. The power saving due to "John Crane" is directly proportional to the reduction in area of the cards.

Power saving is important, of course, but the above diagram represents only one of the many reasons why "John Crane" is preferable to all other makes. It is not at all like the shredded, twisted, braided, granulated, shot, metal and other types of so-called flexible metallic packing and is far superior to fibre packing for numerous reasons that cannot be told in this small space. A knife cuts it just like fabric. Made of smooth, sheet copper foil with high grade lubricant and graphite wrapped between every layer. Any engineer can get this packing on approval provided his rods are new or good. Bulletin No. 1 tells about it.

Crane Packing Company **Box 241, Windsor, Ont.**

General Office and Factory, Chicago, Ill.





USE THE PATENT "MARVEL" GAUGE GLASS WASHER AND SAY GOOD-BYE TO GAUGE GLASS BREAKAGES.

The nut is screwed up THUMB AND FINGER TIGHT to hold the Washer snugly in place.

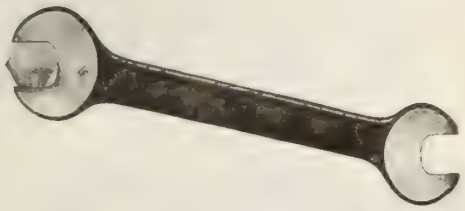
The steam or other pressure is turned on and immediately the washer has expanded the inner lip against the glass, forming a cushion, and the outer wall against the nut, closing every crevice.

The solid section of the washer is made thin enough to allow the glass to become adjusted to its proper alignment without any danger of breaking.

Thomson, Gordon, Ltd.

Hamilton, Ontario

"Thick Heads"



Williams' Superior Drop-Forged "Heavy Wrenches"---Special Design

For Engine Room Troubles

—and you all have 'em!

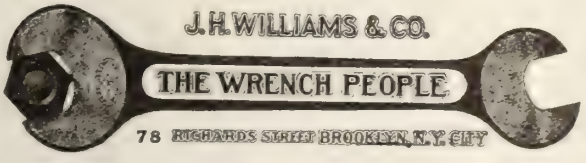
When the "Heavy Wrenches" (Thick Heads) were designed tool torture was Williams' top thought. Result: Extra leverage, larger contact faces, greater head-thickness-at-weakest-point have been provided for, and you get crow-bar service in an otherwise well-balanced tool.

At your service now.

"Big Six"

The abundant usefulness of the "Big Six" Set doesn't impress until you are told of their extraordinary capacity. Seven most important Bolt sizes (¼ to ¾ inch) and eight most important Cap Screw sizes (¼ to 1 inch) in six wrenches.

The handy canvas carrier-roll does the rest. For sale by dealers. Pocket size Catalogue of Wrench subjects free—should be in every Engine Room.



Western Office and Warehouse: 78 So. Clinton St., Chicago, Ill.
The A. G. Low Co., Ltd., 78 Pacific Avenue, Saskatoon, Saskatchewan, Agents for Manitoba, Saskatchewan, Alberta and British Columbia.

"Maple Leaf"
"Domeko"
(Copper Toughened)
"Star" "C-B"

The Above Brands of Babbitt Have No Superiors

In Domeko Babbitt Metal you can find any type of bearing metal desired and every pound is guaranteed.

Manufacturers, shops of every description, and jobbers will find it to their advantage to have our goods, and service at their command.

You can save much money by buying steadily from us. Let us tell you why.

Prices quoted f.o.b. your nearest railway station. Catalogue free on request.

DOMINION METAL COMPANY, LIMITED
SHERBROOKE, QUEBEC

Albany Grease

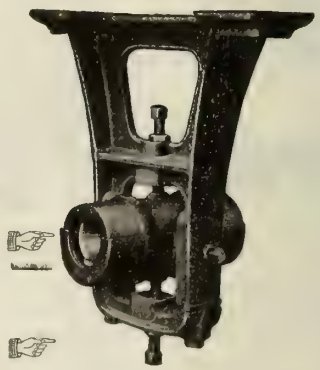
has just rounded out a half century of usefulness. Its incomparable record of lubrication service during the past 50 years stamps it as a most efficient and economical lubricant. For

50 YEARS

Albany Grease has been used by engineers on the bearings of engines, motors, pumps, compressors, line shafting and all their other equipment. If you are not using Albany Grease send for samples and try it.

ALBANY
LUBRICATING
COMPANY
708-10 Washington Street
NEW YORK, U.S.A.
Established 1868

REMEMBER
THE BOND



It cuts the danger of hot bearings to a minimum because it is equipped with an up-to-date and efficient ring oiling device that keeps the bearings constantly oiled, without wasting oil. The reservoir once filled requires no attention for at least six months. Any misalignment in the shaft line is easily corrected by the universal adjustment.

Our catalog on Power Appliances is full of pointers. Send for it to-day.

Canadian Bond Hanger & Coupling Co., Ltd.
ALEXANDRIA, ONTARIO

Here It is

it is yours for the asking

Everywhere that the new Jeffrey Carrier has been installed it has proved to be indeed the Super-Service Conveyor for handling Coal and Ashes in Power Plants. Nearly 20 years of actual experience is back of it.

Its assured Reliability of action at all times, and its Durability for Long Service will interest you.

The Extreme Hardness of its pivoting parts; its rolling contacts and its sliding surfaces will surprise you.

Write to-day for your copy of this new Bulletin which gives to you in a few words, with many clear illustrations, convincing facts of the Rugged Construction and Enduring Qualities of the Jeffrey Carrier.

Your Copy is Now Ready

The Jeffrey Mfg. Co., Power Bldg., Montreal, Can.
Kindly send me copy of Bulletin on the new Jeffrey Carrier.

Name .....

Address .....

MAPLE LEAF BRAND

Stitched Cotton Duck

BELTING

Better and Cheaper Belting Service

In actual test Maple Leaf Brand Belting stood a breaking strain of 75% greater than leather, and 25% greater than rubber belting. It is sure grip, true running, and being waterproof, is not affected by dampness.

Maple Leaf Belt Dressing—The Best for all Kinds of Belts

Dominion Belting Co., Limited

HAMILTON, CANADA

Quebec Branch---51 Duluth Building, Montreal

ABSOLUTELY NECESSARY

G. C. KUECHLER,

Machinist and General Machine Repairer,

Sacramento, Cal.,
August 14, 1917

Magnolia Metal Co.

Gentlemen:—

Replying to your inquiry as to the results obtained from the use of your Magnolia Metal in the manufacture of the Acme Centrifugal Pumps, and the general repairing of Gas Engines, I am pleased to advise that the results are satisfactory in every respect.

During many years as a mechanic I have used babbitt metal of many different grades and various makes, but have come to regard Magnolia Metal in my work not only advisable, but absolutely necessary to obtain the maximum in results.

Yours very truly,

G. C. KUECHLER.

PRACTICAL ENGINEER POCKET BOOK:

Over 600 pages. A valuable reference work imported from England and sold as an advertising medium at the low price of 40c post paid.

Address Montreal Office.

SOLD BY LEADING DEALERS EVERYWHERE OR BY

MAGNOLIA METAL CO.

OFFICE AND FACTORY:

225 St. Ambroise St., MONTREAL

Morse Rocker-Joint Silent Chains

IN USE BY THE LARGEST POWER TRANSMISSION IN THE WORLD.

IN THE LEADING MINES, MILLS, POWER PLANTS, FACTORIES for EVERY SORT AND CONDITION OF DRIVE.

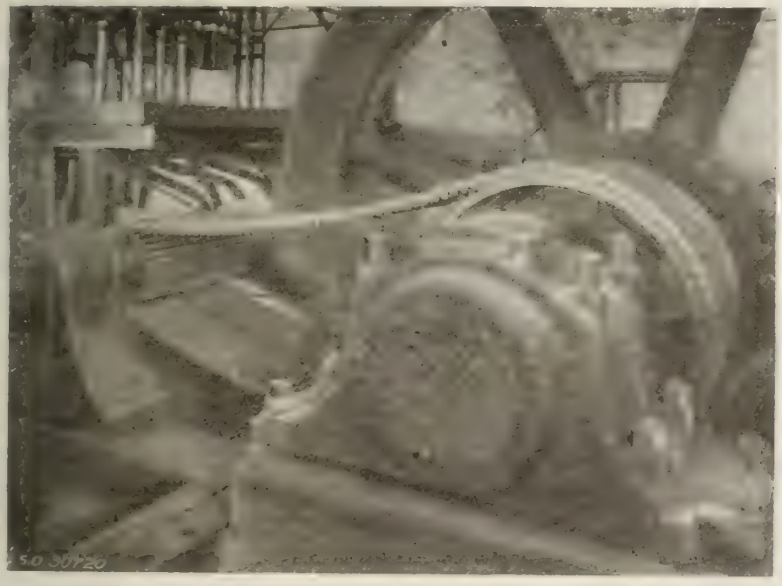
The Rocker Joint is the exclusive patented feature. There is no sliding friction. Depends on construction, not lubrication, for its life and durability.

WHY?

ASK THE BUYER & USER
about
99% EFFICIENCY EVENNESS
DURABILITY CLEANNESS
ECONOMY MAINTENANCE

Let MORSE Engineers Design Your New Drives.

Ox-bow, largest drive in the world.



POWER

Transmission Must be Figured In Terms of DOLLARS

Power Costs
Replacement Costs
Shut-Down Costs
Repair Costs
Time Lost Costs
Production Costs
Damaged Goods Losses
Shipping Losses

FIGURE IT OUT

Would you like to know?

WRITE

Write for information. Address nearest office. Facts will suprise you

MORSE CHAIN COMPANY GENERAL OFFICE AND WORKS ITHACA, N.Y., U.S.A.

Boston	141 Milk St.
Chicago	Merchants' L. & T. Bldg.
Cleveland	421 Engineers' Bldg.
Detroit	1003 Woodward Ave.
Greensboro, N.C.	805 Ashboro St.
New York	50 Church St.
Pittsburgh	Westinghouse Bldg.
San Francisco	Monadnock Bldg.

REPRESENTATIVES

ATLANTA	Earl F. Scott, M.E., 702 Chandler Bldg.
KANSAS CITY, MO.	Morse Engineering Co., Chemical Bldg.
MINNEAPOLIS	Strong & Scott Mfg. Co., 413 Third St. S.
MONTREAL	Jones & Glassco, St. Nicholas Bldg.
TORONTO	Jones & Glassco, Traders Bank Bldg.
ST. LOUIS	Morse Engineering Co., Chemical Bldg.

Superintendents and Engineers Send for Diary and Data Book

If any advertisement interests you, tear it out now and place with letters to be answered.

HINTS TO BUYERS

DOMINION COAL COMPANY LIMITED

"Dominion" and "Springhill" BITUMINOUS STEAM and GAS COALS

GENERAL SALES OFFICE

112 St. James St. Montreal

NOTICE

TO

Stationary and Hoisting Engineers

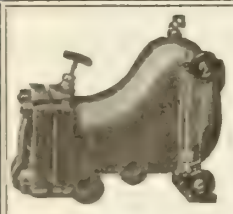
Everyone operating a STATIONARY steam plant of 50 h.p. or over in the Province of Ontario must hold a Stationary Engineer's Certificate from the Board of Stationary and Hoisting Engineers. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary and Hoisting Engineers' Act.

Everyone operating a HOISTING steam plant working at a pressure of 20 pounds or over, irrespective of horse power, and used for hoisting in structural operations or excavating purposes, in the Province of Ontario, must hold a Hoisting Engineer's Certificate from the Board of Stationary and Hoisting Engineers. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary and Hoisting Engineers' Act.

Application forms for obtaining STATIONARY or HOISTING Engineers' Certificates, may be had upon applying to the Chairman.

HON. F. G. MACDIARMID, Minister of Public Works and Highways. W. C. McGHIE, Chairman of Board.

W. A. RIDDELL, M. A. PH. D., Superintendent, Trades & Labour Branch.



McDANIEL IMPROVED STEAM TRAP

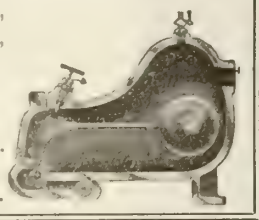
FOR HIGH OR LOW PRESSURE.

Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

MAY WE SEND ONE FOR TRIAL?

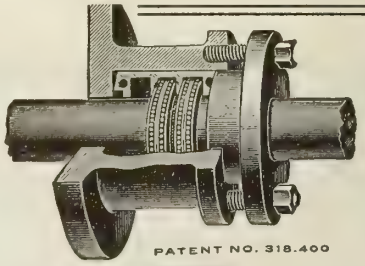
Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators.

SEND FOR CATALOGUE.



THE GARTH COMPANY
26 Craig Street MONTREAL, CAN.

WATSON & McDANIEL CO.
No. 146 N. 7th Street. PHILADELPHIA, Pa.



PATENT NO. 318,400

PAT. NO.	500,899	PAT. NO.	829,116
" "	534,104	" "	830,630
" "	602,328	" "	858,103
" "	654,541	" "	878,238
" "	654,542	" "	894,537
" "	725,368	" "	895,791
" "	774,490	" "	898,066
" "	775,193	" "	905,103
" "	775,194	" "	934,629
" "	791,300	" "	979,206
" "	805,669	" "	1000,76

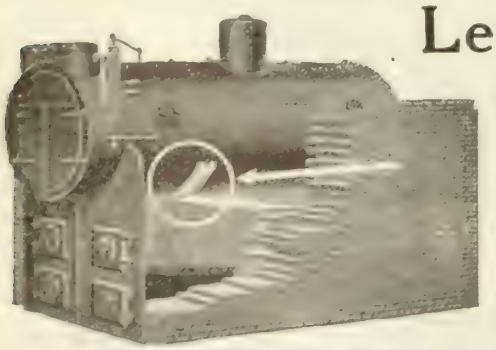
Why not Buy the Best, when in market for Packing?

HOLMES' Metallic Packing

Is Guaranteed 3 Years

Lasts many times longer. 30 days' trial. Less oil. No cutting. Easily applied to any Steam Engine, Air Compressor or Gas Engine. Satisfaction or no pay. Write us.

HOLMES METALLIC PACKING CO.,
Wilkes-Barre, Pa.
Incorporated 1897



Leakage Stopped

Permanently stopped by the National Boiler Seam Protector, which anyone can attach in 30 minutes. It will also save your boiler from fire cracks, mud cracks and blisters. Write for long list of pleased users.

Free trial on request.

NATIONAL BOILER SEAM PROTECTOR CO. OF CANADA

Head Office: 910 New Birks Bldg., Montreal
Toronto Office: 568 Manning Ave., Toronto

Water Turbines, Hydraulic Governors, Centrifugal Pumps

OUR LINDSAY WORKS

Boving Hydraulic & Engineering Co., Limited
LINDSAY, ONTARIO

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

Self-Lubricating

In Bulk

SAFETY PLASTIC

METALLIC PACKING

FOR STEAM, WATER, AIR, GAS, ETC.

Pat. Dec. 22, 1903 Highest Award World's Fair, St. Louis, 1904

GUARANTEED TO LAST THREE YEARS

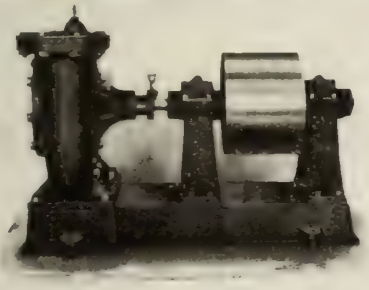
WITHOUT RENEWAL

Drop us a line and let us tell you all about this Remarkable Packing.

STEEL MILL PACKING CO., WINDSOR, ONT. Established 1899

Practically Frictionless

In Cotton Tubes



Send that PUMP inquiry to

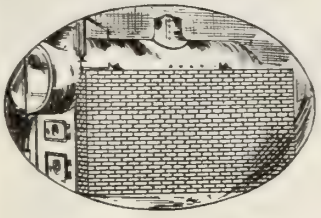
The Smart-Turner Machine Co.

LIMITED

HAMILTON, CANADA

FIRE-BRICK WORK

in all its Branches

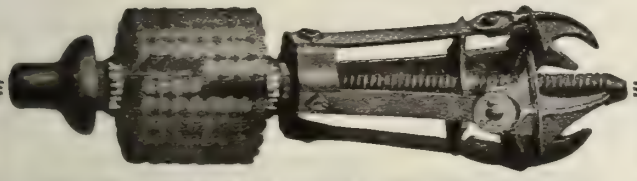


Your boilers need protection. Let me brick them up for you; this is my specialty. First-class, durable work—moderate cost.

Write for prices and particulars.

J. H. Wenting, Toronto, Ont.

Mason Contractor Phone Beach 1353 256 Lee Ave.



Looks like a good tool and it's just a little better than it looks. Adopted as standard by thousands of engineers who know from experience that it always gets results.

Pilleys Combination Flue Brush and Scraper

is adjustable to the tube—scraps and brushes thoroughly in one operation. Guaranteed against defective materials and that wires will not pull out or lay over. For sale by leading Canadian jobbers.

Eastern Office: 71 Fulton St., New York.

PILLEY PACKING & FLUE BRUSH MFG. CO.

623 South Third Street ST. LOUIS, MO.

JAMISON COLD STORAGE DOOR CO. INC

formerly

JONES COLD STORE DOOR CO.

OPEN RITE CLOSE TITE

Manufacturers of the

ORIGINAL "JONES" AND "NOEQUAL" TYPES

HAGERSTOWN, MD. P.O.BOX 93 U.S.A.

THE LADD VERTICAL WATER TUBE BOILER

The Goldie-McCulloch Co., Ltd.

Galt, Ontario

Canadian licencees under patents 162401 and 162402 dated May 4, 1915.

The George T. Ladd Company,

Pittsburgh, Pa.

Owners and manufacturers for the United States.

Write for new Catalogue No. 17.

Mechanical Drawing

By Ervin Kenison, S.B.

Instructor in Mechanical Drawing, Massachusetts Institute of Technology

176 pp., 140 illus. Cloth binding. Gives a course of practical instruction in the art of Mechanical Drawing, based on methods that have stood the test of years of experience. Includes orthographic, isometric and oblique projections, shade lines, intersections and developments, lettering, etc., with abundant exercises and plates.

Price, $1.00

MacLean Publishing Co.

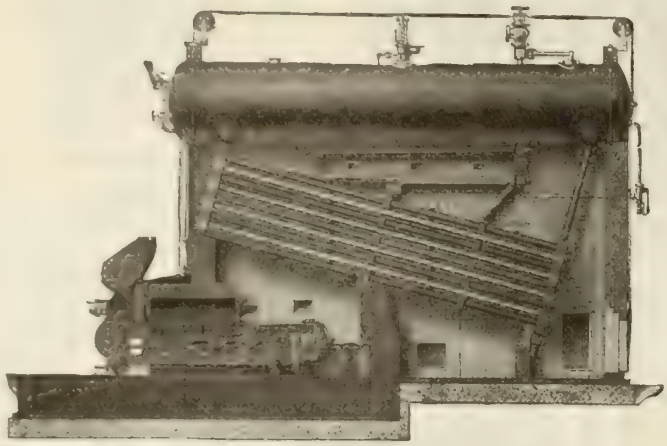
Technical Book Dept.

143-153 University Ave., Toronto

If any advertisement interests you, tear it out now and place with letters to be answered.

"ALL BRITISH"
"B.&W." PATENT WATER TUBE STEAM BOILERS

HIGHEST ECONOMY, SAFETY, DURABILITY. OVER 20,000,000 H.P. IN USE.



Babcock & Wilcox Patent Water Tube Steam Boiler, Superheater and Mechanical Stoker.

ALSO

Steam Superheaters
Mechanical Stokers
Coal-Handling Machinery
Piping, Feed Water Heaters
Water Softeners and Purifiers
and **ELECTRIC CRANES**

BABCOCK & WILCOX, Limited

HEAD OFFICE FOR CANADA - COLLEGE ST. (ST. HENRY), MONTREAL
TORONTO OFFICE, TRADERS BANK BUILDING

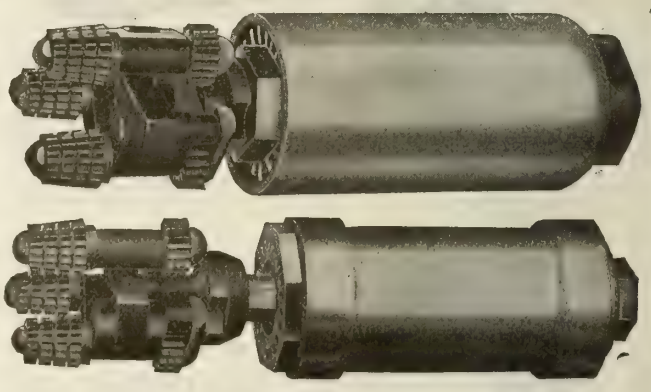
BABCOCK & WILCOX LIMITED

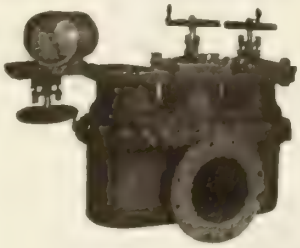
LAGONDA
BOILER TUBE CLEANERS

The latest Lagonda Water and Air-Driven Boiler Tube Cleaners are the most powerful and efficient tube cleaners made. They develop higher speed and greater power than has heretofore been secured with any Turbine Cleaner, and their use will materially shorten the time required in cleaning boilers.

These new Lagonda Cleaners are built for all sizes of tubes, either straight or curved, and they can be driven by water, air or steam.

Ask for Catalog L.





LAGONDA Multiple Water Strainers

The Lagonda Multiple Water Strainer in your water supply main will remove all objectionable solid matter and insure constant and economic conditions of pump and condenser operation. They are easily and quickly cleaned, without interruption of water supply, and take up small floor space. **Ask for Catalog R-2.**

BABCOCK & WILCOX LIMITED

St. Henry, MONTREAL
Branch Office: Traders Bank Building, Toronto

POWER HOUSE BUYERS' DIRECTORY

If what you want is not listed here write us, and we will tell you where to get it. Let us suggest that you consult also the advertisers' index facing the inside back cover, after having secured advertisers' names from this directory. The information you desire may be found in the advertising pages. This department is maintained for the benefit and convenience of our readers. The insertion of our advertisers names under proper headings is gladly undertaken, but does not become part of an advertising contract.

ACCUMULATORS, HYDRAULIC
Rawlin Pump Co., Toronto.
AIR COCKS
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.
AIR VALVES
Mueller Mfg. Co., H., Sarnia, Ont.
ALTERNATORS
Lancashire Dynamo & Motor Co., Toronto, Ont.
AMMETERS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. H. W. Johns-Manville Co., Toronto, Ont.
AMMONIA VALVES AND FITTINGS
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Frick Co., Waynesboro, Franklin Co., Pa.
Homestead Valve Mfg. Co., Pittsburgh, Pa.
York Mfg. Co., York, Pa.
AMMONIA PURIFIERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Mfg. Co., York, Pa.
AMMONIA TANKS
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford, Ont.
ANTIMONY
Dominion Metal Co., Sherbrooke, Que.
ARCHES, COMBUSTION CHAMBER
Canadian Fairbanks-Morse Co., Ltd. Montreal.
ASH CARRYING SYSTEMS
Babcock & Wilcox, Ltd. Montreal.
Waterous Engine Works Co., Brantford, Ont.

ASBESTOS SPECIALTIES
Durabla Mfg. Co., New York, N.Y.
Garlock Packing Co., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.
AUTOMATIC ICE RECORDING DOORS AND CHUTES
Jamison Cold Storage Door Co., Hagerstown, Md.
BABBITT AND ANTI-FRICTION METAL
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Dominion Metal Co., Sherbrooke, Que.
Hoyt Metal Co., Toronto.
Magnolia Metal Co. Montreal.
Wm. C. Wilson & Co., Toronto.
BALL BEARINGS
Can. S K F Co., Toronto, Ont.
BALLCOCKS
D'Este Co., Julian, Boston, Mass.
BATTERIES AND ACCESSORIES
Can. H. W. Johns-Manville Co., Toronto, Ont.
BELT CEMENT
Graton & Knight Mfg. Co., Montreal.
BELT DRESSING
Cling Surface Co., Buffalo.
Jos. Dixon Crucible Co., Jersey City.
Dominion Belting Co., Hamilton, Ont.
Graton & Knight Mfg. Co., Montreal.
BELT LACING, LEATHER
Graton & Knight Mfg. Co., Montreal.
BELT TIGHTENERS
Waterous Engine Works Co., Brantford, Ont.
BELT PULLEYS
American Pulley Co., Philadelphia, Pa.
Waterous Engine Works Co., Brantford, Ont.
BELTING, BALATA
Federal Engineering Co., Toronto, Ont.
BELTING, LINK
Graton & Knight Mfg. Co., Montreal.
Waterous Engine Works Co., Brantford, Ont.
BELTING, STITCHED COTTON DUCK
Dominion Belting Co., Hamilton, Ont.
BELTING, LEATHER
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Garlock Packing Co., Hamilton, Ont.
Goodyear Tire & Rubber Co., Toronto.
Graton & Knight Mfg. Co., Montreal.
Main Belting Co., Montreal.
D. K. McLaren Ltd., Montreal.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.
BELTING, RUBBER
Can. H. W. Johns-Manville Co., Toronto, Ont.
Goodyear Tire & Rubber Co., Toronto.
Jeffrey Manufacturing Co., Montreal.
Thomson-Gordon, Ltd., Hamilton, Ont.
United States Rubber Co., New York.
BELTING, WOVEN COTTON
Federal Engineering Co., Toronto, Ont.
BINS, COAL, COKE AND ORE
Jeffrey Manufacturing Co., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford, Ont.
BLOWERS
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Can. Sirocco Co., Windsor, Ont.
Coppus Eng. & Equip. Co., Worcester, Mass.
Green's Economiser, Ltd., Toronto.

BOILER COMPOUNDS
Can. Economic Lubricant Co., Montreal, Que.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Metlskin Mfg. Co., Rochester, N.Y.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Wm. C. Wilson & Co., Toronto.
BOILER COMPOUND FEEDERS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Morehead Mfg. Co., Woodstock.
Lunkenheimer Co., Cincinnati, O.
BOILER FEED PUMPS
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Steam Boiler Equipment Co., Toronto, Ont.
Darling Bros., Ltd., Montreal, Que.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Laurie & Lamb, Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
BOILER FEED REGULATORS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Mason Regulator & Engineering Co., Montreal.
Northern Equipment Co., Erie, Pa.
BOILER GRAPHITE
Joseph Dixon Crucible Co., Jersey City, N.J.
BOILER MOUNTINGS
Babcock & Wilcox, Ltd. Montreal.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Ltd., Montreal, Que.
Inglis Co., The John, Toronto, Ont.
Lunkenheimer Co., Cincinnati, O.
Mason Regulator & Engineering Co., Montreal.
BOILER PRESERVATIVES
Johns-Pratt Co., The, Hartford, Conn.
Metlskin Co., Inc., Rochester, N.Y.
BOILER AND FURNACE BRICK WORK
Wenting, J. H., 256 Lee Ave., Toronto, Ont.
BOILER HOUSE ACCESSORIES
Babcock & Wilcox, Ltd. Montreal.
Canadian Griscom-Russell Co., Ltd., Montreal.
Cole, Ltd., Geo. W., Toronto.
Mason Regulator & Engineering Co., Montreal.
BOILER SEAM PROTECTOR
National Boiler Seam Protector Co., Montreal.
BOILER SETTINGS
Beveridge Paper Co., Montreal.
Gates, John W., St. James St., Montreal.
BOILERS, HORIZONTAL, RETURN, TUBULAR AND WATERTUBE
Babcock & Wilcox, Ltd. Montreal.
Cole, Ltd., Geo. W., Toronto.
Goldie & McCulloch Co., Galt.
Frick Co., Waynesboro, Franklin Co., Pa.
Inglis Co., The John, Toronto, Ont.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Jones Underfeed Stoker Co., Toronto.
Leonard & Sons, E., London, Can.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Ladd, The Geo. T., Co., Pittsburgh, Pa.
McAvity, T., & Sons, Ltd., St. John, N.B.
Waterous Engine Works Co., Brantford, Ont.
BOILERS, MARINE, LOCOMOTIVE AND VERTICAL
Babcock & Wilcox, Ltd. Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Goldie & McCulloch Co., Galt.
Inglis Co., The John, Toronto, Ont.
Engineering and Machine Works of Canada, Ltd. St. Catharines, Ont.
Leonard & Sons, E., London, Can.
John McDougall Caledonian Iron Works, Montreal.
Waterous Engine Works Co., Brantford, Ont.
BOOKS
Audel & Co., Theo, New York, N.Y.
MacLean Publishing Co., Toronto.
BOXES, FUSE AND METER
Johns-Pratt Co., The, Hartford, Conn.
BRASS FOUNDERS
McAvity, T., & Sons, Ltd., St. John, N.B.
D'Este Co., Julian, Boston, Mass.
Mueller Mfg. Co., H., Sarnia, Ont.
BRINE COOLERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.
BRINE TANKS
Frick Co., Waynesboro, Franklin Co., Pa.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford, Ont.
York Manufacturing Co., York, Pa.
BUSHINGS
Steel Mill Packing Co., Windsor, Ont.
CABLE
Wm. C. Wilson & Co., Toronto.

CALORIMETERS
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Taylor Instrument Co., Rochester, N.Y.
CANS, OILY WASTE
Jas. Morrison Brass Mfg. Co., Toronto.
CAST IRON FITTINGS
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
CASTINGS, BRASS AND IRON
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Hamilton Co., Wm., Peterboro, Ont.
Lunkenheimer Co., Cincinnati, O.
John McDougall Caledonian Iron Works Co., Ltd., Montreal.
McAvity, T., & Sons, Ltd., St. John, N.B.
Mueller Mfg. Co., H., Sarnia, Ont.
Victoria Foundry Co, Ottawa, Ont.
Waterous Engine Works Co., Brantford, Ont.
Wood & Co., R. D., Philadelphia, Pa
CELLAR DRAINERS
Morrison Brass Mfg. Co., James, Toronto, Ont.
Mueller Mfg. Co., H., Sarnia, Ont.
CEMENT, HIGH TEMPERATURE
Beveridge Paper Co., Montreal.
Gates, John W., St. James St., Montreal.
Green's Economiser, Ltd., Toronto.
CEMENT, PIPE JOINT
Wm. C. Wilson & Co., Toronto.
CEMENT MACHINERY
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Waterous Engine Works Co., Brantford, Ont.
CEMENT, INSULATING, REFRACTORY
Green's Economiser, Ltd., Toronto.
CHAIN DRIVES
Coventry Chain Co., Coventry, England.
Morse Chain Co., Ithaca, N.Y.
CHAIN WHEELS
Babbitt Steam Specialty Co., New Bedford, Mass.
CHIMNEYS, STEEL
Babcock & Wilcox, Ltd. Montreal
MacKinnon, Holmes & Co., Sherbrooke, Que.
CHUTES, COAL
Can. Allis-Chalmers, Ltd., Toronto, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que
CLEANERS, BOILER TUBE
Babcock & Wilcox, Ltd., Montreal.
Can. H. W. Johns-Manville Co., Toronto.
Cole Ltd., Geo. W., Toronto.
Garlock Packing Co., Hamilton, Ont.
Green's Economiser, Ltd., Toronto
Liberty Mfg. Co., Pittsburgh, Pa.
Laurie & Lamb, Montreal, Que.
Pilley Packing & Flue Brush Mfg. Co., St. Louis, Mo.
Roto Co., Hartford, Conn.
CLOCKS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Foxboro Co., The, Foxboro, Mass.
CLOSETS
Mueller Mfg. Co., H., Sarnia, Ont.
CLUTCHES
Waterous Engine Works Co., Brantford, Ont.
COAL
Dom. Coal Co., Montreal
COAL AND ASH CONVEYORS
Babcock & Wilcox, Ltd. Montreal.
Jeffrey Manufacturing Co., Montreal.
Waterous Engine Works Co., Brantford, Ont.
COAL HANDLING MACHINERY
Babcock & Wilcox, Ltd. Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Jeffrey Manufacturing Co., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford, Ont.
COAL HOLE COVERS
Can. Allis-Chalmers, Ltd., Toronto, Ont.
COILS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.
COLD STORAGE INSULATION
Armstrong Cork & Insulation Co., Montreal, Que.
Beveridge Paper Co., Ltd., Montreal, Que.
COMMUTATOR TRUING DEVICES
Jordan Bros., Inc., New York, N.Y.
CONDENSERS
Alberger Heater Co., Buffalo, N.Y.
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Toronto.
Belliss & Morcom, Birmingham, Eng.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Darling Bros., Ltd., Montreal, Que.
Goldie & McCulloch Co., Galt.
Laurie & Lamb, Montreal.
John McDougall Caledonian Iron Wks., Montreal.
Waterous Engine Works Co., Brantford.
CONDENSERS, AMMONIA AND STEAM
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

COLLECTORS, PNEUMATIC
Sturtevant Co. of Canada, B. F., Galt, Ont.
CONSULTING ENGINEERS
Walter J. Francis, Montreal.
Laurie & Lamb, Montreal.
COLD STORAGE DOORS AND WINDOWS
Jamison Cold Storage Door Co., Hagerstown, Md.
COMPRESSORS, AIR
American Steam Pump Co., Battle Creek, Mich.
Belliss & Morcom, Birmingham, Eng.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Darling Bros., Ltd., Montreal, Que.
Inglis Co., The John, Toronto, Ont.
Laurie & Lamb, Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Smart-Turner Machine Co., Ltd., Hamilton.
Taylor Instrument Co., Rochester, N.Y.
COMPRESSORS, GAS
Can. Allis-Chalmers, Ltd., Toronto, Ont.
CONDUITS
Can. H. W. Johns-Manville Co., Toronto, Ont.
CONDENSATION RECEIVER
Cole, Ltd., Geo. W., Toronto.
G. M. Basse Regulator Co., Chicago.
CONNECTIONS, FLANGED
Jefferson Union Co., Lexington, Mass.
Dart Union Co., Ltd., Toronto, Ont.
CONTRACTORS' STRUCTURAL STEEL
Canadian Fairbanks-Morse Co., Ltd. Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
CONVEYOR MACHINERY
Babcock & Wilcox, Ltd. Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Jeffrey Manufacturing Co., Montreal.
Morse & Patterson, Toronto, Ont.
Waterous Engine Works Co., Brantford.
Wood, Peddar Co., Ottawa, Ont.
COOLER, DOORS
Jamison Cold Storage Door Co., Hagerstown, Md.
CORK INSULATION
Armstrong Cork & Insulation Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
COTTON HOSE
Garlock Packing Co., Hamilton, Ont.
COUNTERS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Foxboro Co., The, Foxboro, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
COUNTERSHAFTS
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Victoria Foundry Co., Ottawa, Ont.
COUPLINGS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Jeffrey Manufacturing Co., Montreal.
McAvity & Sons, T., St. John, N.B.
Victoria Foundry Co., Ottawa, Ont.
COUPLINGS, BOILER, FLANGED PIPE, JOINT PIPE, UNION, STEAM PIPE
Jefferson Union Co., Lexington, Mass.
Dart Union Co., Ltd., Toronto, Ont.
COUPLINGS, SHAFT
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
CRANES, ALL KINDS
Babcock & Wilcox, Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
CRANES, ELECTRIC
Babcock & Wilcox, Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
CRANES, HAND POWER
Babcock & Wilcox, Ltd., Montreal.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Brown Co., Wanesboro, Pa.
Smart-Turner Machine Co., Ltd., Hamilton.
CRANES, OVERHEAD TRAVELLING
Babcock & Wilcox, Ltd., Montreal.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Smart-Turner Machine Co., Ltd., Hamilton.
CRANES, POST JIB
Babcock & Wilcox, Ltd., Montreal.
CRANES, SWING JIB
Babcock & Wilcox, Ltd., Montreal.
CRANES, WALL
Babcock & Wilcox, Ltd., Montreal.
CRANE MOTORS
Lancashire Dynamo & Motor Co., Toronto, Ont.
CRANK AND CROSSHEAD PIN OILERS
Lunkenheimer Co., Cincinnati, O.
CRIMPS, LEATHER
Graton & Knight Mfg. Co., Montreal
CRUSHING MACHINERY
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Jeffrey Mfg. Co., Columbus, Ohio.
CYLINDER OIL
E. H. Kellogg & Co., New York.
DAMPER REGULATORS
Babcock & Wilcox, Ltd., Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Darling Bros., Ltd., Montreal, Que.
G. M. Basse Regulator Co., Chicago.
D'Este Co., Julian, Boston, Mass.
Elliott Co., Pittsburgh, Pa.
Mason Regulator Co., Boston, Mass.
Jas. Morrison Brass Mfg. Co., Toronto.
DISCS, FIBRE
Bermingham Paper Co., Ltd., Montreal, Que.
Johns-Pratt Co., The, Hartford, Conn.
DISCS, LEATHER
Graton & Knight Mfg. Co., Montreal.
DISTILLING APPARATUS
Canadian Griscom-Russell Co., Ltd., Montreal.
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.
DOORS, COLD STORAGE AND FREEZER
Jamison Cold Storage Door Co., Hagerstown, Md.
DOUBLE PIPE CONDENSERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.
DRAFT APPARATUS SYSTEMS, MECHANICAL
Green's Economiser, Ltd., Toronto.
DRYING MACHINERY
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Sirocco Co., Windsor, Ont.
DUST SEPARATORS
Sturtevant Co. of Canada, B. F., Galt, Ont.
DYNAMOS
Canadian Fairbanks-Morse Co., Ltd., Montreal
Sturtevant Co. of Canada, B. F., Galt, Ont.
ECONOMIZERS
Babcock & Wilcox, Ltd., Montreal.
Canadian Fairbanks-Morse Co., Ltd., Montreal
Green's Economiser, Ltd., Toronto.
EJECTORS
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.
Smart-Turner Machine Co., Ltd., Hamilton.
ELECTRICAL ACCESSORIES AND MACHINERY
Can. H. W. Johns-Manville Co., Toronto, Ont.
Beveridge Paper Co., Ltd., Montreal, Que.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Economy Fuse & Mfg. Co., Montreal, Que.
MacGovern & Co., Inc., New York.
Milton & Prentiss, Toronto, Ont.
ELECTRICAL SUPPLIES
Can. General Electric Co., Toronto, Ont.
Can. H. W. Johns-Manville Co., Toronto, Ont.
ELEVATORS
MacKinnon, Holmes & Co., Sherbrooke Ont.
John MacDougall Caledonian Iron Works, Montreal.
ELEVATING MACHINERY
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Goldie & McCulloch Co., Galt.
Hamilton Mfg. Co., Wm., Peterboro, Ont.
Jeffrey Manufacturing Co., Montreal
Waterous Engine Works Co., Brantford.
ENAMELWARE
H. Mueller Mfg. Co., Sarnia, Ont.
ENGINEERS' SUPPLIES
Beveridge Paper Co., Ltd., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Ltd., Montreal, Que.
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.
Jas. Morrison Brass Mfg. Co., Toronto.
ENGINES, AUTOMATIC AND DROP VALVE
Frick Co., Waynesboro, Franklin Co., Pa.
Waterous Engine Works Co., Brantford.
ENGINES, CORLISS AND ROCKING VALVE
Bawden Pump Co., Toronto.
Frick Co., Waynesboro, Pa.
Goldie & McCulloch Co., Galt.
Green's Economiser, Ltd., Toronto.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Waterous Engine Works Co., Brantford.
ENGINES, DIESEL
Can. Allis-Chalmers, Ltd., Toronto, Ont.
ENGINES, GAS AND GASOLINE
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Laurie & Lamb, Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
ENGINES, STEAM
Belliss & Morcom, Birmingham, Eng.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Can. Sirocco Co., Windsor, Ont.
Goldie & McCulloch Co., Galt.
Hamilton Mfg. Co., Wm., Peterboro, Ont.
Inglis Co., The John, Toronto, Ont.
Laurie & Lamb, Montreal.
Leonard & Sons, E., London, Can.
John MacDougall Caledonian Iron Works, Montreal.
Waterous Engine Works Co., Brantford.
ENGINES, HOISTING, LOGGING, CABLEWAY
Can. Allis-Chalmers, Ltd., Toronto, Ont.
ENGINES, MARINE
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
ENGINES, SAW MILL
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Laurie & Lamb, Montreal.
Waterous Engine Works Co., Brantford.
ENGINES, SINGLE COMPOUND AND TRIPLE EXPANSION
Canadian Griscom-Russell Co., Ltd., Montreal.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Laurie & Lamb, Montreal.
John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Kerr Engine Co., Walkerville.
Waterous Engine Works Co., Brantford.
ENGINES, VERTICAL
Laurie & Lamb, Montreal.
ENGINEERING BOOKS
MacLean Publishing Co., Toronto
EXHAUSTERS
Green's Economiser, Ltd., Toronto.
EXHAUST HEADS
Can. Sirocco Co., Windsor, Ont.
Darling Bros., Ltd., Montreal, Que.
Direct Separator Co., Syracuse, N.Y.
Elliott Co., Pittsburgh, Pa.
Jas. Morrison Brass Mfg. Co., Toronto.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Watson & McDaniel Co., Philadelphia.
EXPANSION JOINTS
Alberger Heater Co., Buffalo, N.Y.
Direct Separator Co., Syracuse, N.Y.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
FANS, VENTILATING
Can. Sirocco Co., Windsor, Ont.
C. T. Coe Co., 10 Johnson St., Newark, N.J.
Coppus Engr. & Equip. Co., Worcester, Mass.
Green's Economiser, Ltd., Toronto.
Sturtevant Co. of Canada, B. F., Galt, Ont.
FEED WATER HEATERS
Alberger Heater Co., Buffalo, N.Y.
Babcock & Wilcox, Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Stewart Heater Co., Buffalo, N.Y.
Waterous Engine Works Co., Brantford.
FEED WATER PURIFIERS
Stewart Heater Co., Buffalo, N.Y.
FEED WATER REGULATORS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Chaplin, Fulton Mfg. Co., Pittsburg, Pa.
Elliott Co., Pittsburgh, Pa.
Laurie & Lamb, Montreal.
FILTERS
Bowser & Co., Inc., S. F., Toronto, Ont.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
FILTERS, WATER
Canadian Griscom-Russell Co., Ltd., Montreal.
Darling Bros., Ltd., Montreal, Que.
Frick Co., Waynesboro, Franklin Co., Pa.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Scaife & Sons, Wm. B., Pittsburgh, Pa.
York Manufacturing Co., York, Pa.
FIRE BRICK, PLASTIC
Gates, John W., St. James St., Montreal.
Wenting, J. H., Toronto.
FIREPROOF COLD STORAGE DOORS AND WINDOWS
Jamison Cold Storage Door Co., Hagerstown, Md.
FITTINGS, AIR, AUTOMOBILE, GAS, HYDRAULIC, PIPE, PIPE FLANGED, SCREWED PIPE, STEAM
Jefferson Union Co., Lexington, Mass.
Dart Union Co., Ltd., Toronto, Ont.
H. Mueller Mfg. Co., Sarnia, Ont.
FLANGED STEAM FITTINGS
Direct Separator Co., Syracuse, N.Y.
McAvity, T., & Sons, Ltd., St. John, N.B
FLANGES
Dart Union Co., Ltd., Toronto, Ont.
Jefferson Union Co., Lexington, Mass.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
FLOORING COMPOSITION
Armstrong Cork & Insulation Co., Montreal, Que.
FLUE CLEANERS
Babcock & Wilcox, Montreal.
Liberty Mfg. Co., Pittsburg, Pa.
Pilley Packing and Flue Brush Mfg. Co., St. Louis, Mo.
William B. Pierce Co., Buffalo, N.Y.
Roto Co., Hartford, Conn.
Wm. C. Wilson & Co., Toronto.
FLUE GAS ANALYSIS INSTRUMENTS
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y
Uehling Instrument Co., New York.
Precision Instrument Co., Detroit, Mich.
Penberthy Injector Co., Windsor, Ont.
FLUES, GAS AND SMOKE
Green's Economiser, Ltd., Toronto.
FLUMES, STEEL
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
FREEZER DOORS
Jamison Cold Storage Door Co., Hagerstown, Md.
FRICTION LEATHERS
Graton & Knight Mfg. Co., Montreal.
FURNACES, BOILER
Gates, J. W., Montreal, P.Q.
Green's Economiser, Ltd., Toronto.
FURNACES, SMOKELESS
Babcock & Wilcox, Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Detroit, Mich.
FUSES
Can. H. W. Johns-Manville Co., Toronto, Ont.
Economy Fuse & Mfg. Co. of Canada, Montreal.
Johns-Pratt Co., The, Hartford, Conn.
GAS ANALYSIS INSTRUMENTS, ETC.
Penberthy Injector Co., Windsor, Ont.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y
Uehling Instrument Co., New York, N.Y.
GASKETS, RUBBER, ASBESTOS
Can. H. W. Johns-Manville Co., Toronto, Ont.
Durabla Mfg. Co., New York, N.Y.
Frick Co., Waynesboro, Franklin Co., Pa.
Garlock Packing Co., Hamilton, Ont.
Johns-Pratt Co., The, Hartford, Conn.
Peerless Rubber Mfg. Co., New York, N.Y.
Sarco Co., Inc., New York, N.Y.
Thomson-Gordon, Ltd., Hamilton, Ont.

In the big steel plants that are speeding up on war equipment for Uncle Sam.

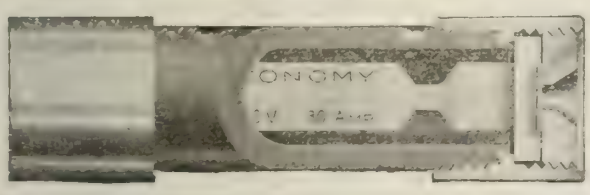
ECONOMY renewable FUSES

insure electrical safety and cut annual fuse maintenance costs 80%. An inexpensive little "Drop Out" Renewal Link restores a blown Economy Fuse to its original efficiency.

WRITE FOR CATALOG 24

Economy Fuse & Mfg. Co. of Canada, Limited
UNITY BLDG. - - MONTREAL

Manufacturers in Canada of S & B High Potential Fuses to 150,000 Volts.



LANCO BALATA BELTING

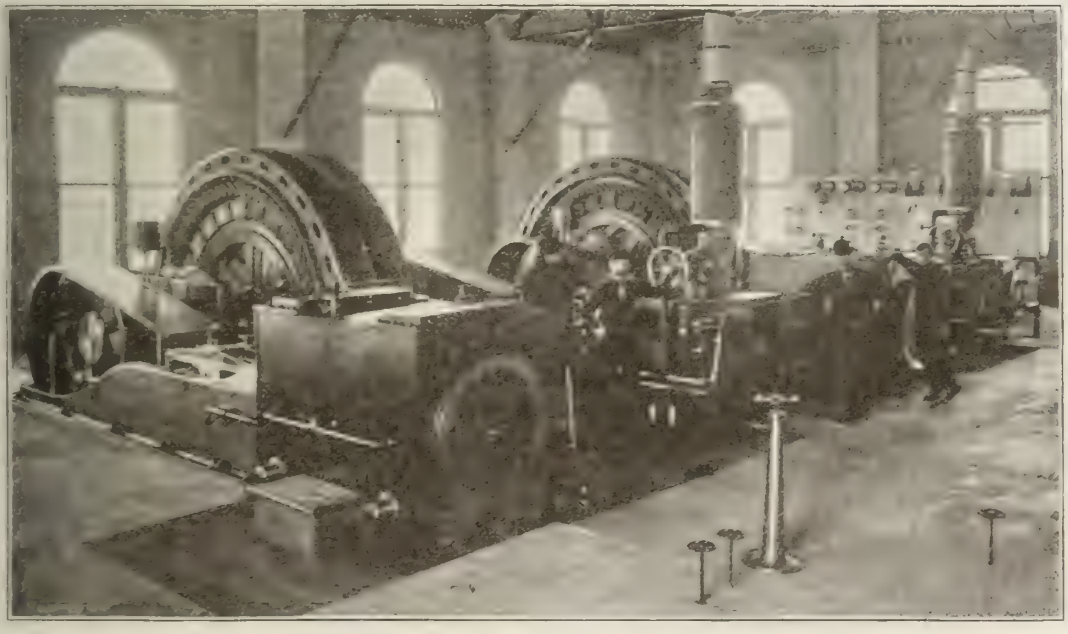
is now one of the most expensive belts on the market.

When the cost of raw materials increased the price of this belt to where it is to-day, we were a little afraid that it would result in a diminution of our sales. We have been very agreeably disappointed—the sales have not dropped off.

There are cheaper belts on the market that will give as good service but not for so long. That is the secret of the steady demand for Lanco Balata Belting. The method by which this belt is made ensures a very strong and long-lived material. The duck is very heavy and is so tightly woven that the only method of using a gum that would hold the plies tightly together is by impregnating the duck with a solution of gum. This method is used in making Lanco Balata Belting, and when the solvent evaporates it leaves the gum dry, pliable, and with a strength that, as far as we know, has never been equalled by any other gum. The duck is, of course, stretched while in the solution and until the solvent has evaporated. Balata gum softens at a temperature of 120° F., but under any atmospheric conditions, except those of heat, it will give a length of service that makes its price worth while.

Federal Engineering Co.
Limited
172 John Street, Toronto

25 Cycle Engine Generator Sets For Sale



1—250 KW.
1—300 KW.

25 Cycle
3 phase
Westinghouse
Generators
Direct
connected to
McIntosh &
Seymour Cross
Compound
Gridiron Valve
Engines 150
R.P.M.

These units were in use only seven months and are in first class condition.
Write for further particulars and quotations.

Power Plant Equipment Co., Dominion Bank Building Toronto, Ont.

If any advertisement interests you, tear it out now and place with letters to be answered.

GASKETS, LEAD, COPPER AND LEATHER
Graton & Knight Mfg. Co., Montreal, Que.
Shell Bar Boico Supply Co., Toronto, Ont.
Sarco Co., Inc., New York, N.Y.
Wm. C. Wilson & Co., Toronto, Ont.

GAS COLLECTORS
Precision Instrument Co., Detroit, Mich.

GAS PRODUCER PLANTS
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Laurie & Lamb, Montreal.

GAUGE COCKS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Garlock Packing Co., Hamilton, Ont.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.
W. J. Wall, Montreal.

GAUGE GLASSES
Wm. C. Wilson & Co., Toronto.

GAUGES, AMMONIA, OIL, GAS, AIR
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y

GAUGES, PRESSURE, VACUUM, DRAFT AND RECORDING, AND MICROMETER
Babcock & Wilcox, Montreal.
Foxboro Company, Foxboro, Mass.
Green's Economiser, Ltd., Toronto.
Lunkenheimer Co., Cincinnati, O.
Milton & Prentiss, Toronto.
Precision Instrument Co., Detroit, Mich.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.

GAUGES, WATER
Babcock & Wilcox, Montreal.
Jenkins Bros., Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
Penberthy Injector Co., Windsor, Ont.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

GEARS, FIBRE CUT
Beveridge Paper Co., Ltd., Montreal, Que.

GEARS, CUT, WORM, MORTISE
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

GENERATORS, DIRECT CURRENT
Lancashire Dynamo & Motor Co., Toronto, Ont.

GENERATORS, STEAM TURBO
Can. General Electric Co., Toronto, Ont.
Laurie & Lamb, Montreal.

GENERATORS AND CONVERTORS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. General Electric Co., Toronto, Ont.

GOVERNORS, ENGINE
Escher Wyss & Co., Montreal, Que.
McAvity, T., & Sons, Ltd., St. John, N.B.
Waterous Engine Works Co., Brantford.

GRAPHITE, BOILER
Jos. Dixon Crucible Co., Jersey City.
Wm. C. Wilson & Co., Toronto.

GRATES, DUMPING, ROCKING, STATIONARY
Babcock & Wilcox, Montreal.
Boiler Repair & Grate Bar Co., Toronto, Ont.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
C. T. Coe Co., 10 Johnson St., Newark, N.J.
Can. Steam Boiler Equipment Co., Toronto, Ont.
Galt Foundry Co., Galt, Ont.
Mason Regulator & Engineering Co., Montreal.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Waterous Engine Works Co., Brantford.

GREASE CUPS
Albany Lubricating Co., New York City.
Detroit Lubricator Co., Walkerville.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

GREASE AND OIL EXTRACTORS
American Steam Gauge & Valve Mfg. Co., Bos
Canadian Griscom-Russell Co., Ltd., Montreal.
Elliott Co., Pittsburgh, Pa.
Laurie & Lamb, Montreal.

GREASES
Albany Lubricating Co., New York City.
Can. Economic Lubricant Co., Montreal, Que.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Jos. Dixon Crucible Co., Jersey City.
Wm. C. Wilson & Co., Toronto.

HAND LEATHERS OR PADS
Mfg. Co., Montreal

HANGERS
Can. General Electric Co., Toronto, Ont.
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Can. S K F Co., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Co., Galt.
Waterous Engine Works Co., Brantford.

HEATERS
Alberger Heater Co., Buffalo, N.Y.
Babcock & Wilcox, Ltd., Montreal.
Can. Blower Co., Wiarton, Ont.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
Harrison Mfg. Co., Wm., Peterboro, Ont.
Laurie & Lamb, Montreal.
McAvity & Sons, T., St. John, N.B.
Scaife & Sons, Wm. B., Pittsburgh, Pa.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Waterous Engine Works Co., Brantford.

HEATERS, EXHAUST STEAM
Can. Allis-Chalmers, Ltd., Toronto, Ont.

HEATERS, METERING
Can. Allis-Chalmers, Ltd., Toronto, Ont.

HEATING SYSTEMS, FANS
Can. Sirocco Co., Windsor, Ont.

HOISTS, GRIP
Jordan Bros., Inc., New York, N.Y.

HOISTING AND CONVEYING MACHINERY
Babcock & Wilcox, Ltd., Montreal.
Hamilton Mfg. Co., Wm., Peterboro, Ont.
Waterous Engine Works Co., Brantford.

HOSE, METALLIC
Pennsylvania Flexible Metallic Tubing Co., Boston, Mass.

HOSE, STEAM, SUCTION AND WATER
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Asbestos Co., Montreal.
Garlock Packing Co., Hamilton, Ont.
Goodyear Tire & Rubber Co., Toronto.
Peerless Rubber Mfg. Co., New York, N.Y.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

HYDRANTS
Wood & Co., R. D., Philadelphia, Pa.

HYDRAULIC ACCUMULATORS
Smart-Turner Machine Co., Ltd., Hamilton.

HYDRAULIC MACHINERY
Bawden Pump Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Hamilton Mfg. Co., Wm., Peterboro, Ont.
John McDougall Caledonian Iron Wks., Montreal.

HYDRAULIC PRESSES
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

ICE MAKING MACHINERY
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Griscom-Russell Co., Ltd., Montreal.
Frick Co., Waynesboro, Franklin Co.
Linde Canadian Refrigeration Co., Montreal.
York Mfg. Co., York, Pa.

INDICATORS, ELECTRIC—ALL TYPES
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Uehling Instrument Co., New York, N.Y.

INDICATORS, STEAM AND GAS ENGINE
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Canadian Fairbanks-Morse Co., Montreal.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Green's Economiser, Ltd., Toronto.
Uehling Instrument Co., New York, N.Y.

INDICATORS—AMMONIA, HYDRAULIC
Can. Detroit Lubricator Co., Walkerville, Ont.

INDICATORS, SPEED
L. S. Starrett Co., Athol, Mass.

INJECTORS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

INSTRUMENTS, RECORDING
Green's Economiser, Ltd., Toronto.
Taylor Instrument Companies, Rochester, N.Y.

INSULATING BRICK
Armstrong Cork & Insulation Co., Montreal, Que.
Beveridge Paper Co., Ltd., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.

INSULATING COMPOUNDS
Johns-Pratt Co., The, Hartford, Conn.

INSULATORS
Ed. Bennis & Co., Little Fulton, Bolton, Eng.
Beveridge Paper Co., Ltd., Montreal, Que.
Johns-Pratt Co., The, Hartford, Conn.

IRON FILLER
Can. H. W. Johns-Manville Co., Toronto, Ont.

KILNS
Green's Economiser, Ltd., Toronto.

LACE LEATHERS
Graton & Knight Mfg. Co., Montreal.
Wm. C. Wilson & Co., Toronto.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Can. B. K. Morton Co., Toronto, Montreal.
Canuck Supply Co., Ltd., Montreal, Que.
Crane Packing Co., Chicago, Ill.

LAMPS, ARC
Canadian Fairbanks-Morse Co., Montreal.
Can. General Electric Co., Toronto, Ont.
Can. H. W. Johns-Manville Co., Toronto, Ont.

LAMPS, ELECTRIC
Wm. C. Wilson & Co., Toronto.

LAMPS, INCANDESCENT
Canadian Fairbanks-Morse Co., Montreal.
Can. General Electric Co., Toronto, Ont.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Can. Laco-Philips Co., Ltd., Toronto, Ont.

LAMPS, NITRO
Can. Laco-Philips Co., Ltd., Toronto, Ont.

LAMPS, TUNGSTEN AND NITRO
Can. General Electric Co., Toronto, Ont.
Can. Laco-Philips Co., Ltd., Toronto, Ont.

LEAD
Dominion Metal Co., Sherbrooke, Que.

LEATHER STRAPPING
Graton & Knight Mfg. Co., Montreal.

LININGS, FIRE BRICK, STEEL STACK
Green's Economiser, Ltd., Toronto.

LUBRICANTS
Albany Lubricating Co., New York City.
Canadian Economic Lubricant Co., Montreal.
Jos. Dixon Crucible Co, Jersey City.

LUBRICATORS, CYLINDER
Albany Lubricating Co., New York City.
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

LUBRICATORS, FORCE FEED
Can. Detroit Lubricator Co., Walkerville, Ont.
Darling Bros., Montreal.
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

LUBRICATORS, PLAIN
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

MACHINERY INSULATION
Armstrong Cork & Insulation Co., Montreal, Que.
Beveridge Paper Co., Ltd., Montreal, Que.

MANGENESITE PASTE
Wm. C. Wilson & Co., Toronto.

MASON CONTRACTOR
Wenting, J. H., 256 Lee Ave., Toronto.

MECHANICAL STOKERS
Babcock & Wilcox, Ltd., Montreal.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Dertoit, Mich.

METERS, ELECTRIC
Can. H. W. Johns-Manville Co., Toronto, Ont.

METERS, STEAM
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Green's Economiser, Ltd., Toronto.

METERS, WATER
Allen General Supplies, Toronto, Ont.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Foxboro Company, Foxboro, Mass.
McAvity & Sons, T., St. John, N.B.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Precision Instrument Co., Detroit, Mich.

MIXING VALVES
Mueller Mfg. Co., H., Sarnia, Ont.

MILL AND MINING MACHINERY
Canadian Fairbanks-Morse Co., Montreal.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Goldie & McCulloch Co., Galt.
Hamilton Co., Wm., Peterboro, Ont.
Waterous Engine Works Co., Brantford.

METER TESTERS
Mueller Mfg. Co., H., Sarnia, Ont.

MOTORS
Canadian Fairbanks-Morse Co., Montreal.
Can. General Electric Co., Toronto, Ont.
Green's Economiser, Ltd., Toronto.
Milton & Prentiss, Toronto.

MOTORS, DIRECT CURRENT
Lancashire Dynamo & Motor Co., Toronto, Ont.

MOTORS, INDUCTION
Lancashire Dynamo & Motor Co., Toronto, Ont.

MOTORS, SYNCHRONOUS
Lancashire Dynamo & Motor Co., Toronto, Ont.

OAKUM
Wm. C. Wilson & Co., Toronto.

OFFICE RAILINGS
Jas. Morrison Brass Mfg. Co., Toronto.

OIL CUPS
Albany Lubricating Co., New York City.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

OILER, COMPOUND FEEDERS
Lunkenheimer Co., Cincinnati, O.

OILERS, GAUGE
Lunkenheimer Co., Cincinnati, O.

OILERS, MULTIPLE
Can. Detroit Lubricator Co., Walkerville, Ont.
Lunkenheimer Co., Cincinnati, O.

OIL FILTERS AND CIRCULATING SYSTEMS
Bowser & Co., Inc., S. F., Toronto, Ont.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
Jas. Morrison Brass Mfg. Co., Toronto.

OIL SEPARATORS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
Direct Separator Co., Syracuse, N.Y.
Elliott Co., Pittsburgh, Pa.
Leitch Co., Arthur S., Toronto, Ont.
Liberty Mfg. Co., Pittsburgh.
Jas. Morrison Brass Mfg. Co., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.

OILING SYSTEMS
Albany Lubricating Co., New York City.
Bowser & Co., Inc., S. F., Toronto, Ont.
Lunkenheimer Co., Cincinnati, O.

OILS, LUBRICATING
Albany Lubricating Co., New York City.
Can. Economic Lubricant Co., Montreal, Que.
Kellogg & Co., E. H., New York, N.Y.
Wm. C. Wilson & Co., Toronto.

PACKING, ASBESTOS
Johns-Pratt Co., The, Hartford, Conn.

PACKING ENGINE
Can. Asbestos Co., Montreal, Que.
Garlock Packing Co., Hamilton, Ont.
Johns-Pratt Co., The, Hartford, Conn.
Peerless Rubber Mfg. Co., New York, N.Y.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING FIBRE
Beveridge Paper Co., Ltd., Montreal, Que.
Can. B. K. Morton Co., Montreal, Que.
Johns-Pratt Co., The, Hartford, Conn.
Wm. C. Wilson & Co., Toronto.

PACKING, HYDRAULIC
Can. Asbestos Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Can. B. K. Morton Co., Toronto, Montreal.
Crane Packing Co., Chicago, Ill.
Durabla Manufacturing Co., New York.
Garlock Packing Co., Hamilton, Ont.
Goodyear Tire & Rubber Co., Toronto.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

Fearless and Entertaining

This is the most momentous time in history, and you want your reading to keep you abreast of what is happening in the world. You want articles that are timely, vital, fearless. Here's what is offered in June MACLEAN'S:

Must the British Empire Cease to Exist? Must all nations, as separate nations, cease to exist? Read what is said on this subject by - - - - - - - - - - **H. G. Wells**

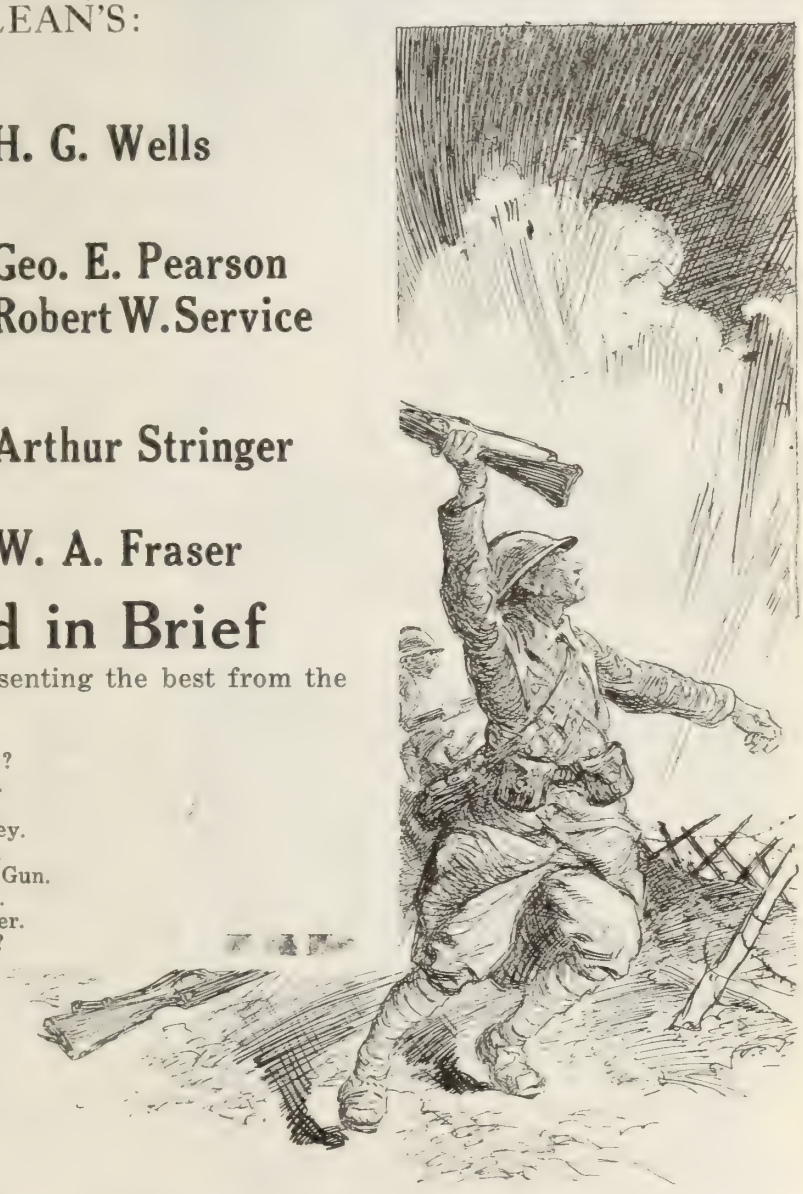
When a thousand guns play on a single trench, what happens in that trench? A powerful description by one who lived through it by - - - - - - - - - **Geo. E. Pearson**

A soul-stirring ballad of the trenches by **Robert W. Service**

Galvanizing the Government at Ottawa. An article on the work of the Ginger Group.

A gripping mystery story by - - - **Arthur Stringer**

The Three Sapphires—A new serial story combining Hindu mystery and war intrigue by a great Canadian novelist. **W. A. Fraser**



News of the World in Brief

The following articles are reprinted as representing the best from the best magazines the world over:

Is This Germany's Plan?
Is Japan Seeking a New Ally?
How Allied Victory Was Lost.
Is Foch Another Napoleon?
How Germany Annexed Turkey.
The Death of General Maude.
That Mysterious Long Range Gun.
How Bolo Pasha Was Caught.
The World is Growing Warmer.
Super-Kaiser or Little Willie?

JUNE MACLEAN'S

"Canada's National Magazine"

At All News Stands - 20c.

PACKING, METALLIC
Can. B. K. Morton Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Crane Packing Co., Chicago, Ill.
Greene, Tweed & Co., New York.
Holmes Metallic Packing Co., Wilkesbarre, Pa.
[illegible] & Peerless, Toronto.
Steel Mill Packing Co., Windsor, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, ROD
Can. Asbestos Co., Montreal, Que.
Can. B. K. Morton Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Crane Packing Co., Chicago, Ill.
Garlock Packing Co., Hamilton, Ont.
Canuck Supply Co., Ltd., Montreal, Que.
Steel Mill Packing Co., Windsor, Ont.
Peerless Rubber Mfg. Co., New York, N.Y.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, SHEET
Can. Asbestos Co., Montreal, Que.
Can. B. K. Morton Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Canuck Supply Co., Ltd., Montreal, Que.
Durabla Manufacturing Co., New York.
Garlock Packing Co., Hamilton, Ont.
Jenkins Bros., Ltd., Montreal.
Johns-Pratt Co., The, Hartford, Conn.
Peerless Rubber Mfg. Co., New York, N.Y.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, AMMONIA, STEAM AND WATER
Can. Asbestos Co., Montreal, Que.
Can. B. K. Morton Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Canuck Supply Co., Ltd., Montreal, Que.
Crane Packing Co., Chicago, Ill.
Garlock Packing Co., Hamilton, Ont.
Greene, Tweed & Co., New York.
Goodyear Tire & Rubber Co., Toronto.
Johns-Pratt Co., The, Hartford, Conn.
Steel Mill Packing Co., Windsor, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, LEATHER
Can. B. K. Morton Co., Toronto, Montreal.
Canuck Supply Co., Ltd., Montreal, Que.
Garlock Packing Co., Hamilton, Ont.
Graton & Knight Mfg. Co., Montreal.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING PISTON
Crane Packing Co., Chicago, Ill.

PACKING, VALVE STEM
Crane Packing Co., Chicago, Ill.
Johns-Pratt Co., The, Hartford, Conn.

PAINTS
Wm. C. Wilson & Co., Toronto.

PAINT, DAMP RESISTING
Toch Bros., Toronto, Ont.

PATTERNS
Victoria Foundry Co., Ottawa, Ont.

PENSTOCKS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.

PILLOW BLOCKS
Can. Bond Hanger & Coupling Co., Alexandria Ont.
Waterous Engine Works Co., Brantford.

PIPE COILS
Frick Co., Waynesboro, Pa.
York Mfg. Co., York, Pa.

PIPE COVERINGS, STEAM, BRINE, AMMONIA AND ICE WATER
Armstrong Cork & Insulation Co., Montreal, Que.

PIPE, CAST IRON
Wood & Co., R. D., Philadelphia, Pa.

PIPE STEEL
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

PIPE VISES AND CUTTERS
Armstrong Mfg. Co., Bridgeport, Conn.

PIPE, GAS
Can. Allis-Chalmers, Ltd., Toronto, Ont.

PIPES, WATER
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

PIPING AND FITTINGS
Frick Co., Waynesboro, Franklin Co., Pa.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
York Mfg. Co., York, Pa.

PIPING, STEAM
Babcock & Wilcox, Ltd., Montreal.

PLATE WORK
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd. St. Catharines, Ont.
Hamilton Co., Wm., Peterboro, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

PLUG COCKS
Homestead Valve Mfg. Co., Pittsburgh, Pa.

PLUMBING SUPPLIES
Mueller Mfg. Co., H., Sarnia, Ont.
Wm. C. Wilson & Co., Toronto.

POWER PUMPS
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
Waterous Engine Works Co., Brantford.
Garlock Packing Co., Hamilton, Ont.
Laurie & Lamb, Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.

POWER, TRANSMISSION MACHINERY
American Pulley Co., Philadelphia, Pa.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Goldie & McCulloch Co., Galt.
Hamilton Co., Wm., Peterboro, Ont.
Jeffrey Manufacturing Co., Montreal.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
MacGovern & Co., New York.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Morse Chain Co., Ithaca, N.Y.
Waterous Engine Works Co., Brantford.

PRESSES
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

PRESSURE, BLOWERS, CENTRIFUGAL
Can. Sirocco Co., Windsor, Ont.

PULLEYS
American Pulley Co., Philadelphia, Pa.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Wm. Hamilton Co., Ltd., Peterboro.
Jeffrey Manufacturing Co., Montreal.
Victoria Foundry Co., Ottawa, Ont.
Waterous Engine Works Co., Brantford.

PULP MILL MACHINERY
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Hamilton Co., Wm., Peterboro, Ont.
Jeffrey Manufacturing Co., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

PUMPING MACHINERY
American Steam Pump Co., Battle Creek, Mich.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Bawden Machine Co., Toronto.
Laurie & Lamb, Montreal.
McAvity & Sons, T., St. John, N.B.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.
Waterous Engine Works Co., Brantford.

PUMPING MACHINERY, ELECTRICAL
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Jeffrey Manufacturing Co., Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.

PUMPS, AIR
American Steam Pump Co., Battle Creek, Mich
Bawden Machine Co., Ltd., Toronto.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Montreal.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co. Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
Storey Pump & Equipment Co., Ltd., Toronto

PUMPS, ACID
Bawden Pump Co, Toronto.

PUMPS, CONTRACTORS'
Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
McAvity & Sons, T., St. John, N.B.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, ELECTRICAL
American Steam Pump Co., Battle Creek, Mich

PUMPS, FEED WATER
Can. Allis-Chalmers, Ltd., Toronto, Ont.

PUMP GOVERNORS AND REGULATORS
Bawden Machine Co., Ltd., Toronto.
Darling Bros., Montreal.
G. M. Davis Regulator Co., Chicago.
D'Este Co., Julian, Boston, Mass.
Elliott Co., Pittsburgh, Pa.
Mason Regulator Co., Boston, Mass.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.
Watson & McDaniel Co., Philadelphia.

PUMP STRAINERS
Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Darling Bros., Ltd., Montreal.
Liberty Mfg. Co., Pittsburgh, Pa.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, HAND AND POWER
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Darling Bros., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, BOILER FEED
Bawden Pump Co, Toronto.

PUMPS, CENTRIFUGAL
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Darling Bros., Montreal
Hamilton Co., Wm., Peterboro, Ont.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Pulsometer Engineering Co., Ltd., London, Eng.
Smart-Turner Machine Co., Hamilton, Ont
Storey Pump & Equipment Co., Ltd., Toronto
Sturtevant Co. of Canada, B. F., Galt, Ont.
Victoria Foundry Co., Ottawa, Ont.
Waterous Engine Works Co., Brantford.

PUMPS, DUPLEX
Can. Allis-Chalmers, Ltd., Toronto, Ont.

PUMPS, GEARED, COMPOUND
American Steam Pump Co., Battle Creek, Mich
Bawden Machine Co., Ltd., Toronto.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Montreal.
Inglis Co., The John, Toronto, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, ELECTRICAL
Bawden Pump Co, Toronto.

PUMPS, HYDRAULIC, PRESSURE
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Darling Bros., Montreal.
Inglis Co., The John, Toronto, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.

PUMP LEATHERS
Beveridge Paper Co., Ltd., Montreal, Que.
Can. B. K. Morton Co., Toronto, Montreal.
Graton & Knight Mfg. Co., Montreal.

PUMPS, OIL
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Ltd., Toronto.
Bowser & Co., Inc., S. F., Toronto, Ont.
Can. Detroit Lubricator Co., Walkerville, Ont.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, STEAM TURBO
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Darling Bros., Montreal.
Escher Wyss & Co., Montreal, Que.
Pulsometer Engineering Co., Ltd., London, Eng.

PUMP TANK, RECEIVER
American Steam Pump Co., Battle Creek, Mich.
Smart-Turner Machine Co., Hamilton, Ont.

PUMPS, STEAM
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Ltd., Toronto.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
Inglis Co., The John, Toronto, Ont.
Laurie & Lamb, Montreal.
Leitch Co., Arthur S., Toronto, Ont.
McAvity & Sons, T., St. John, N.B.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, TRIPLEX
Smart-Turner Machine Co., Hamilton, Ont.

PUMPS, VACUUM
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Ltd., Toronto.
Laurie & Lamb, Montreal.
Leitch Co., Arthur S., Toronto, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PYROMETERS
Foxboro Co., The, Foxboro, Mass.
Green's Economiser, Ltd., Toronto.
Jas. Morrison Brass Mfg. Co., Toronto.
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.

RADIATOR TRAPS
Sarco Co., Inc., New York, N.Y.

RADIATOR AIR VENTS
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

RAGS
Wm. C. Wilson & Co., Toronto.

REBOILERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

RECEIVERS, AIR
Can. Allis-Chalmers, Ltd., Toronto, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.

RECORDING INSTRUMENTS
Can. H. W. Johns-Manville Co., Toronto, Ont.
Foxboro Co., The, Foxboro, Mass.
Green's Economiser, Ltd., Toronto.
Precision Instrument Co., Detroit, Mich.
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.

REFRIGERATOR DOORS, WINDOWS, ETC.
Jamison Cold Storage Door Co., Hagerstown, Md.

REFRIGERATING MACHINERY
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Griscom-Russell Co., Ltd., Montreal.
Frick Co., Waynesboro, Franklin Co., Pa.
Linde Canadian Refrigeration Co., Montreal.
Vilter Mfg. Co., Milwaukee, Wis.
York Mfg. Co., York, Pa.

REFUSE DESTRUCTOR
Canadian Griscom-Russell Co., Ltd., Montreal.
Laurie & Lamb, Montreal.

REGULATORS, PRESSURE
Chaplin-Fulton Mfg. Co., Pittsburgh, Pa.
D'Este Co., Julian, Boston, Mass.
Jas. Morrison Brass Mfg. Co., Toronto.
Taylor Instrument Co., Rochester, N.Y.

REGULATORS, TEMPERATURE
Sarco Co., Inc., New York, N.Y.
Taylor Instrument Co., Rochester, N.Y.

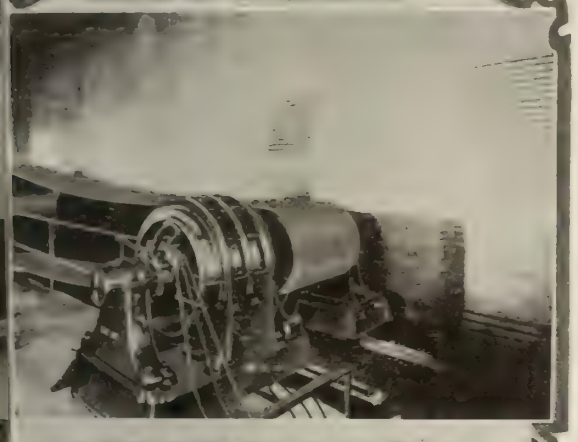
RETORTS
MacKinnon, Holmes & Co., Sherbrooke, Que.

REVOVLING DOORS FOR HARDENING ROOMS
Jamison Cold Storage Door Co., Hagerstown, Md.

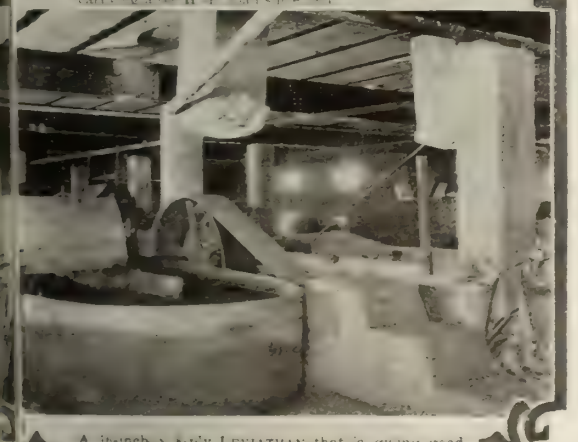
ROOFING
Wm. C. Wilson & Co., Toronto.

ROPE
Wm. C. Wilson & Co., Toronto.

A 24-inch x [illegible]-ply LEVIATHAN, transmitting [illegible] H.-P. [illegible] now in good condition.



A 75-foot x 48-inch x 10-ply LEVIATHAN, 500 H.-P., 3 phase, 60 cycle, 2,400 volts, 600 r.p.m.; has been carrying [illegible] H.-P. load since [illegible]



A 16-inch x 5-ply LEVIATHAN that is giving good service.

A 12-inch x 5-ply LEVIATHAN; motor drive; giving excellent service.

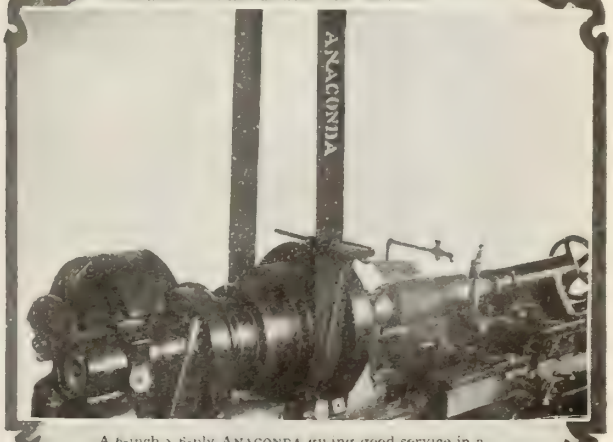
MAIN BELTING CO

of Canada Limited

St. Peter Street
MONTREAL

Toronto Winnipeg
Calgary Edmonton

An 825-foot x 36-inch x 6-ply ANACONDA, installed March 4th, 1912. Handles 1000 tons stone per day. Is as good condition as when first installed.



A 6-inch x 6-ply ANACONDA giving good service in a shell plant.

A 450-foot x 24-inch x 6-ply ANACONDA. Conveying Hot Crushed Rock from dryers in Cement Plant. Carries 2000 tons per day, 24 hours' constant work.

A 120-foot x 46-inch x 16-ply ANACONDA Bucket Elevator Belt. Handles 1750 tons crushed rock per day.

ROPE PRESERVATIVE
Cling Surface Co., Buffalo.
ROTARY CONVERTERS
Canadian Fairbanks-Morse Co., Montreal.
RUBBER HOSE
Can. H. W. Johns-Manville Co., Toronto, Ont.
Garlock Packing Co., Hamilton, Ont.
Liberty Mfg. Co., Pittsburg, Pa.
Thomson-Gordon, Ltd., Hamilton, Ont.
RUBBER MOLDS
Bawden Machine Co., Ltd., Toronto.
SAFES
Canadian Fairbanks-Morse Co., Montreal.
Goldie & McCulloch Co., Galt.
SCALE REMOVERS
Babcock & Wilcox, Ltd., Montreal.
Beveridge Paper Co., Ltd., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Roto Co., Hartford, Conn.
William B. Pierce Co., Buffalo, N.Y.
SEAM PROTECTORS, GIRTH
National Boiler Protector Co. of Canada, Montreal, Que.
SHAFTING
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Hamilton Co., Wm., Peterboro, Ont.
Waterous Engine Works Co., Brantford.
SHAKING AND DUMPING GRATES
Babcock & Wilcox, Ltd., Montreal.
Galt Foundry Co., Galt, Ont.
Waterous Engine Works Co., Brantford.
SMOKE BOXES, STACKS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Green's Economiser, Ltd., Toronto.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.
SMOOTH-ON
Wm. C. Wilson & Co., Toronto.
SPECIAL MACHINERY
Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Hamilton Co., Wm., Peterboro, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Waterous Engine Works Co., Brantford.
SPEED INDICATORS
Foxboro Co., The, Foxboro, Mass.
Schaeffer & Budenburg Mfg. Co., Brooklyn, N.Y.
L. S. Starrett Co., Athol, Mass.
SPLICE PROTECTORS
Jordan Bros., Inc., New York, N.Y.
SPROCKET CHAIN ATTACHMENTS
Waterous Engine Works Co., Brantford.
SPROCKET RIMS
Babbitt Steam Specialty Co., New Bedford, Mass.
SPUR WHEELS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Hamilton Co., Wm., Peterboro, Ont.
Waterous Engine Works Co., Brantford.
STACKS, STEEL
Babcock & Wilcox, Ltd., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
STAND PIPES, STEEL
MacKinnon, Holmes & Co., Sherbrooke, Que.
STAYBOLTS, FLEXIBLE
Can. Allis-Chalmers, Ltd., Toronto, Ont.
STEAM SEPARATORS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Darling Bros., Montreal.
Direct Separator Co., Syracuse, N.Y.
D'Este Co., Julian, Boston, Mass.
Ellison Co., Pittsburgh, Pa.
Leitch Co., Arthur S., Toronto, Ont.
Penberthy Injector Co., Windsor, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Watson & McDaniel Co., Philadelphia.
STEAM SPECIALTIES
Alberger Heater Co., Buffalo, N.Y.
Canadian Fairbanks-Morse Co., Montreal.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
D'Este Co., Julian, Boston, Mass.
Liberty Mfg. Co., Pittsburg, Pa.
Lunkenheimer Co., Cincinnati, O.
Mason Regulator & Engineering Co., Montreal.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor.
Watson & McDaniel Co., Philadelphia.
STEAM TRAPS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Anderson Co., Y. D., Cleveland, O.
Canadian Fairbanks-Morse Co., Montreal.
Can. Sirocco Co., Windsor, Ont.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
Davis Regulator Co., G. M., Chicago.
D'Este Co., Julian, Boston, Mass.
Dunham Co., Ltd., C. A., Toronto, Ont.
Elliott Co., Pittsburgh, Pa.
J. T. Long, 94 Adam St., Montreal, Que.
Can. Morehead Mfg. Co., Woodstock.
Mason Regulator & Engineering Co., Montreal.
Nashua Mach. Co., Boston, Mass.
Sarco Co., Inc., New York, N.Y.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Watson & McDaniel Co., Philadelphia.
STEEL BARRELS
Smart-Turner Machine Co., Hamilton, Ont.
STEEL DRUMS
Smart-Turner Machine Co., Hamilton, Ont.
STEEL TANKS
Babcock & Wilcox, Ltd., Montreal.
Hamilton Co., Wm., Peterboro, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works, Brantford, Ont.
STOKERS
Babcock & Wilcox, Ltd., Montreal.
Ed. Bennis & Co., Little Fulton, Bolton, Eng.
Detroit Stoker Co., Detroit, Mich.
Galt Foundry Co., Galt, Ont.
Green's Economiser, Ltd., Toronto.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Dertoit, Mich.
STRAINERS
Babcock & Wilcox, Ltd., Montreal.
Bawden Machine Co., Ltd., Toronto.
Elliott Co., Pittsburgh, Pa.
Self-Cleansing Strainer Co., Chicago.
STRUCTURAL STEEL WORK
Babcock & Wilcox, Ltd., Montreal.
Hamilton Co., Wm., Peterboro, Ont.
MacKinnon, Holmes & Co., Ltd., Sherbrooke, Que.
SUPERHEATERS, STEAM
Babcock & Wilcox, Ltd., Montreal.
Green's Economiser, Ltd., Toronto.
SWITCHBOARDS
Can. General Electric Co., Toronto, Ont.
SWITCHES AND SWITCH BOXES
Can. H. W. Johns-Manville Co., Toronto, Ont.
TACHOMETERS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Foxboro Co., The, Foxboro, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
TANKS, BLOW-OFF
Darling Bros., Montreal.
John McDougall Caledonian Iron Works, Montreal
Waterous Engine Works Co., Brantford.
TANKS, FREEZING, STORAGE AND WATER COOLING
Frick Co., Waynesboro, Franklin Co., Pa.
TANKS, OIL
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Bowser & Co., inc., S. F., Toronto, Ont.
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Hamilton Co., Wm., Peterboro, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.
TANKS, WATER
Inglis Co., The John, Toronto, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.
TAPPING MACHINES
Mueller Mfg. Co., H., Sarnia, Ont.
TECHNICAL BOOKS
MacLean Publishing Co., Toronto.
THERMOMETERS
Foxboro Co., The, Foxboro, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Milton & Prentiss, Toronto.
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.
THERMOSTATS
Sarco Co., Inc., New York, N.Y.
TIN
Dominion Metal Co., Sherbrooke, Que.
TOOLS
Mueller Mfg. Co., H., Sarnia, Ont.
TRANSFORMERS
Can. General Electric Co., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.
TRANSMISSION MACHINERY
American Pulley Co., Philadelphia, Pa.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Goldie & McCulloch Co., Galt, Ont.
Hamilton Co., Wm., Peterboro, Ont.
Jeffrey Manufacturing Co., Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Waterous Engine Works Co., Brantford.
TRAPS, STEAM AND WATER-LINE
D'Este Co., Julian, Boston, Mass.
TRUCKS, FACTORY
Beveridge Paper Co., Ltd., Montreal, Que.
Canadian Fairbanks-Morse Co., Montreal.
TUBE CLEANERS
Babcock & Wilcox, Ltd., Montreal.
Elliott Co., Pittsburgh, Pa.
Liberty Mfg. Co., Pittsburg, Pa.
Pilley Packing and Flue Brush Mfg. Co., St. Louis, Mo.
Roto Co., Hartford, Conn.
TUBE CUTTERS
Babcock & Wilcox, Ltd., Montreal.
Liberty Mfg. Co., Pittsburg, Pa.
TUBES, BOILER
Babcock & Wilcox, Ltd., Montreal.
TUBE EXPANDERS
Babcock & Wilcox, Ltd., Montreal.
Liberty Mfg. Co., Pittsburg, Pa.
TUBING, FELXIBLE METALLIC
Pennsylvania Flexible Metallic Tubing Co., Cleveland, O.
TUNGSTEN LAMPS
Bawden Machine Co., Toronto.
TURBINE OIL
Kellogg & Co., E. H., New York, N.Y.
TUNGSTEN LAMP (Vacuum and Gas Filled Types)
Penberthy Injector Co., Windsor, Ont.
Can. Laco-Phillips Co. of Toronto, Ont
TURBINE WATER WHEELS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Boving Co., Hamilton.
Engineering and Machine Works of Canada, Ltd. St. Catharines, Ont.
TURBINES, STEAM
Belliss & Morcom, Birmingham, Eng.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Coe Co., C. T., 10 Johnson St., Newark, N.J.
Coppus Engr. & Equip. Co., Worcester, Mass.
Escher Wyss & Co., Montreal, Que.
Green's Economiser, Ltd., Toronto.
Kerr Turbine Co., Wellsville, N.Y.
Laurie & Lamb, Montreal.
John McDougall Caledonian Iron Works, Montreal.
Sturtevant Co. of Canada, B. F., Galt, Ont.
UNIONS
Canadian Fairbanks-Morse Co., Montreal.
Dart Union Company, Toronto.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
UNIONS, BALL JOINT, COMBINATION, FLANGED PIPE, GROUND JOINT, MALLEABLE IRON, FLANGE, PIPE, SWING
Jefferson Union Co., Lexington, Mass.
Dart Union Company, Ltd., Toronto, Ont.
VACUUM GOVERNORS
Smart-Turner Machine Co., Ltd., Hamilton.
Canadian Steam Boiler Equipment Co., Toronto
G. M. Davis Regulator Co., Chicago.
Leitch Co., Arthur S., Toronto, Ont.
VACUUM REGULATING VALVES
Can. Steam Boiler Equipment Co., Toronto, Ont.
Darling Bros., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
VACUUM TRAPS
Can. Morehead Mfg. Co., Woodstock, Ont.
Can. Sirocco Co., Windsor, Ont.
Cole, Ltd., Geo. W., Toronto.
Nashua Mach. Co., Boston, Mass.
VALVE DISCS
Wm. C. Wilson & Co., Toronto.
VALVE LEATHER
Beveridge Paper Co., Ltd., Montreal, Que.
Can. B. K. Morton Co., Toronto, Montreal.
Graton & Knight Mfg. Co., Montreal.
VALVE RESEATING MACHINES
Darling Bros., Montreal.
VALVES
Babcock & Wilcox, Ltd., Montreal.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Canadian Fairbanks-Morse Co., Montreal.
Can. Steam Boiler Equipment Co., Toronto, Ont
Frick Co., Waynesboro, Franklin Co., Pa.
G. M. Davis Regulator Co., Chicago.
D'Este Co., Julian, Boston, Mass.
Homestead Valve Mfg. Co., Pittsburg.
Jenkins Bros., Montreal.
Kerr Engine Co., Walkerville, Ont.
Liberty Mfg. Co., Pittsburg, Pa.
Lunkenheimer Co., Cincinnati, O.
Mason Regulator & Engineering Co., Montreal.
Mason Regulator Co., Boston, Mass.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor.
Pratt & Cady, Hartford, Conn.
Victoria Foundry Co., Ottawa, Ont.
Watson & McDaniel Co., Philadelphia.
Wm. C. Wilson & Co., Toronto.
Wood & Co., R. D., Philadelphia, Pa.
York Manufacturing Co., Philadelphia.
VALVES, ACID RESISTING
Homestead Valve Mfg. Co., Pittsburg.
McAvity & Sons, T., St. John, N.B.
Victoria Foundry Co., Ottawa, Ont.
VALVES, BACK PRESSURE
Can. Allis-Chalmers, Ltd., Toronto, Ont.
VALVES, BLOW-OFF
Babcock & Wilcox, Ltd., Montreal.
Canadian Fairbanks-Morse Co., Montreal.
Elliott Co., Pittsburg, Pa.
Homestead Valve Mfg. Co., Pittsburg.
Jenkins Bros., Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Watson & McDaniel Co., Philadelphia.
Yarnall-Waring Co., Philadelphia, Pa
VALVE CHAIN WHEEL
Babbitt Steam Specialty Co., New Bedford, Mass
VALVES, FOOT
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Smart-Turner Machine Co., Ltd., Hamilton.
VALVES, GATE
Babcock & Wilcox, Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
VALES, HYDRAULIC
Yarnall-Waring Co., Philadelphia, Pa
VALVES, MULTIPORT
Can. Allis-Chalmers, Ltd., Toronto, Ont.
VALVES, NON-RETURN STOP
Canadian Fairbanks-Morse Co., Montreal.
VALVES, RELIEF
American Steam Gauge & Valve Mfg. Co., Boston Mass,
McAvity & Sons, T., St. John, N.B.

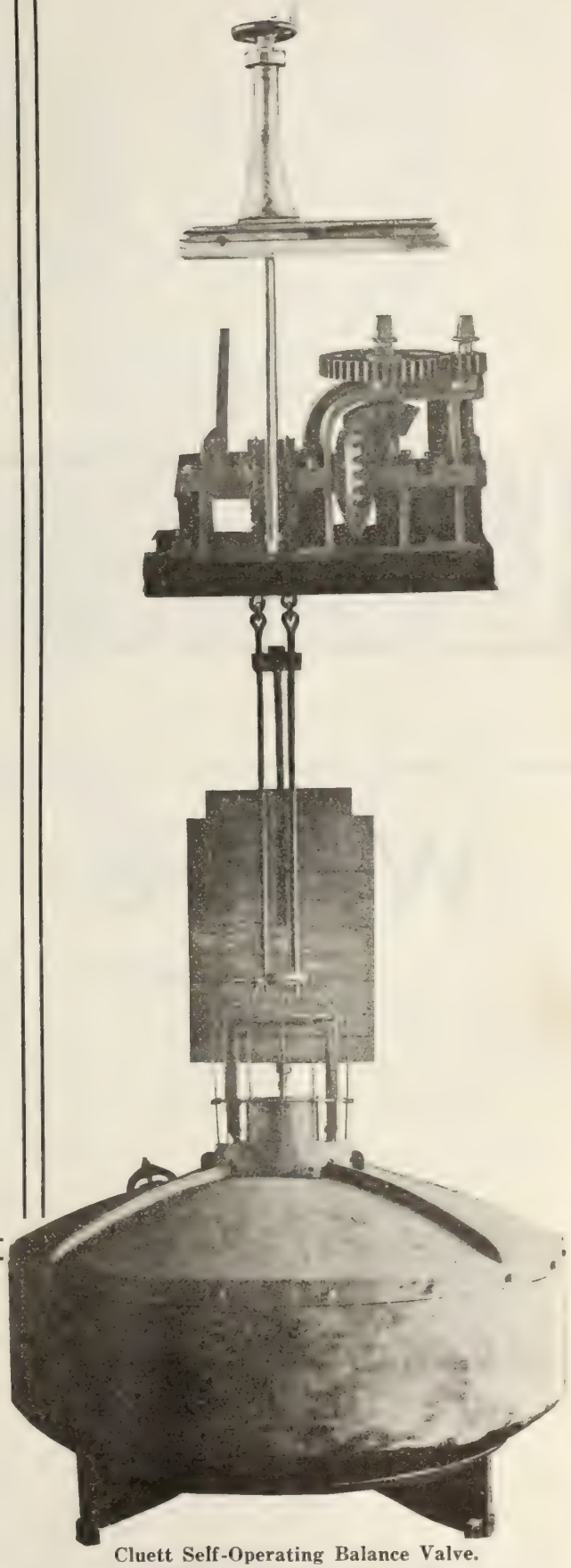
OUR Engineering Department is prepared to furnish estimates of all kinds of

Power Plant Equipment

and to furnish specifications on power plant construction —hydraulic, steam or air.

Cut shows a Cluett Self-Operating Balance Valve, four of which were installed by us at St. Andrews Rapids Locks, Winnipeg. **EIGHT TURNS OF THE 8-INCH HAND-WHEEL OPENS A 60-INCH VALVE.**

It will be to your interest to get in touch with us. We are always available for consultation.



Cluett Self-Operating Balance Valve.
Patent No. 107480, Sept., 1907.
Built by Victoria Foundry Co., Ltd.

The Victoria Foundry Co. Limited

OTTAWA, ONTARIO

VALVES, REDUCING
De Este Co., Julian, Boston, Mass.
Leitch Co., Arthur S., Toronto, Ont.
Liberty Mfg. Co., Pittsburg, Pa.
Mason Regulator Co., Boston, Mass.
Jas. Morrison Brass Mfg. Co., Toronto.
Mueller Mfg. Co., H., Sarnia, Ont.
Watson & McDaniel Co., Philadelphia.

VALVES, RADIATOR
Jenkins Bros., Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.

VALVES, POP
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.

VALVES, PUMP
Beveridge Paper Co., Ltd., Montreal, Que.
Canadian Fairbanks-Morse Co., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

VALVES, SAFETY THROTTLE
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Detroit Lubricator Co., Walkerville, Ont.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.

VALVES, VACUUM
Sarco Co., Inc., New York, N.Y.

VAULTS AND VAULT DOORS
Canadian Fairbanks-Morse Co., Montreal.
Goldie & McCulloch Co., Galt.

VENTILATING APPARATUS
Sturtevant Co. of Canada, B. F., Galt, Ont.

VOLTMETERS
Can. H. W. Johns-Manville Co., Toronto, Ont.

WASHERS, FIBRE
Beveridge Paper Co., Ltd., Montreal, Que.

WASHERS, LEATHER
Graton & Knight Mfg. Co., Montreal.

WASTE
Wm. C. Wilson & Co., Toronto.
Can. Steam Boiler Equipment Co., Toronto, Ont.

WATER COLUMNS, GAUGES
Babcock & Wilcox, Ltd., Montreal.
Elliott Co., Pittsburg, Pa.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.
W. J. Wall, Montreal.

WATER HOSE
Can. H. W. Johns-Manville Co., Toronto, Ont.
Liberty Mfg. Co., Pittsburg, Pa.
Pennsylvania Flexible Metallic Tubing Co., Cleveland, O.

WATER LIFTERS
Watson & McDaniel Co., Philadelphia.

WATER MOTORS
Elliott Co., Pittsburg, Pa.

WATER PURIFIERS, SOFTENERS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Laurie & Lamb, Montreal.
Scaife & Sons, Wm. B., Pittsburgh, Pa.

WATER SUPPLY SYSTEMS
Mueller Mfg. Co., H., Sarnia, Ont.

WATER WHEELS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Escher Wyss & Co., Montreal, Que.
MacKinnon, Holmes & Co., Sherbrooke, Que.
John McDougall Caledonian Iron Works, Montreal

WATERWORKS SUPPLIES
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
McAvity & Sons, T., St. John, N.B.

WATTMETERS
Can. H. W. Johns-Manville Co., Toronto, Ont.

WHISTLES, PLAIN OR CHIME
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.

WIRE BRUSHES
Pilley Packing and Flue Brush Mfg. Co., St. Louis, Mo.
Penberthy Injector Co., Windsor, Ont.

WRENCHES
Greene, Tweed & Co., New York.
Trimont Mfg. Co., Roxbury, Mass.
Williams & Co., J. W., Brooklyn, N.Y.

WATER SCAIFE AND WE-FU-GO
PURIFICATION SYSTEMS
SOFTENING & FILTRATION
FOR BOILER FEED AND ALL INDUSTRIAL USES
WM. B. SCAIFE & SONS CO. PITTSBURGH, PA.

Wanted—

Engineers to Contribute to Power House

THIS is a practical paper for practical engineers. It is an educational medium and out to help its readers. It is a technical school and a social meeting place combined. It is first, last and all the time an engineer's paper.

If you should meet two or three or a dozen of your brother engineers you would swap ideas—you'd tell of some idea you had worked out in your plant. Others would describe some pet schemes they had devised. And so you would be mutually benefited.

Why not make Power House your monthly meeting place? Why not describe in this paper some kink or scheme you have worked out and found successful? We will pay you for it and you, in turn, will be multiplying the usefulness of your idea five thousand fold!

Never mind polishing up your letters—just give us the idea; that's the main thing. Never mind how crude your pencil sketch may be. We have draughtsmen who will finish up your drawings so they may be reproduced.

Try this idea a time or two and see how much satisfaction you'll get out of it. Start the ball a-rolling and thus help other engineers, yourself and your paper.

POWER HOUSE, 143-153 University Avenue, Toronto, Ont.

Don't buy that New Electrical Apparatus Just Yet

WE can supply you with high-grade apparatus that has been slightly used and discarded through no fault of its own, at an immense saving in cost. For instance, in many cases we take over entire plants simply because of changed conditions such as increased capacity, change of system, etc.

EVERYTHING IS OVERHAULED AND REFINISHED BY US AND **GUARANTEED** AS GOOD AS NEW, BOTH ELECTRICALLY AND MECHANICALLY.

Our catalogs of offerings should be in the hands of every power plant superintendent each time they are gotten out, and it will be worth while for anyone interested in this class of power plant equipment to be on our mailing list to receive all offerings.

Nearly all of the principal power, lighting and street railway plants in the United States are our customers.

WRITE FOR OUR LATEST CATALOG of **Power House Equipment, Street Cars, Motors, Hoists, Compressors, etc.**

MACGOVERN & COMPANY, Inc.

114 Liberty St., New York City

BOILER INSPECTION

The Steam Boiler Act, Chapter 252 R.S.O., 1914 With Amendments Chapter 58—6, George V.

STEAM BOILERS.

All Steam boilers constructed for use in Ontario must be built from designs which have been approved and allotted a registration number by the Steam Boiler Branch.

Used boilers, boilers sold or exchanged, and unregistered boilers brought into the Province must be inspected prior to being put into operation.

Notice of repairs to steam boilers, stating the nature and extent of same, must be sent to the Steam Boiler Branch, and should such repairs be considered extensive by the Chief Boiler Inspector, the boilers will require to be inspected.

In each and every case the inspections must be made by Inspectors authorized to inspect boilers under the Steam Boilers Act, who are employed only by the Steam Boiler Branch of the Department of Public Works. Official certificates with the maximum working pressure stated thereon are issued to the owners of the boilers so inspected.

STEAM PIPING.

Drawings and Specifications of all high pressure steam piping must be approved and registered by the Steam Boiler Branch before any work of installation is commenced. The drawings submitted should show clearly the dimensions and layout of the main steam lines. Full particulars should be given as to the material used in the construction of the piping, and all valves and other fittings used in connection therewith must be of approved make.

Any deviation from the above requirements shall be deemed a violation of the Steam Boilers Act.

All communications in this respect should be addressed to the Steam Boiler Branch, Department of Public Works, Parliament Buildings, Toronto.

HON. F. G MACDIARMID, Minister of Public Works and Highways

W. A. RIDDELL, M.A. Ph.D., Supt. Trades & Labour Branch

D. M. MEDCALF,
Chief Inspector of Steam Boilers.

Add 10 Feet to the Length of Your Arm

There are two ways to close an overhead valve—either carry a ladder to it—or else give a slight pull on the operating chain of a

Babbitt
—Adjustable—
SPROCKET RIM

The Babbitt Rim is attached to the valve wheel by three hook bolts. It takes only 5 minutes and a wrench to do the job.

Why not try one? Or send for Descriptive Pamphlet.

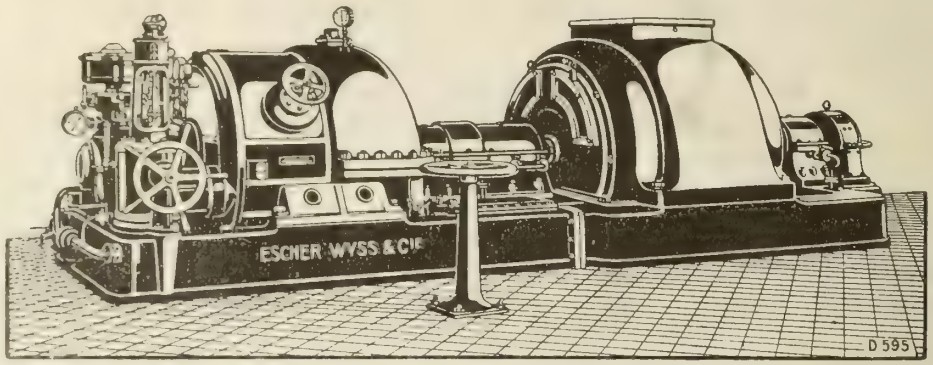
Babbitt Steam Specialty Co.
NEW BEDFORD, MASS. 93-7

Manufactured in Canada, under Canadian Patents, exclusively by the Engineering Specialties Company, Limited, 1080 King St. West, Toronto, Ont.

Escher Wyss & Co., S.A. ZURICH (Switzerland)

Montreal Office: 211 Coristine Building

Zoelly-Steam Turbines



Zoelly-Rotary-Compressors

15/18

ADVERTISING INDEX

A

Albany Lubricating Co. 118
Alberger Heater Co..... 102
American Steam Gauge & Valve Mfg. Co. 100
American Steam Pump Co..... 22
Anderson Co., V. D. 30
Armstrong Cork & Insulation Co. 36

B

Babbitt Steam Specialty Co.... 135
Babcock & Wilcox 124
Bawden Pump Co. 24, 25
Beveridge Paper Co. 10
Boiler Inspection Dept. 135
Boving Hydraulic & Eng. Co... 122
Bowser, S. F., & Co., Inc..... 10

C

Can. Allis-Chalmers Co..... 31
Can. Assoc. Stationary Engrs... 32
Can. Bond Hanger & Coupling Co. 118
Can. Detroit Lubricator Co.... 12
Can. Fairbanks-Morse Co. 97
Can. General Electric Co..... 31
Can. H. W. Johns-Manville Co. 23
Can. Morehead Mfg. Co..... 110
Can. S K F Co..... 103
Can. Steam Boiler Equipment Co. 19
Canuck Supply Co., Ltd..... 106
Chaplin-Fulton Mfg. Co..... 108
Chapman Double Ball Bearing Co. 29
Cling-Surface Co. 116
Cole Ltd., Geo. W. 105
Coppus Engr. & Equip. Co.....8, 9
Coventry Chain Co. 116
Crane Packing Co. 117

D

Darling Bros. 12
Dart Union Co. 20
Davis Regulator Co 95
[illegible] ..... [illegible]
Dixon Crucible Co., Jos. 109
Dominion Belting Co..... 120
Dominion Coal Co..... 122
Dominion Metal Co. 118
Dunham & Co., C. A. 27
Durabla Mfg. Co..... 100

E

Economy Fuse & Mfg. Co. of Canada 127
Elliott Co. 89
Engineering & Mach. Works of Canada, Ltd. 4
Escher Wyss & Co..... 136

F

Federal Engineering Co. 127
Francis & Co., Walter J. 92
Frick Co. 34

G

Galt Foundry Co. 15
Garlock Packing Co..... 11
Garth Co. 122
Gates, John W. 14
Goldie & McCulloch Co..... 40
Goodyear Tire & Rubber Co... 115
Graton & Knight Mfg. Co.... 99
Greene, Tweed & Co..... 101
Green's Economiser Co..... 107

H

Hamilton Co., Wm. 22
Holmes Metallic Packing Co.... 122
Homestead Valve Mfg. Co..... 114
Hoyt Metal Co. 5

I

Inglis Co., John...Inside back cover

J

Jamison Cold Storage Door Co. 123
Jefferson Union Co. 111
Jeffrey Mfg. Co. 119
Jenkins Bros. 113
Johns-Pratt Co., The 21
Jones Underfeed Stoker Co..... 13
Jordan Bros., Inc..... 30

K

Kellogg & Co., E. H. 109
Kerr Engine Co. 114

L

Ladd Co., The Geo. T..... 123
Lancashire Dynamo & Motor Co. 1
Laurie & Lamb 37
Leitch Co., The Arthur S..... 26
Leonard & Sons, E. 109
Lewis Bros., Ltd. 36
Liberty Mfg. Co. 89
Linde Canadian Refrigeration Works Co. 33
Lunkenheimer Co. 112

M

MacGovern & Co. 135
MacKinnon, Holmes & Co..... 92
MacLean's Magazine 129
Magnolia Metal Co..... 120
Main Belting Co. 131
Mason Regulator Co. 4
Mason Regulator & Engr. Co..6, 7
McAvity & Sons, T. 112
McDougall Caledonian Iron Wks. Co. 38
McGhie, W. C. 122
McLaren Ltd., D. K. 17
Metlskin Co., Inc. 98
Milton & Prentiss 16
Morrison Brass Mfg. Co., Jas. Outside back cover
Morse Chain Co. 121
Mueller Mfg. Co. 18
Murphy Iron Works 95

N

National Boiler Seam Protector Co. 122
Northern Equipment Co. 93

O

Ogilvie Flour Mills Co. 94

P

Penberthy Injector Co..Front cover
Pennsylvania Flexible Metallic Tubing Co. 98
Pilley Packing & Flue Brush Mfg. Co. 123
Power Plant Equipment Co..... 127
Pratt & Cady Co., Inc..... 100

R

Roto Co. 28

S

Sarco Co., Inc. 94
Scaife & Sons Co., Wm. B..... 134
Schaffer & Budenberg Mfg. Co. 4
Shell-Bar, Boico Supply, Ltd. .. 16
Smart-Turner Mach. Co..... 123
Starrett, L. S., Co. 16
Steel Mill Packing Co. 123

T

Taylor Instrument Co. 76
Thomson-Gordon, Ltd. 117
Trimont Manufacturing Co. 30

U

Uehling Instrument Co. 26
United States Rubber Co..... Inside front cover

V

Victoria Foundry Co. 133
Vilter Mfg. Co. 35

W

Wall, W. J. 92
Waterous Engine Works Co....2, 3
Watson & McDaniel Co..... 122
Wenting, J. H. 123
Williams & Co., J. H..... 117
Wilson & Co., Wm. C. 109
Wilt Twist Drill Co..... 91
Wood & Co., R. D. 92

Y

Yarnall-Waring Co. 108
York Mfg. Co..... 84

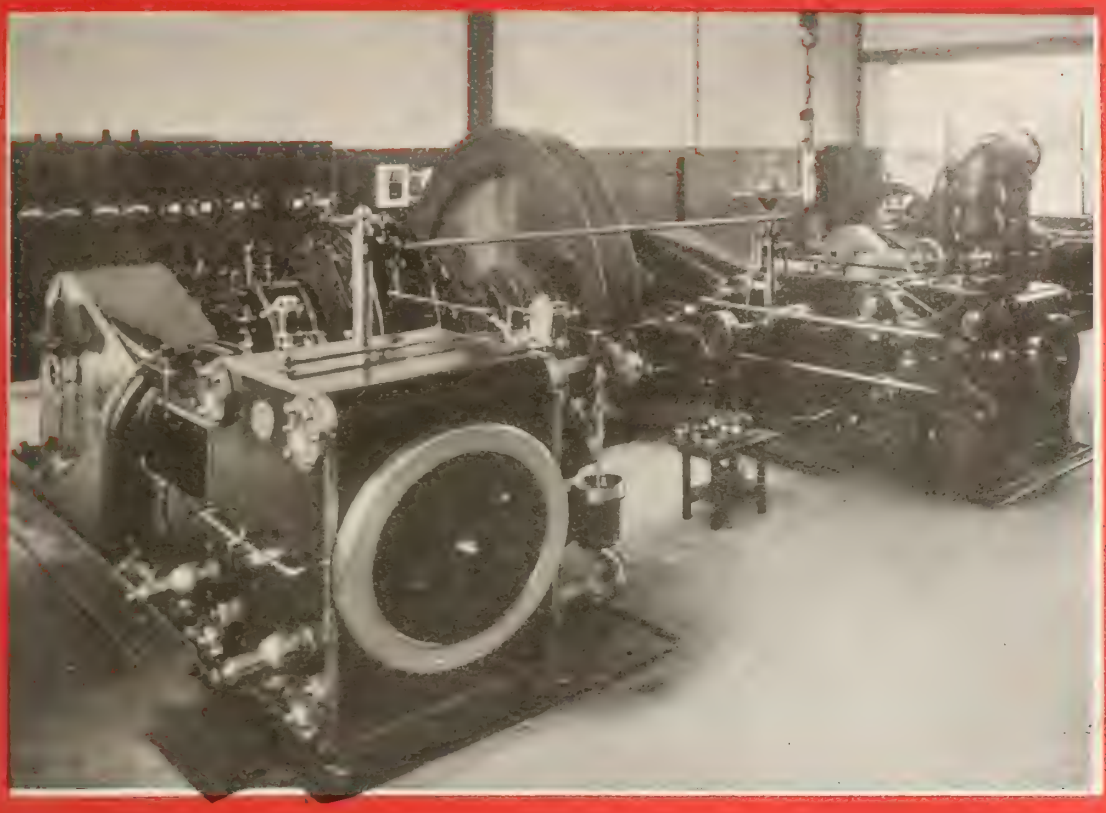


Illustration shows an Inglis Horizontal Cross Compound Heavy Duty Corliss Engine recently installed in the new plant of the Canadian Kodak Company Mount Dennis (near Toronto), Ont.

Cylinders are 18 in. and 30 in. by 30 in. stroke, running at 150 r.p.m. Direct connected to a 300 k.w. Canadian Westinghouse 3-wire, 125-250 volt, d.c. compound wound computing pole type generator.

Engine operates on a steam pressure of 150 pounds, with 5 pounds back pressure. Valve Gear is operated by double wrist plates set for long range cut-off, the governor controlling both high and low pressure cylinders. Flywheel is 11 ft. in diameter and weighs 22,000 pounds.

CANADA'S MOST PROMINENT INDUSTRIAL CONCERNS HAVE SHOWN A PREFERENCE FOR INGLIS ENGINES.

Put your Engine problems in our hands—tell us of your special requirements and Inglis Experts will go into details immediately with you, without charge, and without placing you under any obligation to us whatever.

The John Inglis Company
Limited
ENGINEERS AND BOILER MAKERS
14 Strachan Ave. Toronto, Ont.

INGLIS Engines

Morrison's
STEAM GOODS
and Specialties

Morrison's quality is what quality should be from the user's standpoint. It represents skill and knowledge of the highest order drawn from forty years' varied experience.

Morrison's Steam Goods and Specialties are approved by the Provincial Boiler Inspection Departments.

SOME OF OUR LINES

Stop Valves	Steam Gauges
Check Valves	Vacuum Gauges
Gate Valves	Ammonia Gauges
Safety Valves	General Boiler Mountings
Relief Valves	Gauge Board Outfits
Reducing Valves	Lubricators
Steam Traps	Pipe Fittings
Injectors	Steam Whistles
Ejectors	Engine Indicators
Inspirators	Pipes, Tools, etc.
Jet Pumps	

Do not hesitate to write us for full information on any lines or line in which you are interested.

The James Morrison Brass Mfg. Co., Ltd.

93-97 Adelaide Street, W.
TORONTO

POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power; and to the operation of Refrigerating Machinery.

Published by The MacLean Publishing Company, Limited, 143-153 University Ave., Toronto

MONTREAL: Southam Bldg. LONDON, ENG.: 88 Fleet St., E.C. WINNIPEG: 1207 Union Trust Bldg

Vol. XI—No. 7 Publication Office, Toronto—July, 1918 Published Monthly $1.00 per Year.

"The Gate That's Up-to-Date"

TRADE PENBERTHY

Brass Gate Valves

APPROVED AND REGISTERED

Some Excellent Features:

Outside Bonnet Construction (Strong where others are weak)

Solid Wedge Disc

Non-Rising Spindle

Packing Gland with Follower

Best Quality Steam Metal

No Other Gate Valve

on the market is as pleasing in design, perfect in workmanship, or as satisfactory in service, and the ripe experience of over a quarter of a century in the manufacture of high-grade brass goods is a guarantee that Penberthy Gate Valves will give you real lasting service. Get the genuine and look for our trade mark when you buy Valves.

Stocked by Leading Jobbers.

Penberthy Injector Company, Limited, Windsor, Ont.

Unequaled Service Through Co-operative Distribution

One of the principal objects accomplished by the new method of marketing our mechanical goods is the increased co-operation that has been made possible with dealers and jobbers.

The well-known brands of our subsidiary companies—

Revere Rubber Co.
Peerless Rubber Mfg. Co.
Mechanical Rubber Co., Cleveland.
Mechanical Rubber Co., Chicago.
Sawyer Belting Co.
India Rubber Co.
Eureka Fire Hose Mfg. Co.

are now marketed through ONE strong sales organization—
UNITED STATES RUBBER COMPANY, MECHANICAL GOODS DIVISION

We are now able to offer dealers and jobbers a stronger and more complete line of mechanical goods than ever before offered by any rubber company.

We deeply appreciate the great service rendered by dealers and jobbers to consumers. We feel that in making it possible for consumers to purchase their favorite brands of packing, belting and hose through their own dealer and jobber, we are assisting the consumer as well as the dealer and jobber. Dealers and jobbers everywhere now have an unexampled opportunity to promote the interests of their customers as well as themselves, by taking advantage of the attractive proposition presented in the wide variety of well-known brands assembled in the United States line of mechanical rubber goods. We wish and intend to do everything to extend the numbers of dealers and jobbers, as we realize that this means greater service to consumers.

Dealers and jobbers are enthusiastically co-operating in the new plan, and as merchants they have been quick to grasp the strength of this complete line of mechanical rubber goods, embracing such famous brands as

Rainbow Packing
Honest John Packing
Peerless Spiral Packing
Rainbow Belting
Eureka Fire Hose
Giant Steam Hose
Relio Conveyor Belt
Holdtite Friction Tape
Rainbesto Packing
Buckeye Splicing Tape
Four-Ace Seamless Belting
Paragon Fire Hose
Anaconda Tender Hose
Peerless Air Hose
Kold-Pak Jar Rubbers
Revere Garden Hose
Spring Step Heels
Giant Seamless Belting
Giant Suction Hose
Usudurian Packing

all bearing, in addition to their own well-known trade-mark, the great seal signifying service and quality of the largest rubber manufacturer in the world.

United States Rubber Co.

Mechanical Goods Division

NEW YORK

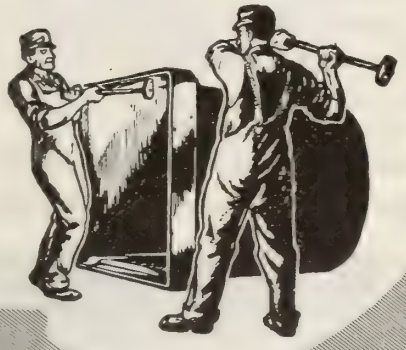
WATEROUS TANKS

WE build Steel Tanks in any size for every use. A separate department of our enlarged Boiler Shop is devoted entirely to this work. Special care is taken to see that every job that goes through is turned out right.

Send us sketches and let us quote you on :

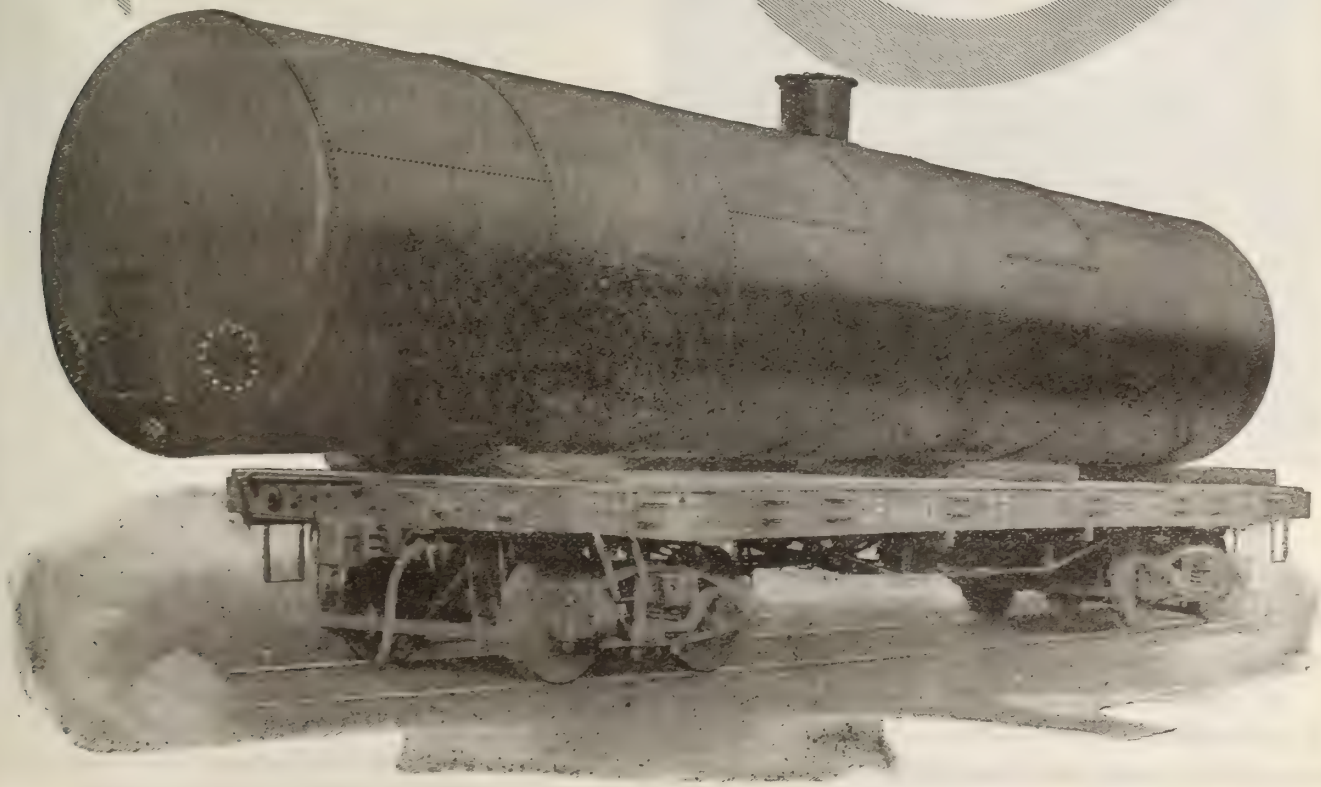
Pressure Tanks	*Steel Reservoirs*	*Storage Bins*	*Gas Tanks*
Washing Tanks	*Steel Retorts*	*Air Tanks*	*Settling Tanks*

Remember, we build Steel Plate Work of all kinds—turned out right, at a reasonable price. Our workmanship is guaranteed.



The Waterous Engine Works Company, Ltd.

BRANTFORD - CANADA



Be Fair to Your Engineer—and *Good* to the Bearings in Your Plant

Supply HOYT METALS

For Hoyt Metals will make the work of your engineer easier, because bearings properly babbitted with Hoyt Metals will not need re-babbitting nearly as soon as bearings babbitted with common alloys. That is readily understood if you consider that more than a theoretically correct formula is essential to the making of a perfect babbitt. There must be long experience in the actual mixing of alloys and a very intimate knowledge of the various services required of a Babbitt.

Hoyt Metal Company

Eastern Avenue and Lewis Street
Toronto, Canada

London, Eng., New York, U.S.A.
St. Louis, Mo., U.S.A.

FROST KING

Hoyt's famous general purpose babbitting metal has been introduced into the most particular power plants in the world, and is there to stay. Represents the accumulated experience of 40 years. A trial will prove its value in your plant.

NICKEL GENUINE

Is designed especially for use in gas engines, gasoline engines, and all classes of marine engines, and is especially adapted for automobiles. For heavy duty, high speed work, is probably as perfect as an alloy can be made.

View Showing Interior of Boiler Department.

Stationary Boilers

Horizontal Tubular
Vertical Tubular
Locomotive Types

To conform with various Provincial codes.

Catalogs gladly furnished to members of the C.A.S.E.

Kindly address nearest office

Engineering & Machine Works of Canada, Limited

Formerly
St. Catharines Works of
The Jenckes Machine Co., Ltd.

Head Office and Works
St. Catharines, Ont.

Sales Offices
710 C.P.R. Building, Toronto
344 St. James Street, Montreal
Hall Machinery Co., Sherbrooke, Que.

Murphy AUTOMATIC Furnace

Murphy Stokers

A few longtime constant users, and there are others!

Lockport Paper Co.,	Lockport, N.Y.	33 years constant use
Hartje Paper Co.,	Steubenville, Ohio	24 years constant use
Sherwin-Williams Co. 12 contracts 20 Stokers	Montreal, P.Q. Cleveland, Ohio Kensington, Ill.	16 years constant use
Laurentide Co., Ltd.,	Grand Mere, P.Q.	13 years constant use
Ford Motor Co.,	Detroit, Mich.	
" " "	Des Moines, Iowa	18 years constant use
" " "	New York, N.Y.	
Ohio Traction Co., 16 Repeat Orders	Cincinnati, Ohio	28 years constant use
		74 Murphy Stokers

For printed matter address

MURPHY IRON WORKS

DETROIT, MICH. BUFFALO, N.Y.

Boiler Scale Costs More than Boico

Think of all you pay for it—Boiler scale. In the course of a year you pay tons of coal, and all the time it acts as a check to power efficiency. Like corroding rust, it slowly but nevertheless surely shortens the life of your boiler.

The cost of Boico is trivial compared with all you pay for scale. For Boico positively removes boiler scale and absolutely prevents further formation. It saves fuel, oil and packing. It will not carry over in the steam; it will not cause foaming or priming, and it is guaranteed not to injure packing or valves in the slightest. **Write for free trial.**

Anti-Clinker Shell Bar Grates

insure more heat from much less coal. Built on a scientific air-draft principle, fully 50% of the total surface air space, they provide ample air to command perfect combustion, adding as much as 25% more heat to the fuel gases and so preventing clinker formation. Moreover, Anti-Clinker Shell Bar Grates cannot twist or warp, and they're easily cleaned.

Copper Asbestos Boiler Gaskets

are made of copper, with pure asbestos cord-filled corrugations. They put a stop to leaks in pipe lines, for they never blow-out and never stick.

Tip-It Patent Welding Process

gives you tools whose shanks are carbon and whose cutting tips are high-speed steel. A money-saver!

Get in touch with us to-day!

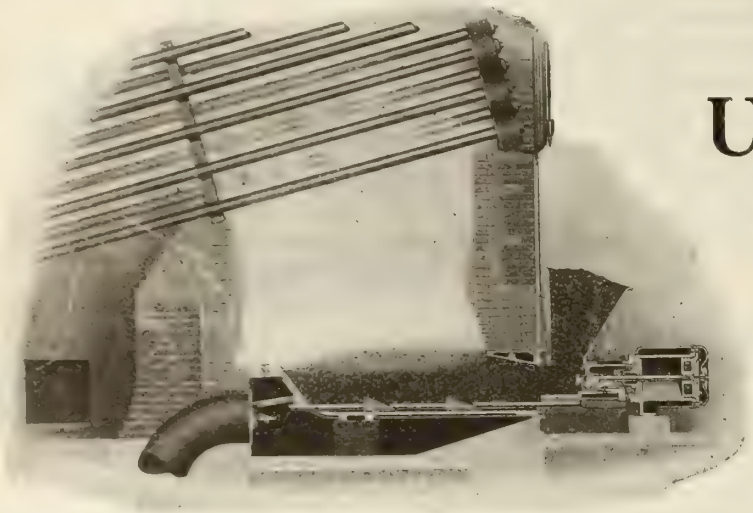
Shell-Bar Boico Supply, Limited

376 Dufferin St., Toronto, Canada

Gives You a Fuel Saving of 15 to 25% and a Smokeless Stack

It gives you a steady steam pressure regardless of fluctuating loads, and scientifically gets all the energy out of coal by perfect automatic control of fuel and draught.

The Jones Underfeed Automatic Stoker hasn't a working part that moves in contact with the fire. It is the simplest stoker built—no grates to lose fuel through—no complicated mechanism.



JONES UNDERFEED STOKER

is the fuel saver needed in your plant. **Let us put you in touch with a number of users.**

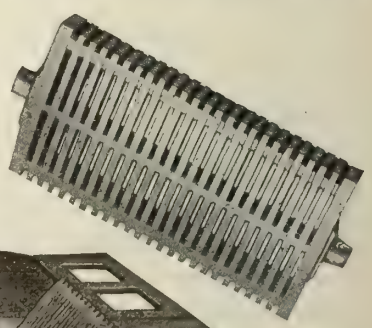
Jones Underfeed Stoker
Company, Limited
37-41 Britain St. - TORONTO

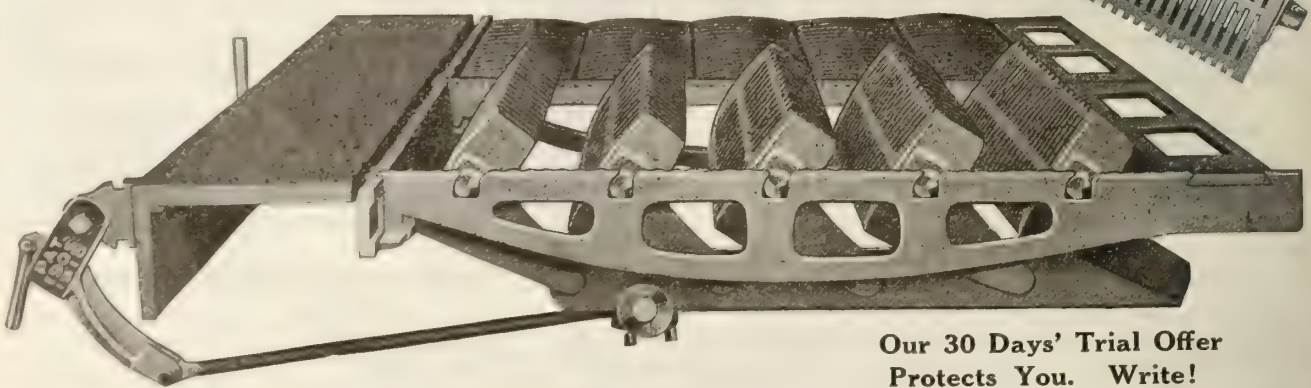
Cyclone SHAKING and DUMPING Grates

Should be under your boilers, because Cyclone Grates get the most out of screenings, hard coal or soft coal of cheapest grades.

No Clinkers and No Waste as a Result of 60% Air Space and 90% Underdraught.

Let us fully explain the jarring, shaking movement of Cyclone Grates, which cleans the ashes off the centre of the bars without letting good fuel drop into the ash pit.





Our 30 Days' Trial Offer Protects You. Write!

AGENTS

The Canadian Steam Boiler Equipment Co., Ltd.
Sole Makers for Canada
20 McGee Street Phone G. 3660 Toronto, Ontario

Problem for Canadian Power Plants!

Present indications are that fuel shortage will constitute an exceedingly serious problem for Canadian power plants throughout the duration of the war.

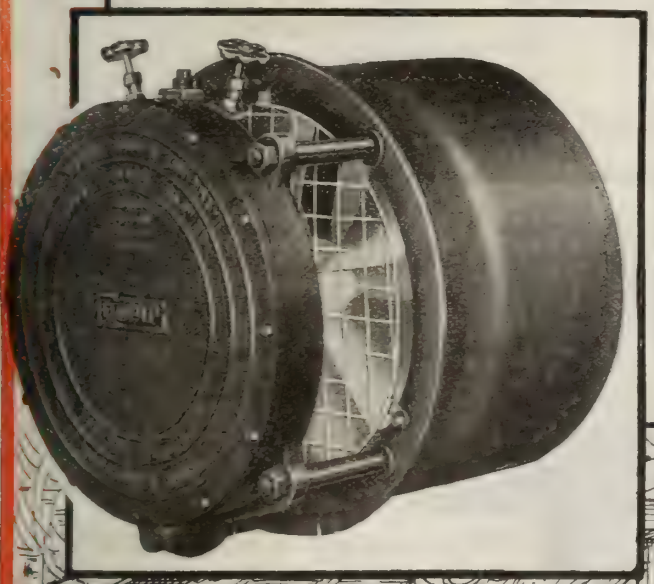
You owe it to your country and you owe it to your own business interests to give this problem your most serious attention. And the time to take action is NOW.

Back up the Fuel Controller in his efforts to ward off a crisis and at the same time save money for yourself by installing

COPPUS Turbo Blowers

Fill the Bill in an Emergency

Overseas shipping and railroads demand the best grade of bituminous coal. They must be supplied equal to their requirements. You may have to burn a low grade of coal as a consequence. But this will not cause you any concern if you have installed **Coppus Turbo Blowers.** They enable power plants to make steam with anything in the form of coal—even what looks like black dirt—and at the same time greatly increase boiler capacity. Because they make combustion conditions instantly adjustable to the coal, no matter what the grade—because the draft is always under CONSTANT CONTROL. Scientifically correct design; simplicity, ruggedness, power and low steam consumption make COPPUS TURBO BLOWERS constant dividend payers under normal conditions as well as indispensable in emergencies. **Write us and let us show you how easily you can cope with the fuel problem which is bound to confront you for one, two or three years to come. The fact that we are equipping on an average 100,000 B.H.P. per month with Coppus Turbo Blowers is ample proof of our ability to serve you.**



Coppus Engineering & Equipment Co.
351 Park Ave. Worcester, Mass.

CANADIAN AGENTS.—Montreal, Mason Regulator & Engineering Co., 135 Dagenais Street. Toronto, The Arthur S. Leitch Co., 506 Kent Bldg. Winnipeg, Wm. Carter, 817 Union Bank Bldg.

Having Commutator Troubles?

The Jordan Commutator Truing Device will true your commutators without a shut-down.

Jordan Bros., Inc.

82 Beekman St. New York City, N.Y.

Canadian Representative :

CANADA SALES CO., 183 Church Street, Toronto, Canada

MASON

Reducing Valves

Pump Regulator
Balanced Valves
Damper Regulators

If you order a Mason you will get absolute satisfaction. This we guarantee you. You simply cannot make a mistake.

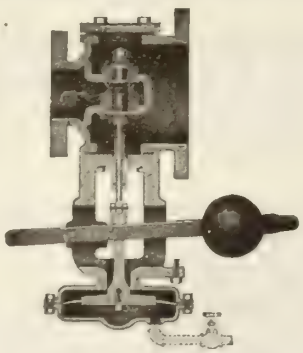
Dependable regulation under every possible condition.

Our complete catalog tells you WHY. Let us mail you a copy.

Mason Regulator Company

BOSTON, MASS.

TORONTO REPRESENTATIVES:
The Arthur S. Leitch Co.,
506 Kent Bldg., Toronto.



Kieley & Mueller Specialties

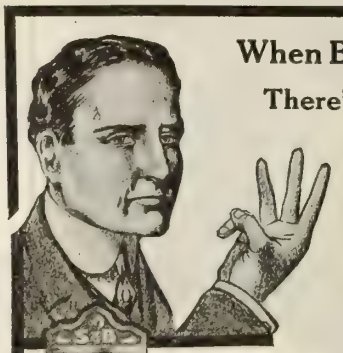
Regulating Valves
Back Pressure Valves
Pump Governors
Separators
Traps

FOR EVERY SERVICE

SALES ENGINEERS

THE ARTHUR S. LEITCH CO.

TORONTO



When Buying Thermometers

There's Just Three Things to Remember—

First, you must have accuracy and sensitiveness—

Second, durability is absolutely essential—

Third, the thermometer must be suitably constructed for the intended application.

Accuracy, sensitiveness and durability are absolutely guaranteed in

"Crescent" Thermometers

And with nearly seventy years of experience to our credit, we are qualified to properly interpret your needs.

Our Catalog P.H. 200 illustrates and describes "Crescent" Thermometers for every application. Also test thermometers, glass thermometers, etc.

Get a copy of Catalog P.H.-200 to-day.

The Schaeffer & Budenberg Mfg. Co.

Brooklyn, New York

Chicago
Pittsburg
St. Louis
Philadelphia
Los Angeles

Canadian Agents:
Milton and Prentiss, Toronto.

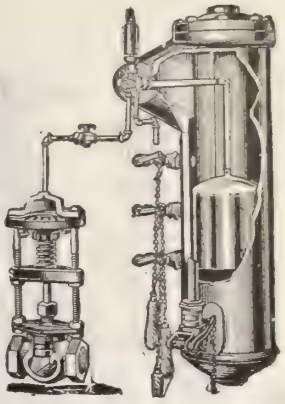
Power Plant thermometers for all temperatures not exceeding 1000° F

Also—"Columbia" Recording Gauges and Thermometers, Gauges, Gauge Testers, Tachometers, Steam Calorimeters, Counters, etc.

MASON'S

QUALITY

MADE-IN-CANADA PRODUCTS



Mason Reducing Valve

In these days of industrial stress and strain you can't afford to equip your power plant with anything but the highest grade equipments. Here is a list of specialties, well known for their quality, which cannot but appeal to engineers and power plant superintendents.

MASON Reducing Valves (Genuine).
MASON Pump-Governors.
MASON Pressure Controllers.
BUNDY Steam Traps for Every Service:
COPPUS Turbine-driven Blowers.
SIMS Hot Water Generators.
SIMS Open Feed Water Heaters.
BUNDY Oil Separators.
ASHTON Gauges and Safety Valves.
FEDERAL Metallic Packing.
EVERLASTING Blow-off Valves.
STRATTON Steam Separators.
REILLY Multicoil Feed Water Heaters.
REILLY Evaporators and Distillers.
REILLY Multiscreen Feed Water Filters.

Every one of these lines is one of the reasons why we make permanent friends of our customers.

SERVICE—Our Salesmen are practical engineers. They know the practical application of our lines to actual conditions and SELL FROM KNOWLEDGE, not from catalog. **This means real service to you.**

BULLETINS UPON REQUEST

Reilly Multicoil Feed Water Heater

The Mason Regulator & Engineering Co., Limited

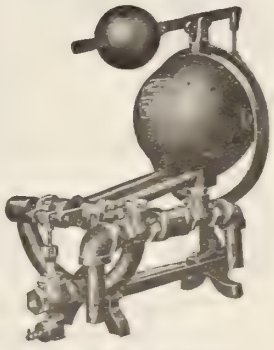
Successors to H. L. PEILER & COMPANY

MONTREAL, Office and Factory, 135 DAGENAIS STREET

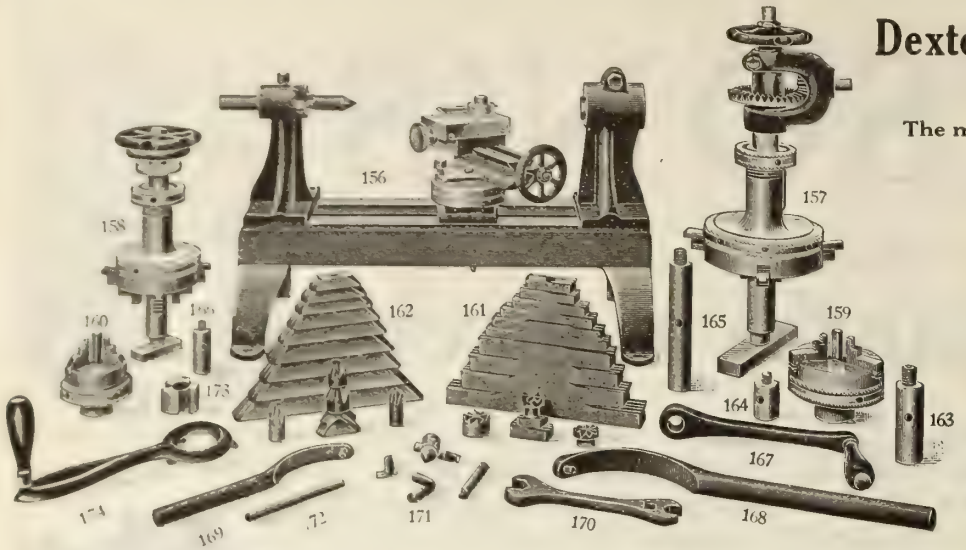
TORONTO REPRESENTATIVE, The Arthur S. Leitch Co., 506 Kent Building, TORONTO

The Ashton Improved Lock-up Pop Safety Valve

The Ashton Improved Single Spring Bourdon Steam and Pressure Guages



New Bundy Return Trap



Dexter Valve Reseating Machine

The much admired machine at the C. A. S. E. Convention

BY request, we are in this issue showing the Dexter Valve Reseating Outfit.

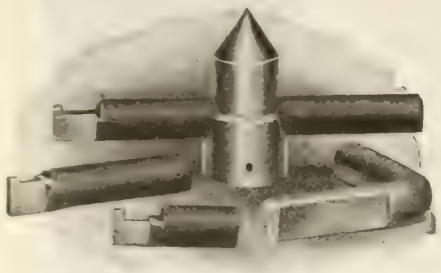
This outfit is complete for reseating all flat and taper seated globe valves from ¼" to 6" inclusive.

It includes two complete improved Globe Valve Reseating Machines. It has fifteen steel cutters for flat and fifteen steel cutters for taper seats, one improved turret disc, including those having radial wings or projections, check valves, etc., one disc holding chuck, extension spindles, and set of recess cutters, spanners, etc., as shown in illustration herewith; all neatly packed in a polished case with tray for cutters.

The great feature with these machines is that with proper care, they will last a life-time, and pay for themselves over and over again.

The price of valves to-day is about three times as much as three years ago. Use a valve reseating machine instead of buying new valves.

The refacing of a flat seated globe valve ten or twelve times reduces the seat to the level of the body of the valve. A new seat can be raised by using this little recess attachment shown in illustration, and the life of the valve extended. This attachment is worth its weight in gold to the user of a Dexter machine.



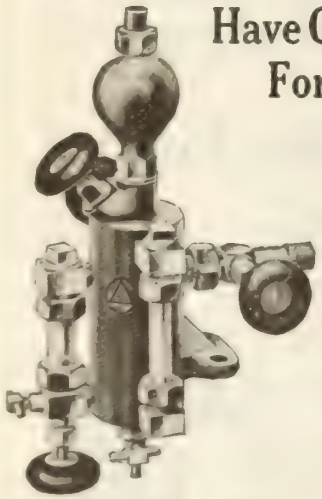
Darling Brothers Limited

120 Prince Street Montreal

Vancouver, Calgary, Winnipeg, Toronto, Halifax

Detroit Lubricators

Have Given Satisfaction For Forty Years.



Built in a sufficient variety of styles to lubricate properly every type of steam engine, pump, gas engine, air compressor, etc.

Send to-day for catalog L 1. The information on lubricating devices contained in it will be valuable to you.

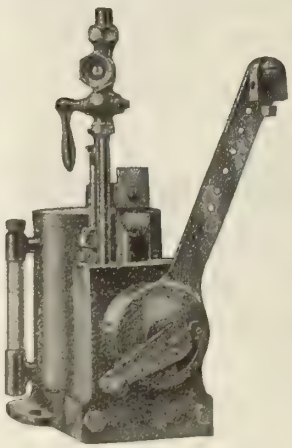
THEIR efficiency holds over half the world's trade.

Makers of Stewart Carburetors.

CANADIAN DETROIT LUBRICATOR COMPANY, LTD.

WALKERVILLE, ONT.

When an Engineer says—



Clutch Drive Pattern

"I HAVE a Rochester Lubricator in my plant that has been running steadily for 12 years," you may rest assured that it will pay you to replace your old lubricator with a Rochester.

One Rochester will prove it. Give it a trial on your engine. Specify it when you buy a new engine, air compressor or pump. Remember all oil is utilized, which eliminates waste, and there is positive lubrication.

THE

ROCHESTER LUBRICATOR

Manufactured by

Greene, Tweed & Co., New York

Sole Agents for Canada

Darling Brothers, Limited

120 Prince Street, Montreal

DART

Trade Mark

BRONZE

eets Bronze at the Joint

Couple up your pipe lines with Dart Unions and be forever free from leaking connections.

Dart Union Pipe Couplings stay tight because the Bronze faces will not rust or corrode, and the heavy iron parts will not stretch or pull apart.

This means no deterioration

Dart Unions are easy to use because of the Ball-shaped Joint which enables you to connect pipes quickly, whether pipes are in or out of alignment.

No upkeep cost. No replacement cost. No loss from leaks.

Order from your jobber.

Made in Canada by

DART UNION COMPANY, LIMITED

TORONTO, CANADA

DART UNION PIPE COUPLINGS STAY TIGHT

If any advertisement interests you, tear it out now and place with letters to be answered.

Linde System

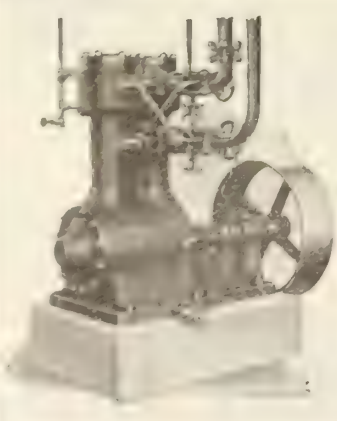
We study your cooling problem, from every angle, with a view not only to accomplish a given result, but to do so with an initial expenditure and operating cost, including maintenance and depreciation that will give the best return for the capital invested.

Our best salesmen are our customers.

The Linde Canadian Refrigeration Company, Ltd.

37 St. Peter St., Montreal

Established and Manufacturing in Canada Since 1896



Ice-making and Refrigerating Machinery

Built in any capacity that you desire. HORIZONTAL OR VERTICAL

Our SMALL MACHINES have the same "regularity of Operation," "Reliability" and "Efficiency" as our large ones.
AMMONIA FITTINGS, CONDENSERS, BRINE COOLERS, ETC.

Our Machines are in daily operation in Canada

CORLISS and POPPET VALVE ENGINES

The Vilter Manufacturing Company

242 Beecher St. - - - Milwaukee, Wisconsin

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

It's Yours for the Asking —Just off the Press

The new edition of Ice and Frost covering, Vertical and Horizontal Refrigerating Machines, is written and arranged in a very comprehensive manner and contains many illustrations.

Better send for it to-day—it will prove interesting.

Ask for a copy of our list of users covering 48 pages of satisfied customers—also your copy of "Ice and Frost."

Frick Company
WAYNESBORO, PA. U.S.A.
ICE MACHINERY SUPERIOR SINCE 1882

Canadian Representatives:
FRICK ICE & REFRIGERATING COMPANY
Montreal, Canada

There is a FRICK Machine for every refrigerating purpose—all types—Vertical — Horizontal — Absorption.

Eight Years of Trench Service

No, this isn't "Somewhere in France." It is a pipe trench "Somewhere in Lincoln, Nebraska," and runs from the main plant of the Lincoln Hotel to the Annex.

This Nonpareil Cork Covering was installed in 1907 and for eight years the brine was never shut off. Constantly subjected to moisture and with a steam pipe close by, the Nonpareil Cork saved ton upon ton of refrigeration year after year with no appreciable loss of efficiency.

While its installation underground in this fashion is not generally recommended

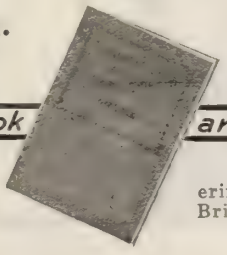
Nonpareil Cork Covering

For Cold Pipes and Tanks

is built for hard service and will last for years, if properly applied. It is made solely of clean granulated cork, one of the best nonconductors of heat known. Furthermore, it does not take up moisture by capillary attraction. Where other coverings become water-logged and worthless, Nonpareil Cork will keep on rendering effective service indefinitely.

Armstrong Cork & Insulation Co. Ltd.
504 McGill Building, Montreal, Que.

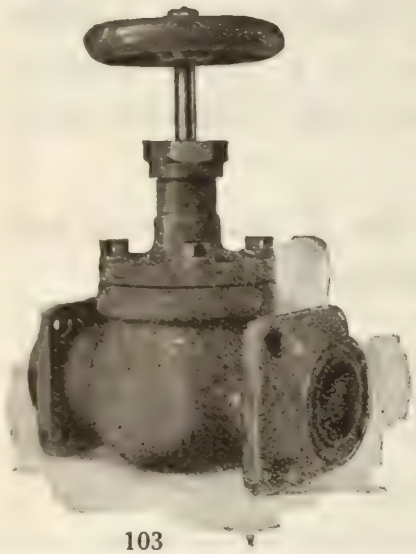
Brine lines insulated with Nonpareil Cork Covering running between the main plant of the Lincoln Hotel to the Annex, Lincoln, Nebraska.—R. L. McCandlish, Engineer, Kansas City, Mo.



This 64-page Book and Sample Free

Also manufacturers of Nonpareil Corkboard Insulation for cold storage rooms; Nonpareil High Pressure Covering for steam lines and boilers; Nonpareil Insulating Brick for furnaces, boiler settings, etc.

112



103

York Ammonia Valves and Fittings

assist materially in the conservation of ammonia.

Dependable Ammonia Valves and Fittings are of vital importance in every Refrigerating and Ice-Making Plant to-day.

YORK Ammonia Valves and Fittings are correctly designed, made under ideal conditions, subjected to an air test under water, and guaranteed tight under all usual working pressures.

A trial order will convince you of the superiority of YORK Valves and Fittings.

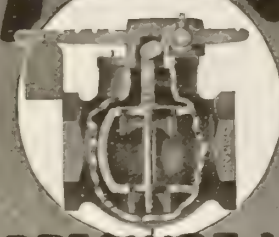
Stocks are carried by our Canadian Representatives at all times. For prices and any other information pertaining to YORK Quality Products, write

CANADIAN ICE MACHINE COMPANY

TORONTO, 82 Chestnut St. MONTREAL, 626 Coristine Bldg.
WINNIPEG, 85 Lombard St.

YORK MANUFACTURING CO., YORK, P.A., U.S.A.
Ice-Making and Refrigerating Machinery Exclusively

DAVIS



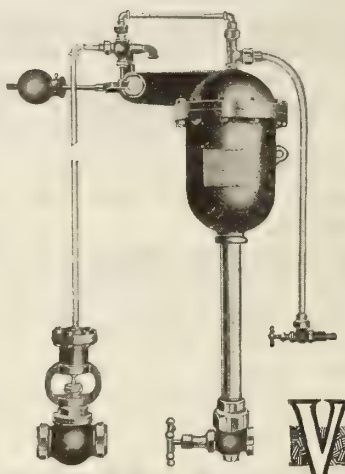
BACK PRESSURE VALVES

are designed to maintain a constant back pressure of steam for heating, drying, cooking or other purposes where light pressure is needed. On the exhaust line of a non-condensing engine, the Davis Back Pressure Valve fills the need. For use with condensing engines or turbines the Combination Back Pressure and Exhaust Relief Valve maintains the back pressure when running non-condensing and acts as an exhaust relief when operating condensing. Noiseless and absolutely reliable — cannot stick or bind.

These consistent steam savers are all illustrated and fully explained in the new Davis Engineering Booklet. For your free copy address the G. M. Davis Regulator Co., 434 Milwaukee Av., Chicago. Branches in principal cities.

DAVIS VALVE SPECIALTIES

STEAM SAVERS SINCE 1875



Keeps the Water Within ¼" of Middle Gauge

This VIGILANT

Automatic Feed-Water Regulator

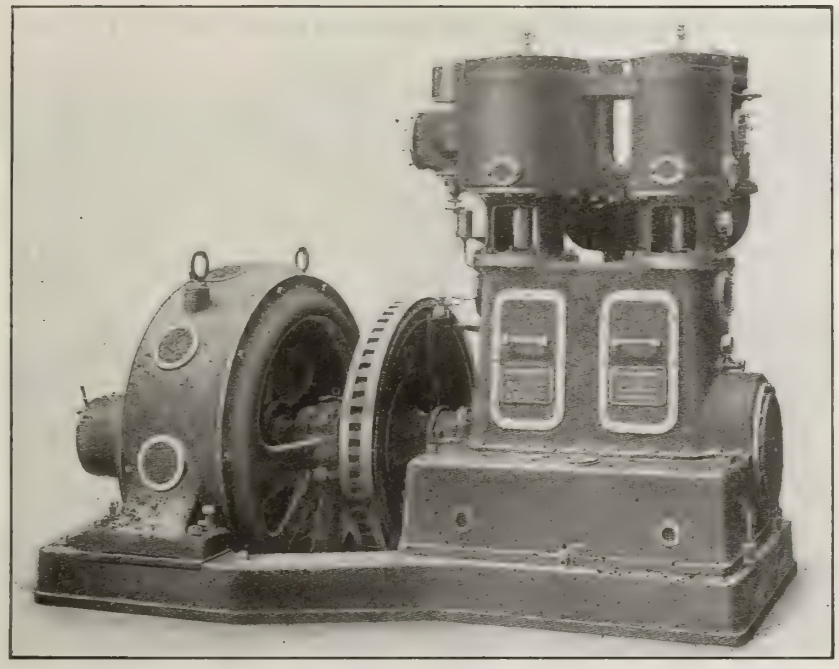
It does precisely **that,** automatically, perfectly, regardless of the load or firing. Therefore it is a positive protection from all high and low water accidents.

Incidentally—and this we can also prove—the Vigilant Feed-water Regulator saves 3 to 17 per cent. on fuel costs.

Ask us to send you catalog.

The Chaplin-Fulton Manufacturing Company
28 Penn Avenue - Pittsburgh, Pa.

BELLISS & MORCOM, LTD.
Engines and Air Compressors



Belliss & Morcom Motor-Driven Air Compressor.

Belliss Steam Engines, Steam Turbines, Diesel Engines,
Air Compressors, Condensing Plants

Heenan Refuse Destructors, Air Coolers, Water Coolers,
Oil Coolers, Dynamometers

Paterson Water Softening Plants and Filters

Centrifugal Pumps

We can make good delivery for War Service.

LAURIE & LAMB

Engineers

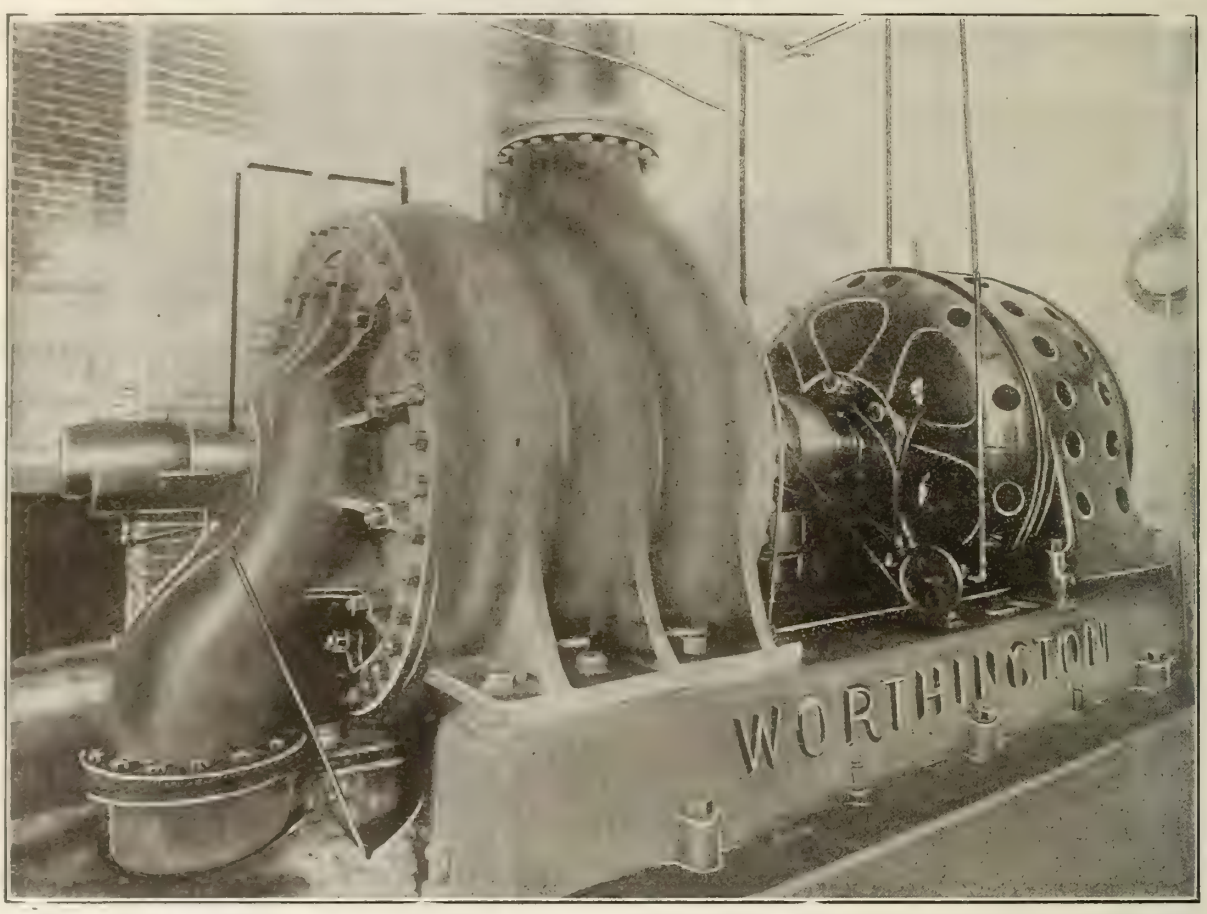
211 Board of Trade Bldg. - - MONTREAL

If any advertisement interests you, tear it out now and place with letters to be answered.

THE JOHN McDOUGALL CALEDONIAN IRON WORKS CO., Limited

Manufacturers of Boilers, Castings, Condensers, Elevators, Engines, Filters, Forgings, Hydraulic Machinery, Pumps — centrifugal and reciprocating, Steam Turbines, Tanks, Water Wheels, Water Works Plants

Works : Seigneurs and William Streets, MONTREAL



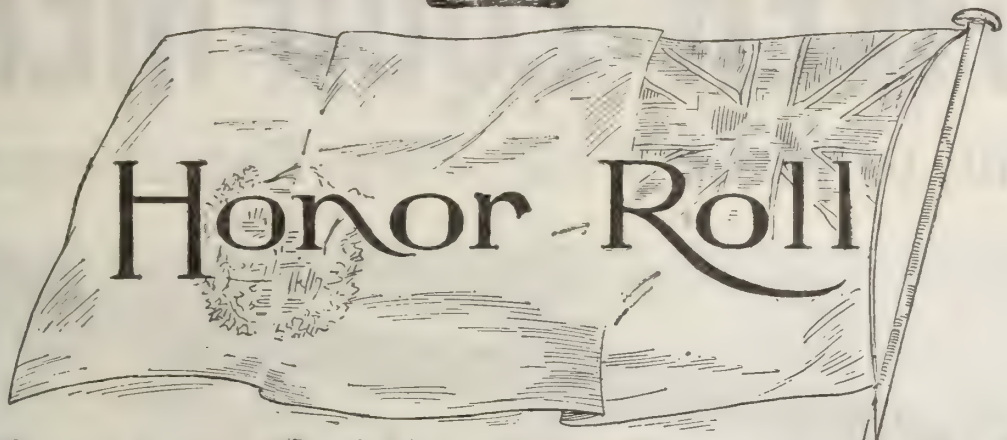
5,000,000 gallons daily—Montreal Water Works—Driven by 400 H.P. Induction Motor.

Our Engineers have spent many years developing Centrifugal Pumps and we are now able to offer you perfected designs in any size pump from inch and a half and up for any service you may desire, and to be driven either with motor, engine or belt.

Write us for Engineering information, or prices, any time.

Sole Canadian Agents for H. R. Worthington Co.

Keeping in Stock at Montreal a large assortment of their Boiler, Feed and General Service Pumps



Honor Roll

The MacLean Publishing Company Ltd.

Publishers of

MacLean's Magazine
Farmers' Magazine
The Financial Post
Hardware and Metal
Canadian Grocer

Dry Goods Review
Men's Wear Review
Bookseller and Stationer
Canadian Machinery

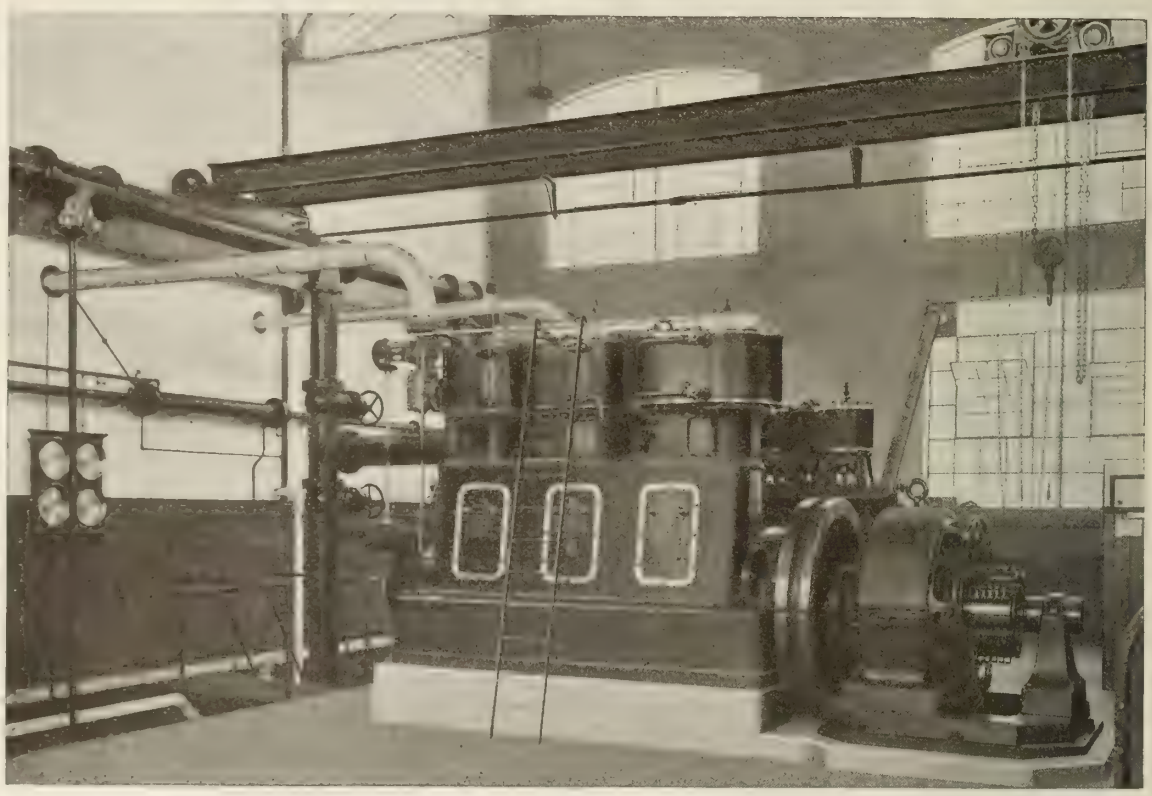
Power House
Canadian Foundryman
Marine Engineering
Sanitary Engineer
Printer and Publisher

D.W.G. Davies
John Dring
Harold Fogarty
A.O. Thompson
E.W. Earle
H. Rose
M.A. Sanderson
G.E. Pearson
G.A. Mundie
Desmond Hemingway
Victor Bercot
G.I. Cook
Hector Pearson
C.W. Catlow
H.S. Jones
Geo. Aubrey
Arthur Batty
Harold Cross
A.W. Hardy
E.A. Humphries

Sidney Metcalf
F.H. Thomas
T. McGillicuddy
Gordon Bennett
Walter Pearson
Roy. Jarratt
A. Macdonald
Ernest. Madigan
L. Makepeace
Harold. Gildner
Edwin. Mackie
C. Denham
F. Black
A.W. MacIntyre
J.W. Zimmerman
C.F. Breckon
P.W. Gowans
C. Hawkins
H.L. Southall
Andrew O'Malley

POWER EQUIPMENT

Built to Meet Your Own Requirements



A corner in the Engine Room of our New Power Plant recently erected at our Main South Works. Equipped with G. & McC. Co. Three-Cylinder Compound and Two-Cylinder Compound Vertical Forced Lubrication Steam Engines.

G. & McC. CO. ENGINES and BOILERS

will provide your plant with

A Continuous and Economical Service

WE BUILD

Horizontal and Vertical Steam Engines; Steam Turbines; Return Tubular and Water Tube Boilers; Heaters; Tanks; Pumps and Condensers; Transmission Machinery; Safes, Vaults and Vault Doors.

The advice of our Engineering Experts, our Catalogues, Specifications, Photographs, etc., will be cheerfully supplied to interested parties.

The GOLDIE & McCULLOCH CO., Limited

Head Office and Works: GALT, Ontario, Canada

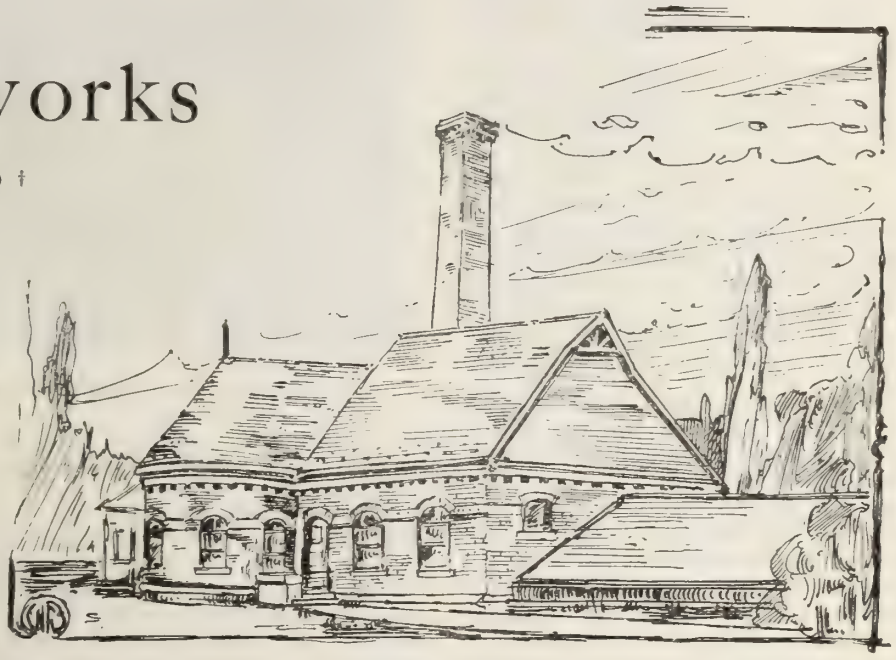
TORONTO OFFICE:	WESTERN BRANCH:	QUEBEC AGENTS:	BRITISH COLUMBIA AGENTS:
Suite 1101-2, Traders Bank Bldg.	248 McDermott Ave., Winnipeg, Man.	Ross & Greig, 412 St. James St. Montreal, Que.	Robt. Hamilton & Co., Vancouver, B.C

POWER HOUSE

Galt Waterworks

By W. F. SUTHERLAND *

Combined steam and hydro-electric pumping station. Spring water of exceptional purity taken from limestone formation used.



THE City of Galt is fortunate in its water supply, having at all times an ample supply of cool and exceedingly pure water of excellent quality. The pumping station, while located on the Grand River a short distance south of the city, draws its supply from springs and wells driven through the underlying limestone formation. This results in the obtaining of a water which, though somewhat hard, is practically free from bacteria and organic contamination and which requires no treatment with chlorine or filters before being used.

*Associate Editor Power House.

Water Supply

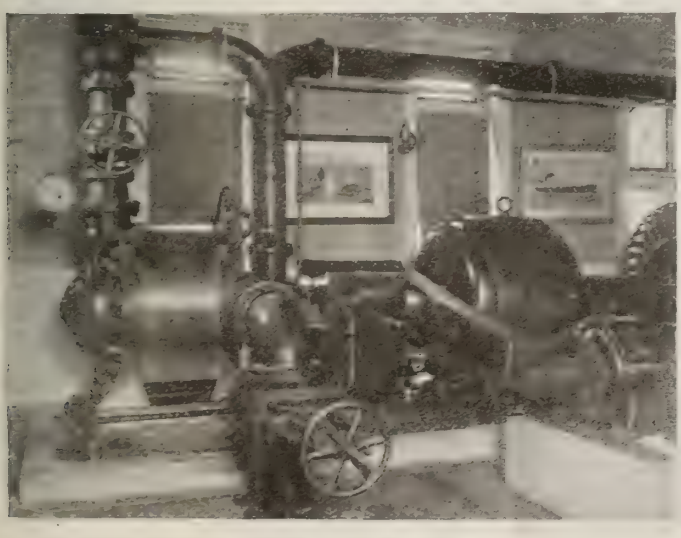
The water from the springs, of which there are a number on the seventeen acres forming the waterworks property, is gathered in a collecting gallery and flows by gravity into a pump-well or basin, forming part of the pump house.

This pump well is about 25 ft. wide and 100 ft. long with concrete walls and bottom, and when full contains about 218,000 gallons of water, thus forming a storage reservoir and an admirable source of supply from which to draw in case of fire or other suden need.

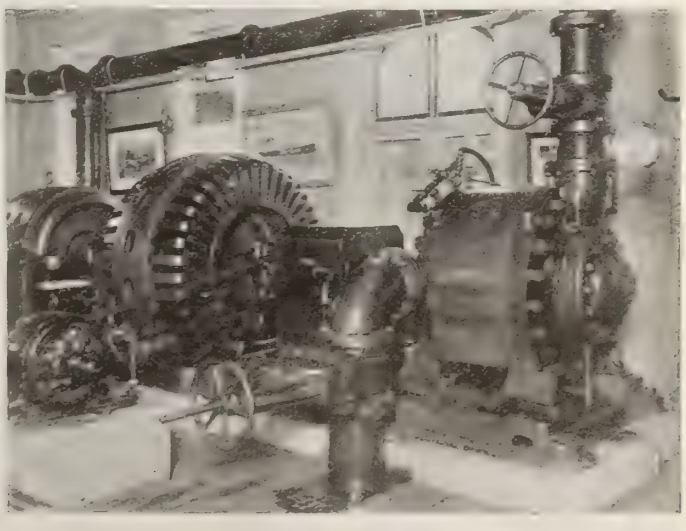
Four wells have been driven to depths ranging from 240 ft. to 252 ft. in depth. Three of these, of 8in. bore for the first 40 ft. and 6in. thereafter, are located outside the pump-house, while the fourth is located under the pump well. This last well is 12ins. for the first 40 ft. and 10ins. for the remaining depth.

Plant

The pump-house is a substantial brick



CANADA FOUNDRY TURBINE PUMP DIRECT CONNECTED TO SWEDISH GENERAL ELECTRIC SYNCHRONOUS MOTOR.



CANADA FOUNDRY TURBINE PUMP DIRECT CONNECTED TO WESTINGHOUSE SYNCHRONOUS MOTOR.

structure built in 1891 when the waterworks was first developed and houses not only the original equipment but the electrical installation since added.

The original equipment consisted of two 72 in. by 16 ft. horizontal tubular boilers, supplying steam to a Jerome Wheelock engine pumping unit. This engine although 27 years old is in excellent condition and beyond the adjustments necessitated by wear has never required a complete overhauling, the cylinders and valves being in perfect condition.

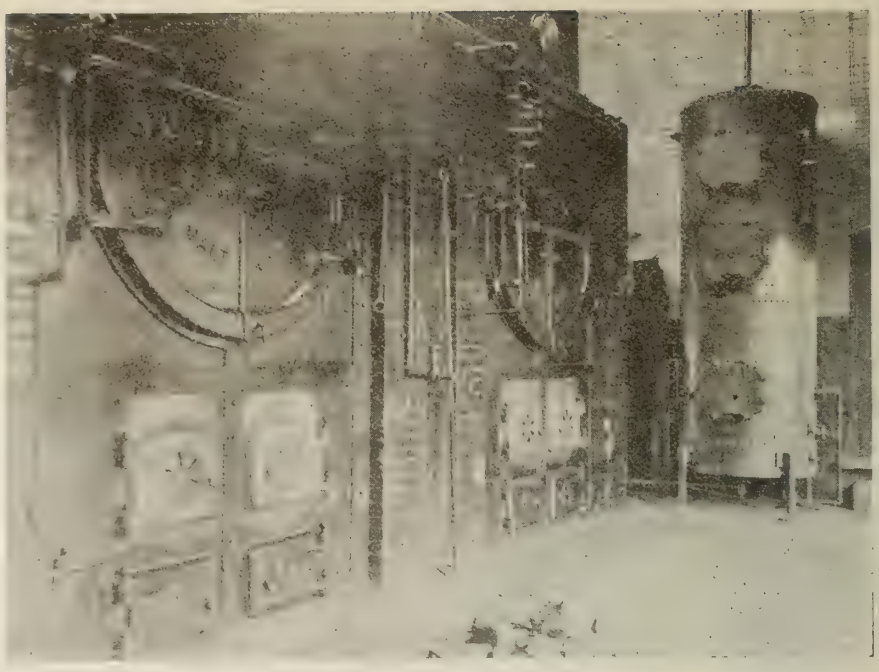
As will be seen from the illustration the engine is cross-compound condensing with the pumping cylinders connected tandem behind the steam cylinders. A jet condenser forms part of the equipment and the air pump is worked from a rocking arm attached to one of the piston rods. The steam cylinder sizes are 13 x 26 ins. by 30 ins., stroke and the pump plungers are 7½ ins. diameter. When running at 50 revs. per min. this unit has a 24 hour duty of 1,500,000 gallons.

Banked fires are carried at all times, the Wheelock engine forming a valuable reserve feature supplementing the electric pumps.

Several years after the original installation was completed it was decided to purchase an additional pump as an auxiliary feature and accordingly a Northey duplex compound pump was added. This dump also shown in one of the illustrations has a capacity of 1,000,000 gallons per 24 hours when running 65 strokes per minute.

Boiler Room

As mentioned above banked fires are carried under the boilers at all times as a precaution in the event of power failure. The boiler room contains two 72 in. by 16 ft. horizontal return tubular boilers installed six years ago by the Goldie & McCulloch Co. A pressure of 120 lbs. is maintained when the steam plant is in operation. An open type Moffat feed water heater and the necessary boiler feed pumps are also installed in the boiler house.



VIEW OF BOILER ROOM SHOWING MOFFATT FEED WATER HEATER.

Turbine Pumps

Several years ago it was found that the capacity of the steam equipment was insufficient to meet the needs of the rapidly growing city, and various methods were considered for increasing the capacity. About this time hydro power was made available, and it was finally decided to instal turbine pumps driven by a synchronous motor.

By the use of a synchronous motor-driven unit power factor correction could be applied to the local hydro system and a considerable economy effected.

The unit as originally installed consisted of two Canada Foundry turbine pumps of 800 gallons per minute capacity delivering water at 11 lbs. pressure and having three stages. These pumps were designed for 270 ft. discharge head when working with a suction lift of 15 ft. The suction inlet of each pump is 10 in., while the discharge is 8 in.

The suction piping of the pumps is so arranged that they may either draw from the wells alone, the tank, or from both wells and tank.

At present one pump draws water from the three outside wells while the other one draws from the well in the pump house, the water also being pumped out of the reservoir when the springs have nearly filled it.

The pumps may be primed either by straight city pressure from the mains or by means of a water injector worked also by city pressure.

Original Pump Layout

As originally installed the two pumps were mounted on the one bedplate with the motor between. Clutches were provided so that either pump could be disconnected for repairs or because of light water requirements. Owing, however, to difficulties in operation and the desire for increased motor capacity for power factor correction this arrangement has since been altered by the addition of another motor, making two separate units.

Dodge couplings are fitted between each motor and its pumps so that the motors may be run solely for power factor correction if desired.

JEROME WHEELOCK PUMPING ENGINE. THIS ENGINE HAS BEEN IN CONSTANT SERVICE SINCE 1891.

Electrical Installation

The original motor installed with the pumps was supplied by the Swedish General Electric Co. This machine is a 2,200 volt 25 cycle motor running at 750 revs. per min. and is rated at 66 amperes full load. It is furnished with a 6.6 kw. belt-driven exciter furnishing exciting current at 20 volts. The exciter runs at 1,650 revs. per min.

The above motor is started by means of a grid resistance starter having seven steps and a total resistance of 6 ohms.

The auto-synchronous motor described

above has the advantages of both the synchronous and slip-ring induction type machines and in design has many points in common with the latter.

The motor is started in a similar manner to an ordinary slip ring induction motor, that is by connecting a resistance across the slip rings and gradually cutting it out step by step as the speed is built up, until at full load speed the slip rings are short circuited. The exciter is then connected to the slip rings by means of a double-throw switch, the starting resistance at the same time being disconnected.

The motor then synchronizes itself and will operate with the same characteristics as a synchronous machine the amount of power factor correction being controlled by the varying of the voltage of the exciter.

If for any reason the exciter should become damaged the motor will operate as a straight induction machine, and should a heavy overload be thrown on the motor when running synchronous, the motor will not stop but will continue to run as an induction motor until the disturbing conditions are removed and it has the opportunity to speed up into synchronism again.

The Canadian Westinghouse Co. installed the second 2,200-volt 25-cycle, 3-phase motor which is rated at 350 k.v.a. This motor also runs at 750 revs. per min. and is fitted with a 3.5 kw. exciter running at 1,400 revs. per min. and having a nominal voltage of 125.

Switching and Controlling Apparatus

The switchboard is divided into two panels, one for each machine. The panel controlling the Swedish General Electric machine is equipped with line ammeter, exciter ammeter and power factor indicating meter, together with the usual exciter field rheostat and other controlling apparatus. A switchboard type hand-operated oil switch forms part of the equipment and is fitted with an overload and no voltage release relay.

Placed on this panel and metering the whole power supply are two Westinghouse graphic meters, one a recording wattmeter and the other a recording power factor meter.

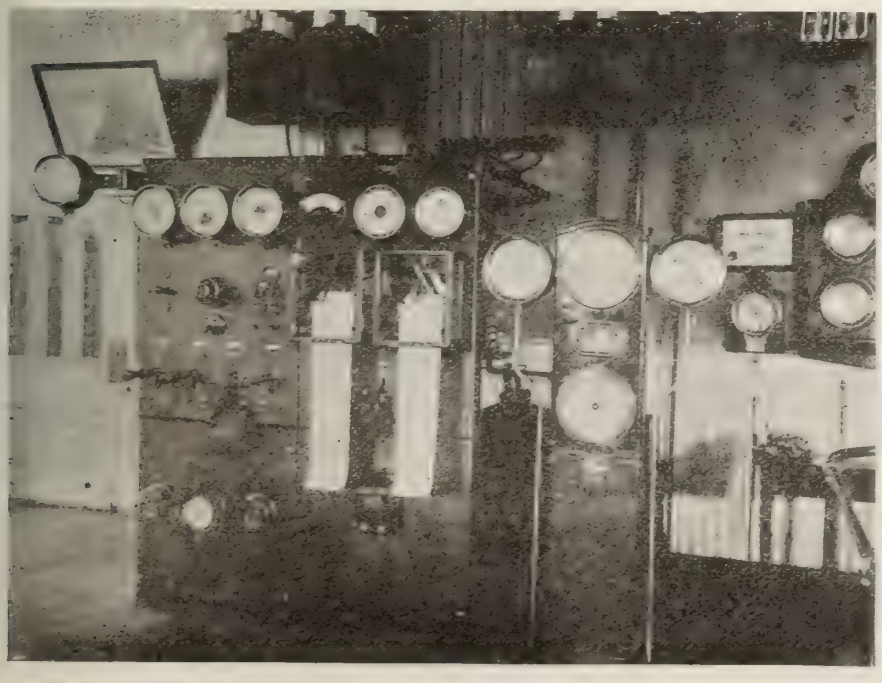
The Westinghouse unit is controlled by the remaining switchboard panel which is also equipped with the usual ammeters, power factor indicator, exciter rheostat and other equipment.

This unit is started by means of auto-transformers placed behind the board and connected to starting switches mounted on the wall well out of reach and remote controlled from the switchboard. These switches are type B Westinghouse oil switches; three are provided, two for the starting positions and the third for the running position. Westinghouse type C.O. relays control this unit.

Water Indicating and Recording Instruments

The city water consumption is very completely recorded by a 10-in. Venturi meter unit, built and installed by the Builders' Iron Foundry, Providence. This meter has a five inch throat and is equipped with dials showing the total volume of water pumped and the rate of flow. A graphic recording dial also forms part of the equipment by means of which an accurate record of the water pumped at any period is maintained.

Bristol recording meter is installed which gives a continuous record of the pressure carried at all times and the value of these various features has been amply proven when disputes have arisen as to the pressure when fires have occurred.



VIEW OF SWITCHBOARD CONTROLLING SYNCHRONOUS MOTORS WITH VENTURI METER ON THE RIGHT.

Distributing System

A standpipe located on the highest of the hills that encircle the city, about 1½ miles from the pumping station, forms part of the waterworks system. When full this standpipe contains 220,000 gallons. The piping system is so arranged that the standpipe can be cut off from the city mains and pumps, in this case delivering direct to the mains, relief valves being provided for proper operation and avoidance of water impact.

The water mains comprise a total length of 32½ miles and vary from 18 in. to 1½ in. in size, the major portion being of 4 in. size. Some steel pipe has been laid at various times but having been severely corroded in places it has been taken up as far as possible and replaced by cast iron. This improvement has resulted in a remarkable saving in the volume of water pumped.

Historical

On several occasions previous to the year 1890 by-laws for various amounts had been submitted to and defeated by the ratepayers of the town, and it was only in that year that sufficient money was voted by the electors for the purpose of constructing the present system.

In the following year contracts were let to the Goldie & McCulloch Co. of Galt for the equipment first installed. This comprised the pumping machinery, hydrants, valves and standpipe. The excavating and laying of the water mains was let to another contractor. Willis Chipman, Esq., was the engineer employed by the corporation for the supervision of the installation.

Since 1891 several bylaws have been carried at various times for the enlarging of the waterworks system and the purchase of additional pumping equipment and the waterworks owes its present excellent and efficient equipment to the public spirit of the community and to those who have ably conducted its affairs from the beginning. From the inception of the system until the year 1902 the waterworks was operated by a committee of the city council and in that year a board of commissioners was formed, of which Dr. J. H. Radford was elected chairman. Dr. Radford has been intimately associated with the waterworks from the beginning. Mr. R. B. McGregor is the present chairman of the board of commissioners, having been elected last year on the retirement of Dr. Radford. The present superintendent of the plant, Mr. P. H. Cowan, has been connected with the system since its beginning, a service of 27 years, and it is through his courtesy that the present account of the plant is written.

Mr. W. S. Fulton, the chief engineer, has been with the system for twenty-two years this June, and his associates in the operation of the plant are Messrs. J. Lockie and D. Wilson.

Canada's Water Powers: Their Relation to the Fuel Situation*

By
J. B. CHALLIES**

AT first "blush" it might appear that water power has only an indirect and limited connection with the recent critical fuel shortage, which through suspended effort has caused temporary industrial stagnation and local domestic hardships of enormous extent and involving great financial loss. Even a casual general survey of our fuel-power requirements, however, will indicate that not only has water power a very direct and important bearing on the present situation, but that water power must, in the future, take a very much greater share in our fuel-power burdens.

It is axiomatic that our heat, light and power needs must be considered as one great national problem, and also that Canada's domestic and industrial development depends primarily on the co-ordinated use of all the fuel-power resources of the Dominion.

Development along independent and divergent lines has, in the past, prevented adequate correlation of the great Canadian industries of fuel production and hydro-power supply. There is now, however, as a result of the fuel shortage, a consensus of opinion among men familiar with fuel and hydro-power matters in Canada that there is between these allied industries enormous scope

*A paper presented before the Canadian Society of Civil Engineers at Toronto, March, 1918.

**Superintendent, Dominion Water Power Branch, Department of the Interior, Ottawa.

Coal Consumption and Production in Canada.

SOURCES OF DATA	CONSUMPTION	BRITISH COLUMBIA	ALBERTA	SASKATCHEWAN	MANITOBA	ONTARIO	QUEBEC	PRINCE EDWARD ID	NEW BRUNSWICK	NOVA SCOTIA	GRAND TOTALS
This data obtained from Alberta Dept. of Public Works, Annual Reports, 1919. Ashcroft Dept. of Mines, Summary Report, 1917. Dominion Bureau of Mines, Annual Reports, 1917. Canada Dept. of Mines, Mines Branch, Publication of Fuel & Coke Statistics, 1918. Canada Dept. of Mines, Annual Reports, 1915-16. New Brunswick Crown Land Dept. Annual Reports, 1915-16. Nova Scotia Dept. of Public Works and Mines, Annual Report of the Mines, 1915-16. U.S. Geological Survey, "Mineral Resources of the United States," Washington, Pages, 1916. U.S. Geological Survey, "Mineral Resources of the United States," Part I, Production, Part II, Distribution and Consumption, 1916.	Domestic										
	Anthracite	10,544 ②	113,110 ②	26,197 ②	1,658 ②	—	—	—	—	—	
	Bituminous	1,311,433 ②	1,951,833 ②	110,413 ②	17,719 ②	—	994,944 ①	82,924 ①	891,031 ①	2,826,300 ①	
	Lignites	21,143 ②	959,526 ②	1,134,346 ②	79,252 ②	—	—	—	—	—	
	Total Domestic	1,343,120	3,024,489	1,302,956	98,629	—	994,944	82,924	891,031	2,826,300	10,701,530
	Imported										
	Anthracite	—	Small	208,000 ②	325,000 ②	2,242,874 ②	1,794,410 ②	—	Small	Small	
	Bituminous	—	Small	718,879 ②	1,627,998 ②	6,459,105 ②	4,174,850 ②	—	—	—	
	Total Imported	—	Small	926,879	1,952,998	8,701,979	5,969,260	—	Small	Small	17,580,603
	Total Consumption	1,343,120	3,024,489	2,229,835	2,051,627	8,701,979	6,964,204	82,924	891,031	2,826,300	28,282,133
	Total Production	2,584,061	4,559,054	281,300	—	—	—	—	143,540	6,912,140	14,480,095
	Production over consumption	1,240,941	1,534,565	—	—	—	—	—	—	4,085,840	
	Consumption over production	—	—	1,948,535	—	—	—	—	747,491	—	
	Consumption no production	—	—	—	2,051,627	8,701,979	6,964,204	82,924	—	—	
		BRITISH COLUMBIA	ALBERTA	SASKATCHEWAN	MANITOBA	ONTARIO	QUEBEC	PRINCE EDWARD ID.	NEW BRUNSWICK	NOVA SCOTIA	

REMARKS

This compilation is based on 1916 figures. Consumption areas became somewhat distorted because 8,000,000 tons, or about ⅛ of the consumption is railway coal, and as such is carried from province to province as traffic necessitates.

Tonnages. (1) Are from Mines and other reports of provinces concerned.
(2) Are from combinations of reports of provinces concerned.
(3) Are calculated, allocating the tonnage according to population and known consumption, both imported and domestic; deductions and additions being made accordingly for domestic and imported tonnages in order to arrive at a reasonable figure. These figures cannot be obtained direct from any Government report.

Differences in totals are accounted for partly by taking arbitrary figures in some cases for purposes of calculation and by different methods of tabulation and statistics.

NOTE: Basic data compiled and tabulated by Mr. J. F. E. Brown, Mining Engineer.

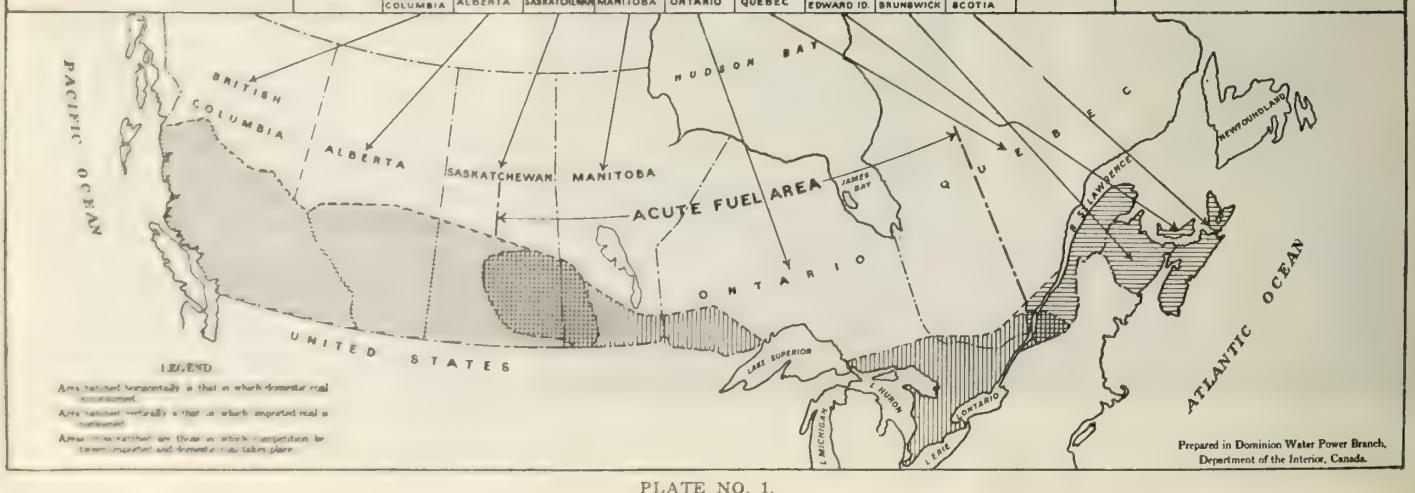


PLATE NO. 1.

for national co-operation which would be conducive to their mutual advantage, as well as to the common weal.

I propose to show: First—That water power must take a very prominent part if the best use of the varied fuel-power resources of Canada is to be achieved, and Second—That there must be evolved a national master fuel-power policy which will realize the best possible co-ordinated and concomitant development and use of all the fuel-power resources of the Dominion.

Canada's Production and Consumption of Coal

Plate No. 1 represents the coal consumption and production in Canada. The tabulated statement on the top of the plate summarizes the consumption in the various provinces of the different classes of coals, both domestic and imported. The greatest consumption is in central Canada, including the provinces of Manitoba, Ontario and Quebec. Coal production is greatest in the extreme western and eastern provinces. British Columgia and Alberta on the one hand and Nova Scotia on the other not only meet their own coal requirements, but produce a very considerable overplus for consumption in the contiguous portions of Central Canada. The central provinces, Manitoba, Ontario and Quebec, are almost wholly dependent on outside sources, mainly imported coals. This is clearly shown by the hatched areas on the map, the horizontal hatching covering the areas which produce their own needs, the vertical hatching covering the areas which are dependent. Where there is cross-hatching both Canadian and imported coals are consumed. It is to be observed that Central Canada, where consumption is greatest, is non-productive. This I have termed the "acute fuel area" of Canada.

Canada Imports Coal and Exports Coal

This "acute fuel area" is now dependent for domestic requirements mainly upon Pennsylvania anthracite and for industrial needs upon American bituminous coals, as well as upon Canadian water power. So far as domestic heating requirements are concerned, Mr. Dick, the consulting mining engineer of the Canadian Conservation Commission, in hispaper on the "Rational Development of Canadian Coal Resources" has pointed out the possibilities of the Western portion of the "acute fuel area" being furnished with briquetted lignite from the prairie provinces. Mr. Stansfield, of the Dominion Miner Branch, in his paper on "The Low Temperature Carbonization and Briquetting of Bituminous Coal," has pointed out the possibilities of meeting the domestic heating requirements of the Eastern portion of the "acute fuel area" by the product from the low temperature carbonization of Nova Scotia bituminous coals. Although both these processes are proven to be practicable, they are as yet in their formative or agitational stage and some considerable time must elapse before they can be placed on a commercial basis to furnish sufficient fuel to substitute for any large portion of the Pennsylvania anthracite now imported for domestic heating. There is at the present time no available supply, even in small quantities, of a Canadian coal fuel to take the place of imported anthracite. Nevertheless, this "acute fuel area" can eventually be made independent of foreign fuel imports and Canada can become self-sustaining, at any rate, in respect of her domestic heating requirements. There must, as a necessary preliminary, be a national, co-ordinated development and use of all the available fuel and power producing agencies in the Dominion. Such a co-ordination must be a matter of gradual evolution and adoption, and will to a great extent hinge on whether Canada can reasonably expect assured fuel imports from the United States for a considerable period in the future.

As we are now exporting large quantities of coals from British Columbia and Nova Scotia into adjacent States of the Union and as we are also exporting about 275,000 horse power of electric

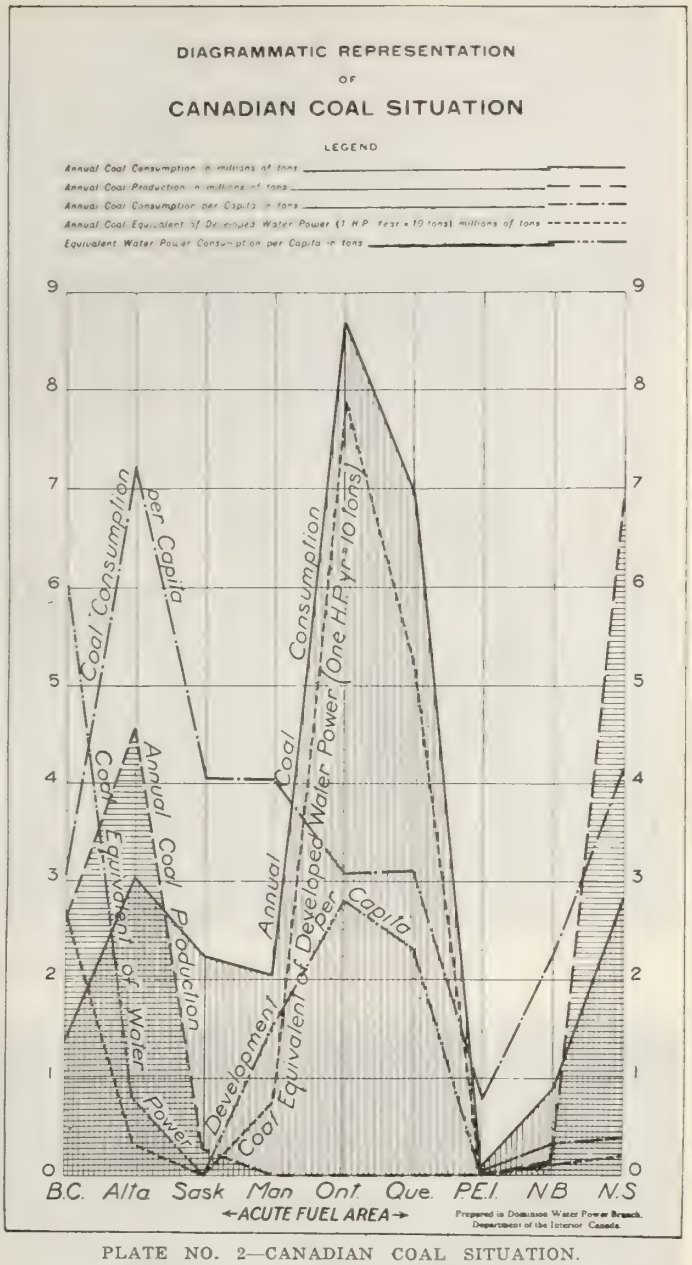
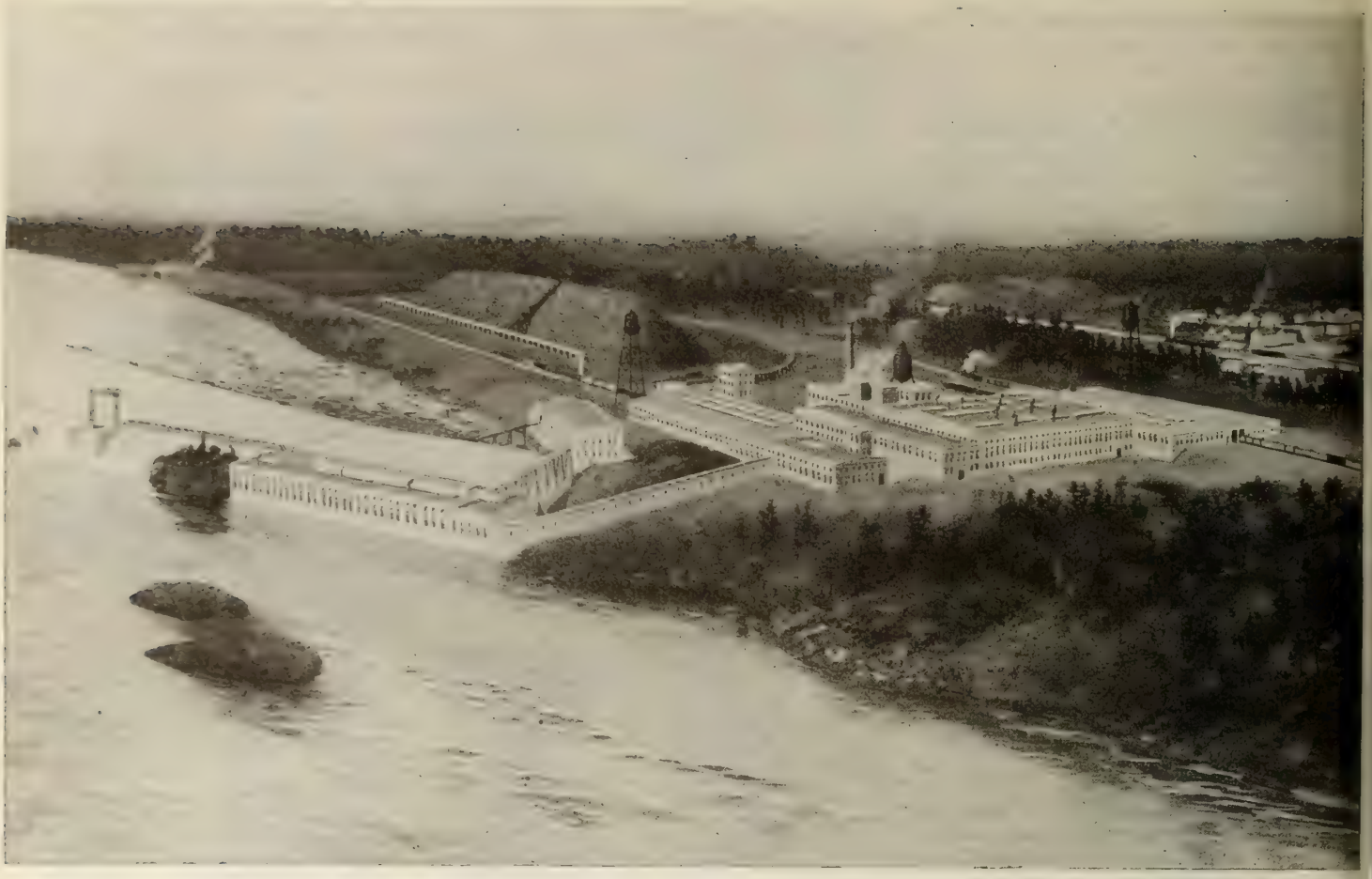

DIAGRAMMATIC REPRESENTATION
OF
CANADIAN COAL SITUATION
LEGEND
Annual Coal Consumption in millions of tons
Annual Coal Production in millions of tons
Annual Coal Consumption per Capita in tons
Annual Coal Equivalent of Developed Water Power (1 H.P. Year = 10 tons) millions of tons
Equivalent Water Power Consumption per Capita in tons
Coal Consumption per Capita
Annual Coal Consumption
Annual Coal Production
Coal Equivalent of Water Power Development
Annual Coal Equivalent of Developed Water Power (One H.P. yr.=10 tons)
Coal Equivalent of Developed Water Power per Capita
0
1
2
3
4
5
6
7
8
9
B.C. Alta Sask Man Ont. Que. P.E.I. N.B N.S
←ACUTE FUEL AREA→
Prepared in Dominion Water Power Branch, Department of the Interior, Canada.

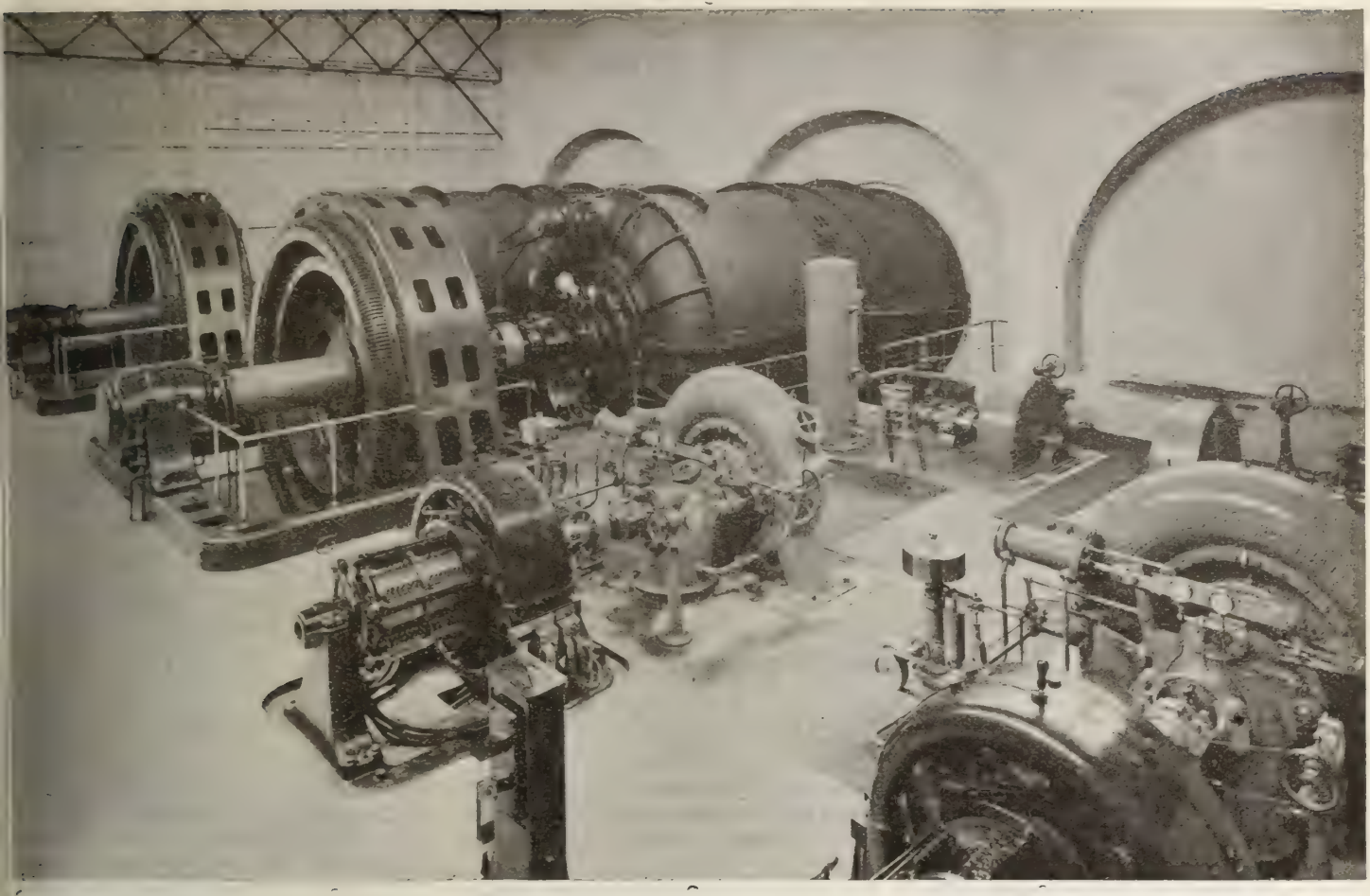
PLATE NO. 2—CANADIAN COAL SITUATION.

GENERAL VIEW OF SPANISH RIVER PULP AND PAPER COMPANY'S PLANT.



GENERAL VIEW OF ABITIBI PULP AND PAPER COMPANY'S PLANT, IROQUOIS FALLS, ONTARIO.

COQUITLAM DEVELOPMENT PLANT NO. 1, LAKE BUNTZEN.



STAVE FALLS DEVELOPMENT. GENERATOR ROOM STAVE FALLS POWER HOUSE.

NICTAUX FALLS, NOVA SCOTIA.

WATER POWER IN EUROPE AND NORTH AMERICA

Dominion Water Power Branch Estimate 1915 (slightly revised)

Country	Area Sq. miles.	Population latest available figures.	H.P.Available	H.P.Developed	Per cent utilized	H.P.Available per sq.mi.	H.P.Developed per sq.mi.	H.P.Per Capita Available	H.P.Per Capita Developed
U.S.A.	2,973,890	98,783,300	28,100,000	7,000,000	24.9	9.4	2.35	0.28	0.071
Canada "A"	2,000,000	8,033,500	18,803,000	1,735,000	9.2	9.4	0.87	2.34	0.216
Canada "B" Populated	"A" excludes Yukon and Northern Area improbable of immediate development "B" included in "A" is area actually settled. 927,800	8,000,000	8,094,000	1,725,000	21.3	8.7	1.86	1.01	0.216
Austria-Hungary	261,260	51,173,800	6,460,000	566,000	8.8	24.8	2.17	0.13	0.011
France	207,500	39,601,500	5,587,000	1,100,000	11.6	26.8	3.14	0.14	0.016
Norway	124,130	2,391,780	5,500,000	1,120,000	20.4	44.3	9.02	2.30	0.468
Spain	190,401	19,588,700	5,000,000	440,000	8.8	26.3	2.31	0.26	0.022
Sweden	172,960	5,522,400	4,500,000	704,500	15.6	26.0	4.08	0.81	0.127
Italy	91,400	28,601,600	4,000,000	976,300	24.4	43.8	10.7	0.14	0.034
Switzerland	15,976	3,781,500	2,000,000	511,000	25.5	125.2	32.0	0.53	0.135
Germany	208,800	64,926,000	1,425,000	618,100	43.4	6.8	2.96	0.02	0.010
Great Britain	88,729	40,831,400	963,000	80,000	8.3	10.9	0.91	0.02	0.002

SOURCE OF INFORMATION The basis of the table is the paper by M. Arthur Surveyer Consulting Engineer, Montreal, read before the Canadian Society of Civil Engineers Subsequent information obtained by Mr H E.M Kensit and Mr. A. M. Beale, of the Dominion Water Power Branch, is incorporated The table is not absolutely correct, but indicates a reasonable summary of the situation.

TABLE GIVING WATER POWERS IN EUROPE AND AMERICA.

energy, equal in value to about 3,000,000 tons of coal, it is obvious the United States cannot afford to place a sudden and complete embargo on coal exportation to Canada. The two countries must deal with each other at least upon a basis of quid pro quo. Providing Canada has her own fuel resources under strict national control, this power exportation should assure her an importation of sufficient coal to tide over any readjustment period necessary to permit of an ultimate dependence on Canadian sources of fuel and power.

KABABEKA FALLS, KAMINISTIQUIA RIVER.

The exportation in the past of Canadian electric energy has not been without compensating advantages. An assured United States market for Canadian power loads has enabled the financing and completion of several hydro-electric projects, the construction of which, so far as domestic markets alone are concerned, would not have been warranted at the time. The initial United States power load has, therefore, made it possible for the domestic market to reap all the benefits of available hydro-electric energy many years sooner than otherwise would have been possible.

While Canada has been receiving far more value in her coal importation than she has given in her power exportation the advantage is rapidly disappearing. It is reasonable to expect that the tendency will be for hydro-power exportation to increase and for coal importation to decrease. The time may come, and in the near future, when the balance will be against Canada.

It is, therefore, imperative that every proposal for increase in the exportation of power be carefully considered from a broad, national standpoint. Such consideration involves the evolution of a formula with regard to power exportations which will have cognizance of Canada's fuel-power needs generally.

We must face the fact that for some time to come we shall require to import United States coal, and that in turn therefor we can, under proper conditions of recovery, safely and profitably export some of our surplus hydro-electric energy.

Mr. B. F. Haanel, Chief of the Fuel Testing Division, Department of Mines, in his clear and comprehensive paper on the "Fuels of Canada," describes the nature, location and extent of our varied, available fuel resources. Mr. Haanel affirms that, while the problems associat-

ed with the distribution of fuel to the various parts of Canada are exceedingly complex and the strictest conservation must be practised, the Dominion is endowed with fuel deposits on such a magnificent scale that all that is necessary is their proper exploitation and economic use for the country to be eventually practically independent of foreign sources of fuel. Mr. Haanel is particularly emphatic that Canada need not go abroad for fuel for household use, if her own fuel resources are properly exploited.

The problem of Canada's fuel needs outside of the "acute fuel area" offers little difficulty, owing to an abundance of both coal and water power. It is simply a matter of efficient and effective use of available resources. Within the "acute fuel area," however, the problem is pressing and prodigious. It resolves itself into two parts, first, provision for domestic or household heating consumption; second, provision for industrial requirements.

Substitutes for Anthracite for Domestic Needs

The requirements for fuel for general household use are, at the present time, furnished by American anthracite; over 4,000,000 tons were used in 1916. Competent experts declare the anthracite coal fields of the United States are in measurable distance of exhaustion and that the supply will not last a hundred years. Having in mind the ever-increasing demands within their own borders for this fuel and the rapid decrease in quality as the supply becomes exhausted, responsible fuel advisers of the United States Government have seriously urged the establishment of an embargo against exportation of anthracite. We in Canada must realize that our supply of this fuel may be gradually restricted. It is, therefore, essential that we, without delay, consider what can be accomplished in the production of a suitable substitute for the United States anthracite.

Substitution of Hydro Power for Coal

The industrial requirements are now met by Canadian hydro power and United States bituminous coal. About 14,000,000 tons were consumed in 1916 for this purpose in the "acute fuel area."

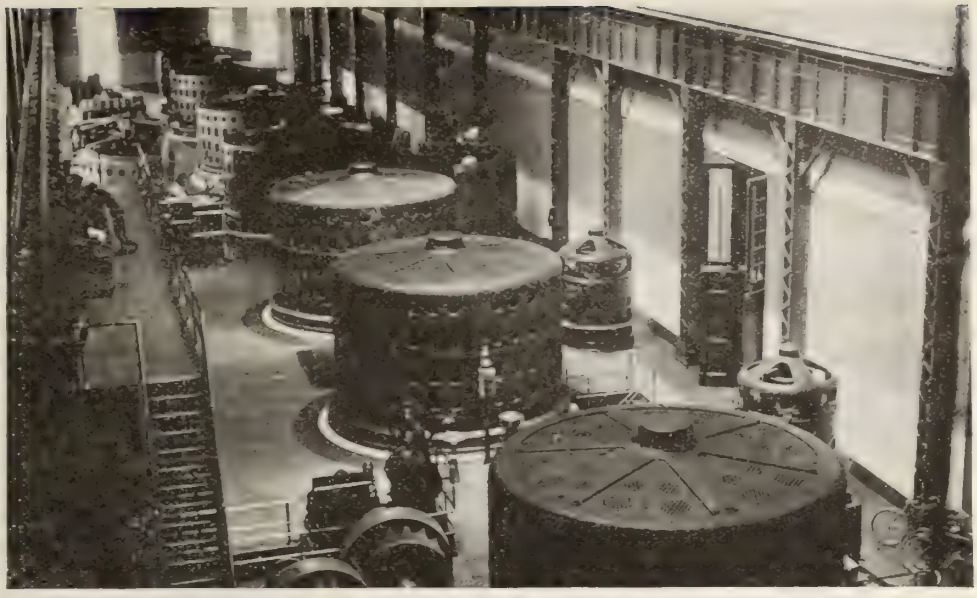
Owing to the large reserves of bituminous coal in Pennsylvania, this class of fuel will probably be available to the "acute fuel area" of Canada for many years. Although not immediately necessary, the ultimate substitution of bituminous coals must nevertheless, be seriously considered. Water power will be the main means of such substitution. The industrial fuel problem, therefore, in the "acute fuel area" becomes largely a matter of substitution of hydro power for fuel power.

Electrification of railways—especially terminals with adjacent engine divisions—would save enormous consumption of bituminous coal and relieve our transportation systems of their greatest burden.

It is estimated that something like 9,000,000 tons of coal was consumed by our railroads in the year 1917. Judging from the results obtained from the electrical operation of railroads in the United States, it would be possible to save at least two-thirds of this coal if electric locomotives were substituted for the present steam locomotives.

This year there would be a saving of 6,000,000 tons of coal in one year, and would require about 900,000 water horse power.

Electrification of steam roads at this juncture is not advocated. Under normal conditions, however, and in certain districts, as in western Ontario, electrification will become an economic necessity in a few years.



POWER HOUSE OF ELECTRICAL DEVELOPMENT COMPANY, NIAGARA FALLS.

The relation between developed water power and the coal production and consumption in the various provinces is represented on Plate 2. It is interesting to note that in the "acute fuel area" there is about as much water power developed, so far as coal value is concerned, as there is coal consumed. It is portentous that the bulk of our water power production at the present time is within the "acute fuel area," and it is reassuring to know that our largest and most important potential water powers are located within transmission range of present congested industrial districts within the "acute fuel area."

When considered in retrospect the

LAC DU BONNET PLANT SPILWAY.

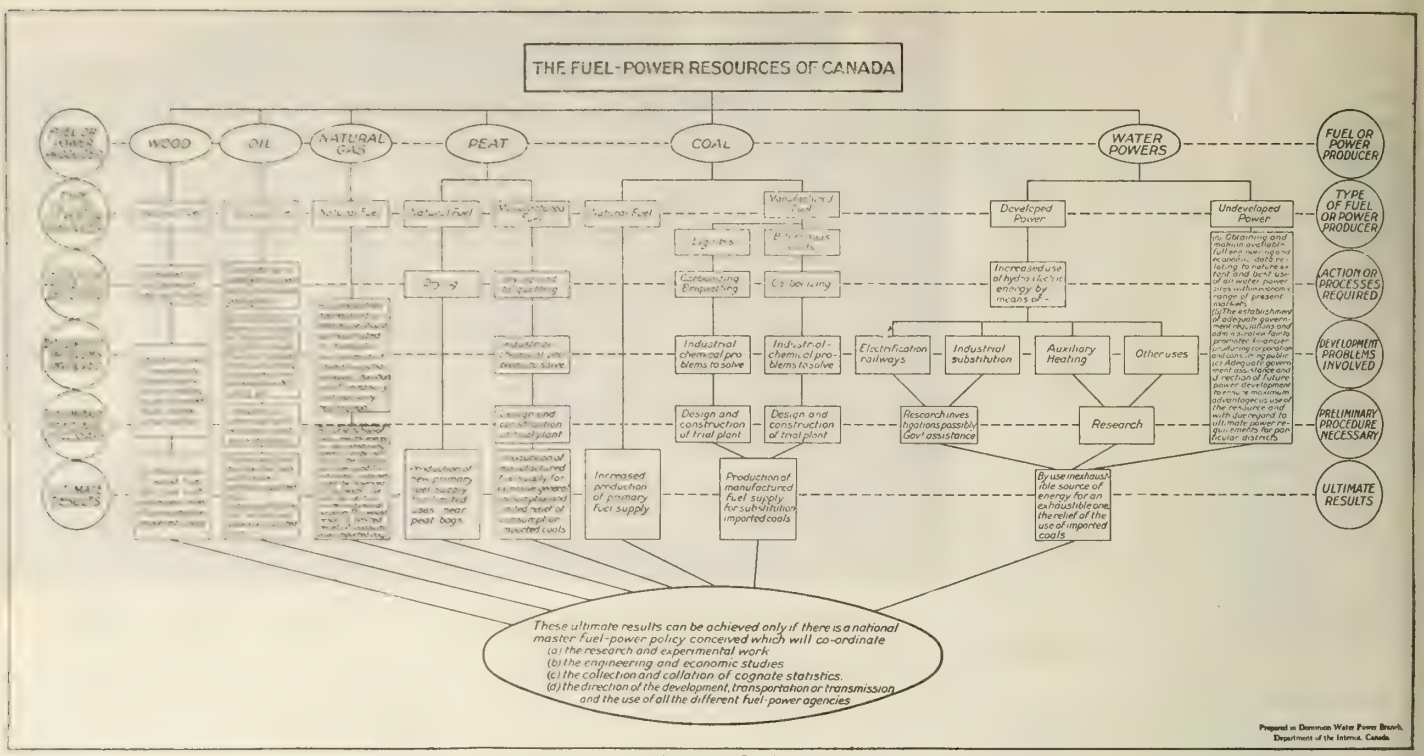

THE FUEL-POWER RESOURCES OF CANADA
WOOD
OIL
NATURAL GAS
PEAT
COAL
WATER POWERS
FUEL OR POWER PRODUCER
TYPE OF FUEL OR POWER PRODUCER
ACTION OR PROCESSES REQUIRED
DEVELOPMENT PROBLEMS INVOLVED
PRELIMINARY PROCEDURE NECESSARY
ULTIMATE RESULTS
Developed Power
Undeveloped Power
Increased use of hydro-electric energy by means of -
Electrification railways
Industrial substitution
Auxiliary Heating
Other uses
Industrial chemical problems to solve
Design and construction of trial plant
Research
Production of manufactured fuel supply for substitution imported coals
Increased production of primary fuel supply
By use inexhaustible source of energy for an exhaustible one, the relief of the use of imported coals
These ultimate results can be achieved only if there is a national master fuel-power policy conceived which will co-ordinate
(a) the research and experimental work
(b) the engineering and economic studies
(c) the collection and collation of cognate statistics.
(d) the direction of the development, transportation or transmission and the use of all the different fuel-power agencies

PLATE NO. 4.

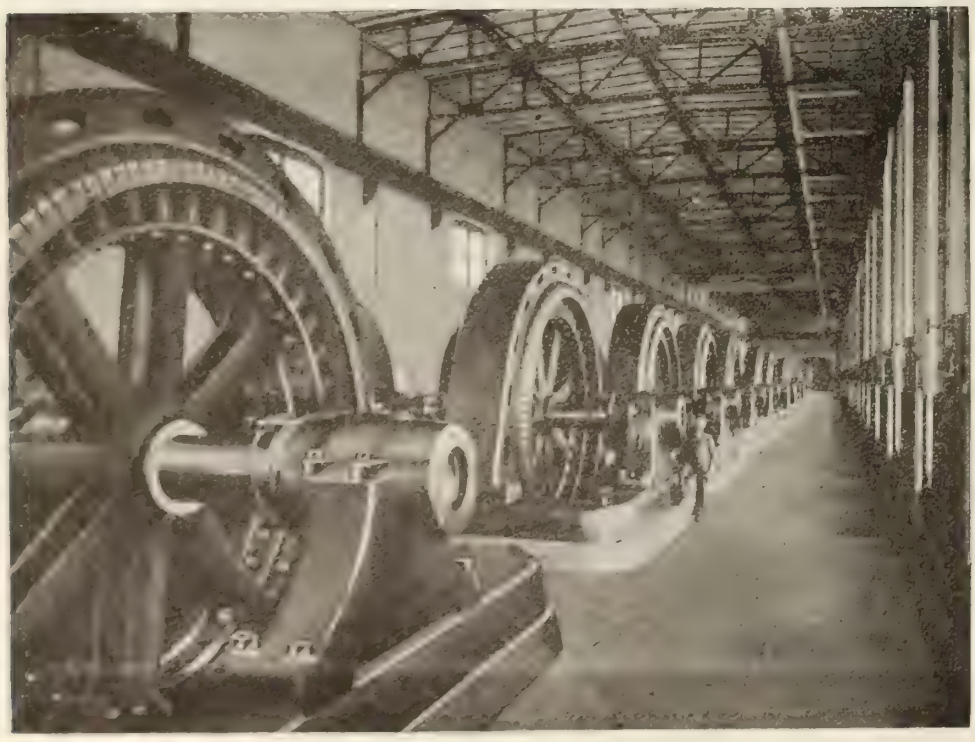
production of hydro power in Canada has undoubtedly been an industrial achievement and an engineering triumph worthy of our nation. In the short space of about twenty-five years, there has been developed and put in use nearly 1,800,000 water horse power. A tabulated statement (see Plate No. 3) of the water power development in other countries, compiled recently from all available data, shows the universal importance of this resource and indicates the splendid comparative position Canada enjoys in both potential and developed water power. The present per capita power development in Canada is larger than all other countries except Norway. It is the same with respect to our known undeveloped water power. No country enjoys to a greater degree the benefits of cheap, dependable hydro power, and no country has had these benefits more universally applied for municipal, industrial and domestic use.

Fortunate Location of Our Water Powers

The outstanding feature of the water powers of Canada is their fortunate location with respect to existing commercial centres. Within economic transmission range of practically every important city from the Atlantic to the Pacific, except those in the Central Western Prairies, there are clustered water power sites, which will meet the probable demands for hydro-power for generations. The following table, prepared by the Dominion Water Power Branch indicates, reasonably accurately, the provincial distribution of the developed and undeveloped water powers within the settled portions of the Dominion.

Province	Available. Power	Developed. Power
Ontario	5,800,000	789,466
Quebec	6,000,000	520,000
Novia Scotia	100,000	21,412
New Brunswick	300,000	13,390
Prince Edward Is.	3,000	500
Manitoba	3,500,000	76,250
Saskatchewan		100
Alberta		32,860
British Columbia	3,000.000	269,620
Yukon	100,000	12,000
Total	18,803,000	1,735,598

To visualize the interdependence and interrelation of all the fuel-power agencies available in Canada, and to offer something as a basis for general discussion, I have prepared a chart (Plate No. 4). If the chart indicates any one thing it conclusively proves the immensity and complexity of the problems involved in effecting the co-ordinated, concomitant development and use of all our fuel-power resources. The chart shows that this can be best realized following the evolution of a national master fuel-power policy for all Canada.



WINNIPEG ELECTRIC RAILWAY. INTERIOR OF GENERATOR ROOM.

Electricity and Hydraulics

PRINCIPLES AND OPERATION OF MODERN ELECTRICAL EQUIPMENT—V

By A. M. Pere.

IN last month's section it was shown that every conductor carrying an electric curent is surrounded by a magnetic field. Magnetism then may be caused by a flow of electricity and magnetism may in its turn cause a flow of electricity, but only under certain conditions.

In Fig. 1 is shown a coil of wire with a voltmeter, or other means of indicating a flow of electricity, in its circuit. If a bar magnet be suddenly plunged into the coil the voltmeter will show a decided deflection, swinging back to zero as the bar magnet comes to rest. If now the bar magnet be pulled out of the coil the voltmeter will again show a deflection but in the opposite direction, again coming to rest at zero as the magnet is far enough removed.

It may be surmised from this that a change in the strength or number of the magnetic lines of force passing through a coil of wire generates current and that this current persists only while such change is taking place.

The effect of changing magnetic strength is also shown in Fig. 2. As long as the switch is open the voltmeter shows no deflection. As soon as

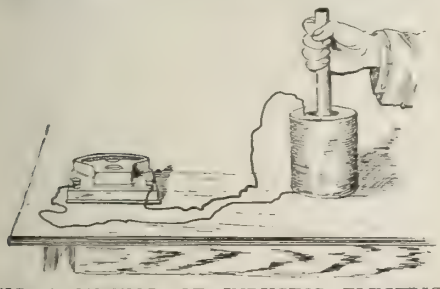


FIG. 1—METHOD OF INDUCING ELECTRIC CURRENT BY MEANS OF BAR MAGNET AND COIL OF WIRE.

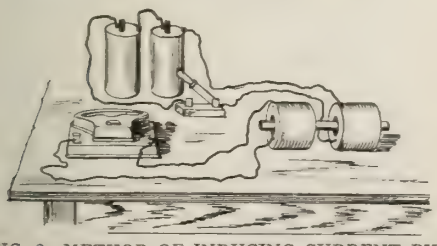


FIG. 2—METHOD OF INDUCING CURRENT BY CHANGING THE MAGNETIC FLUX OF AN ELECTRO MAGNET.

it is closed, however, it will be noticed that a sudden deflection takes place, the indicator quickly returning to zero. On opening the battery circuit the needle again deflects, and again returns to zero.

Motion of a Conductor in a Magnetic Field

A magnet and a conductor carrying a current of electricity exert a mutual force on each other or in other words each tends to produce motion in the other. The converse of this effect is also true, so that when a conductor is moved in a magnetic field in such a manner that it cuts the magnetic lines of force, an electro-motive force is generated in the conductor which tends to cause a flow of current. It must be remembered that in each case the magnetism, while it may be altered in distribution as regards the pole faces is not changed in strength, that is, the magnet is not weakened by the generation of an e.m.f. in a conductor. The energy necessary for this is derived from the

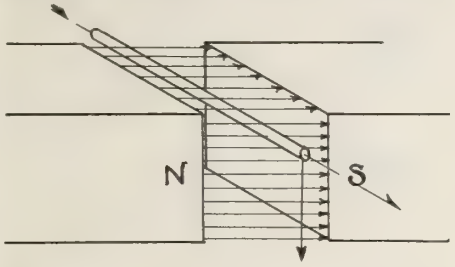


FIG. 3—DIAGRAM ILLUSTRATING THE RELATION BETWEEN THE DIRECTIONS OF MAGNETIC FLUX AND CURRENT PRODUCED BY MOVING CONDUCTOR THROUGH A MAGNETIC FIELD.

work necessary in moving the conductor.

The action of dynamos and motors is explained in the statements given above and the direction of the lines of force, the direction of the current and the direction of movement all bear a fixed relation to each other which is different in the dynamo and motor.

This relation for the **dynamo** is shown in Fig. 3. A magnetic field is shown with the lines of magnetic force proceeding from the north pole to the south pole. If the conductor shown is moved in the downward sense an e.m.f. will be generated which will tend to cause a current to flow in a direction indicated by the arrow. If the direction of motion or magnetic flux be changed the current will flow in the opposite direction and if both be changed together the current direction will remain as before.

Fig. 4 shows a similar arrangement to Fig. 3 but with a closed coil of wire. In this case it may be said that the e.m.f. is generated by the variation in the number of lines of force linking through the coil and this conception explains the action of the two arrangements shown in Figs. 1 and 2 only in Fig. 1 the magnet is moved through the coil and in Fig. 2 the strength of the magnetism is varied.

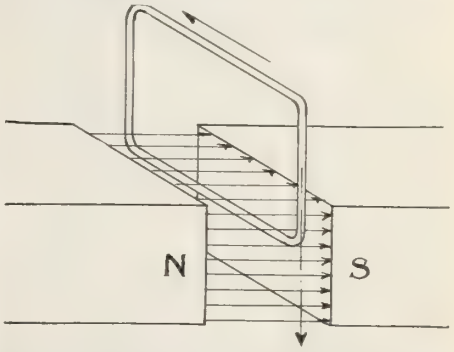


FIG. 4—CURRENT IS GENERATED IN A COIL WHEN PASSED THROUGH A MAGNETIC FIELD.

Dynamos and Motors

A simple and easily remembered means of recalling the relation of these three quantities is shown in Fig. 6.

The **right** hand is shown and if the forefinger be taken as representing the lines of force, and the thumb as representing the direction in which the conductor is moved, then the middle finger shown pointing downwards will represent the direction in which the current will flow.

The relation shown in Fig. 3 for the dynamo is not correct for the motor. When a current is sent through the wire the direction in which it will tend to move will be directly opposite to that shown and the wire will move upwards of its own accord instead of being forced downwards by an exterior force.

This relation for the **motor** may be remembered in a similar manner to that used for the dynamo, only instead of the right hand the left is used. Fig. 7 shows this. The left hand is shown with the forefinger pointing in the direction of the magnetic flux and the middle finger pointing in the direction in which the current flows. The thumb indicates the direction in which the conductor will move under these conditions.

Magnetic Drag

As an aid to understanding the principal underlying the action of the dynamo and motor, Fig. 5 is given. In this illustration the conductor is shown in the centre between the poles of a magnet. The direction of the current flowing through it is assumed to be toward the observer, as shown by the dot at the centre, remembering the convention as to the arrow, the dot meaning

towards and a cross away from the observer. The magnetic field due to a flow of current is shown in direction by the two circles around the conductor,

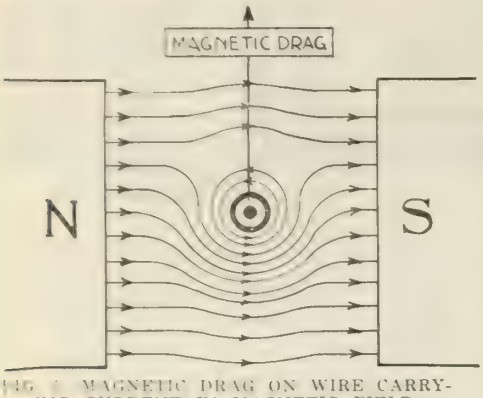


FIG. 6—MAGNETIC DRAG ON WIRE CARRYING CURRENT IN MAGNETIC FIELD.

while the direction of the field due to the magnets is shown by the remaining curved lines. This field will be distorted in the manner shown for the magnetic field due to the conductor opposes the lines of force above the centre of the conductor and reinforces those below.

The resulting distortion of the field will have a tendency to push the conductor up in the direction shown by the arrow much as if the lines of force were stretched bands of India-rubber. In the motor the current is sent through the wire from an outside source and the

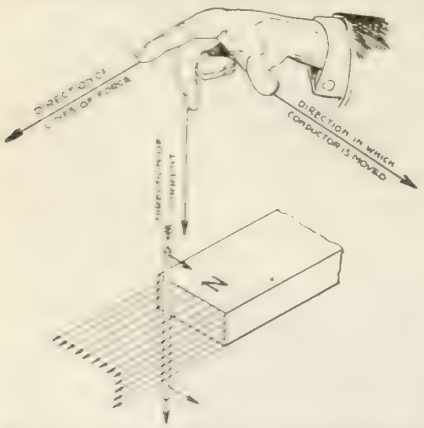


FIG. 6—FLUX CURRENT RELATIONS IN THE DYNAMO AND RIGHT HAND RULE FOR REMEMBERING SAME.

conductor is free to move in the direction indicated but in the dynamo the conductor is forced to move in the opposite direction or downwards, although it resists this movement.

In other words, in the motor the directions of the tendency to move and the actual movement are the same, while in the dynamo they are opposite and the magnetic drag may be spoken of as the resisting force which absorbs the work necessary in rotating the armature.

In the dynamo not only does the direction of the generated e.m.f. depend upon the directions of the magnetic flux and the motion but its strength varies as the speed with which the conductor moves and with the strength of the magnetic field. That is to say, if the speed with which the conductor moves were doubled the voltage generated would also be doubled and if the flux were doubled while the speed remained constant the voltage would be increased to the same extent. If the speed and flux were both doubled the voltage would be quadrupled.

Function of the Commutator

In Fig. 8 is shown a dynamo reduced to the simplest elements possible, a pair of poles, a single loop of wire and a two-part commutator. If the loop turns as shown by the arrow the right hand side will move upwards and the e.m.f. generated will be away from the observer remembering Fig. 7. The left hand side of the loop will be moving downwards and will have an e.m.f. generated in it opposite to that in the right hand side or towards the observer.

These two induced voltages will reinforce each other as is readily seen and if brushes are provided current will be delivered to an outside resistance or other means of putting it to useful work.

It is seen that each side of the loop alternately comes under the influence of the north and south poles and that no matter which side of the loop is near the north pole the e.m.f. generated in it, at this position, will always be towards the observer and that the commutator segment which happens, at this particular instant to be towards the left, will always be of the same polarity or positive. The right hand commutator

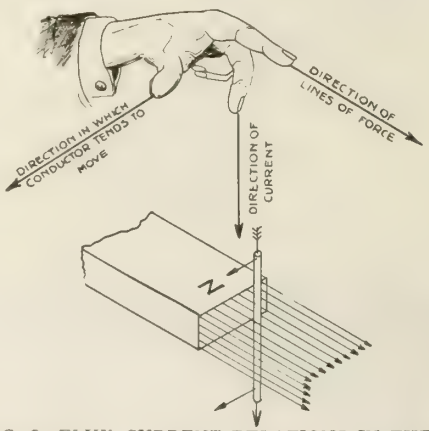


FIG. 7—FLUX CURRENT RELATIONS IN THE MOTOR AND LEFT HAND RULE FOR REMEMBERING SAME.

segment and the side of the loop which is connected to it, being in the field of the south pole will always have a negative polarity.

The brushes, by rubbing on the commutator (see Fig. 8) form not only a path for the current to flow to and from the armature but serve also to give a continuous or uni-directional current.

If instead of a split commutator two

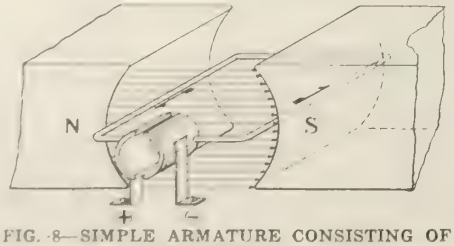


FIG. 8—SIMPLE ARMATURE CONSISTING OF ONLY ONE COIL.

rings had been connected up, one to each end of the coil, an alternating current would be delivered for each side of the loop would have a current flow-

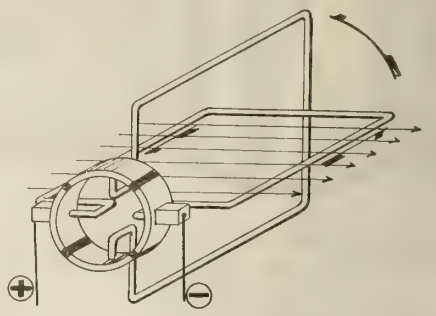


FIG. 9—ARMATURE CONSISTING OF TWO COILS.

ing in it first one way and then the other as it came under the influence of first one pole and then the other.

Multiple Coil Armatures

If two coils of wire similar to the one described above be mounted on an axis at right angles to each other with the four terminals of each coil connected to a four-part commutator as shown in Fig. 9, then the e.m.f. generated will be more nearly uniform in value. Commercial machines having large numbers of coils give an almost uniform current, and in the case of a motor the large numbers of coils present gives a uniform turning movement or torque.

Answers to Last Month's Problems

1. The flux generated in a magnet flows out of the north pole and through the surrounding air or other medium into the south pole.

2. The north magnetic pole of the earth does not correspond to the north pole of a bar magnet as regards the direction of flux travel. The difference may be easily kept in mind by calling the north pole of the magnet the north seeking pole and remembering that the flux travels away from it and into the north pole of the earth.

4. The magnetism flows in a clockwise direction around the wire when the current flows away from the observer and in the opposite direction when the current is reversed.

5. The coiling of a conductor into a coil increases the magnetic flux. In general it may be said that the flux generated is directly proportional to the number of turns if the iron is unsaturated. See the section on ampere turns in part IV.

6. The right hand may be used as a means of determining the polarity of a solenoid. The fingers are extended in the direction in which the current flows around the coil and the thumb extended along the axis of the coil points towards the north pole.

7. Ampere turns is an expression denoting the product of the number of amperes flowing through a coil of wire by the number of turns of which the coil is composed.

8. The number of ampere turns will be $25 \times 100 = 2500$.

This Month's Problems

1. In what manner may a current of electricity be generated in a coil of wire by the action of a magnet. What explanation would you give as to the cause of this generation of e.m.f.

2. What explanation would you give as to the cause of the actions of generators and motors.

3. Without looking at the text, recall to mind the conventions used in remembering the relations between the directions of the magnetic flux, current, and movement of conductor in the generator and motor and in this connection remember that it is important not to get the two conventions mixed.

4. Read over again the section on magnetic drag and note the explanation for the different actions of the conductor in the generator and motor.

5. In the generator how does the voltage generated vary when (a) the speed is varied; (b) the strength of the magnetic field is varied; (c) when both are varied at the same time.

CANADIAN ELECTRICAL ASSOCIATION MEET IN OTTAWA

The twenty-eighth meeting of the Canadian Electrical Association was held at the Chateau Laurier, Ottawa, on June 21, a large attendance being had in view of the present condition of the Canadian electrical industry

Condition of Canadian Utilities

The general conditions obtaining in the central-station industry throughout the eastern section of Canada were reflected in the address of D. H. McDougall of Toronto, the president of the association. Difficulties in obtaining coal and money are as common in Canada as they are in the United States, and the necessity for higher rates is just as pressing. Speaking of the immediate problems, Mr. McDougall said:

"The war and its accompanying sacrifices and hardships have made it necessary that each one of us should assume additional burdens and responsibilities. Our industry has had imposed on it additional duties in the way of operating problems and overloads that required all the skill, nerve and ingenuity that we could muster, and our staffs have been depleted further by conscription and the other war drains, making the maintenance of service a very difficult matter.

"Few of us are able to finance any new extensions to our properties or maturing bond issues. This handicap has been largely met by charging customers the cost of line extensions and by intensifying loads on present lines. Station increases have been almost impossible to finance. In some quarters this has been offset by taking on off-peak business, and this has required the study of factory conditions to educate customers to the necessity and possibility of such methods of operation. The result has been that higher load factors are experienced and some plants have been operated at a load factor deemed impossible even two or three years ago.

"The next difficulty has been with our employees, whose numbers have been decimated by military service, to which they have willingly responded, and by conscription, which I believe has affected us so far in a minor degree.

"I think I am safe in saying that great disorganization on account of these wholesale changes in staffs has only been averted by the loyalty and unselfish performance of duty of those who for one reason or other were unable to answer the call of the bugle.

The Hydroelectric Power Commission

"The outstanding example of failure to live up to contract obligations in the service of electric power in Canada during the past year is the case of the Hydroelectric Commission of Ontario, which, with an unprecedented lack of foresight, made contracts for larger amounts of power than it was able to supply. The total amount of this shortage has been stated to be 100,000 h.p., but, unlike the members of this association, the commission has so far been able to escape the consequences of this selling short of power, as it has refused to recognize the claims of its customers, based on the solemn contracts signed by it, and has pleaded that its shortage has been caused by the war.

"It is hard to believe that such immorality would be protected by the crown and that millions of dollars invested in plants depending on government contracts for their power should be shut down when many of them would otherwise be turning out munitions and other war necessities but for this breach of faith.

"The commission is able to secure large sums for construction work, amounting to about $2,000,000 a year, because its undertaking is supported by the government, although the works it is building cannot be of any service to the country for years to come, long after the war will be over. The amount of money expended by the Hydroelectric Commission so far in transmission and distribution plants is about $70.000,000, and the estimated amount of taxes lost to the people, which they would collect from privately owned companies with similar properties, is about $1.500.000 per year."

Other speakers at the morning session were T. C. Martin, secretary of the National Electric Light Association, who spoke of the work of the national body for the year and of its war committees; Willis MacLachlan of Toronto, who spoke on accident prevention, and with the assistance of operators from the Ottawa Electric Company, gave a demonstration of resuscitation from electric shock; A. A. Dion of Ottawa, whose report for the overhead-line committee dealt chiefly with the grounding of high-tension and secondary circuits, and J. F. Nield, of Toronto, who reported on electrical apparatus.

Four reports were made at the afternoon session, all of which were commented on. William Volkman of the Toronto Power Company reported on the changes made during the past year in the manufacture of meters. A part of the report was devoted to the determination of power factor, because with the load conditions and the extremely high cost of additions to line capacity any relief which might be obtained by improving the power factor of consumers' loads is of great importance. Three methods for determining the power factor of loads were outlined in detail.

H. E. Randall of Montreal reported on the commercial light and power sales and on the use of electricity during the past year. The great value of the central-station industry to the country and the important part it is accomplishing in the production of munitions, in solving the servant problem, in the conservation of fuel, man power and material, and in building up industrial conditions of Canada, were described in detail.

As the Canadian Electrical Association's representative on the National Electric Light Association's lighting sales bureau, E. N. Hyde of Montreal reported on industrial lighting conditions.

A very interesting report was presented by P. T. Davies of Montreal on rate research. It was pointed out that the obligations of customers in Canada to provide themselves with suitable electrical apparatus have been increased in view of the shortage of power and the high cost of machinery. Nearly all companies are requiring customers to keep power factors within reasonable limits at all times and to pay for any deficiencies.

Officers for the coming year were elected as follows: President, A. Monro Grier, Canadian Niagara Power Company, Toronto, Ont.; first vice-president, E. A. Dunlop, Pembroke, (Ont.) Electric Light Company; second vice-president, C. S. Bagg, Montreal Light, Heat & Power Company, Cons.; third vice-president, A. P. Doddridge, Quebec Railway, Light, Heat & Power Company; secretary-treasurer, W. Volkman, Toronto Electric Light Company. The managing committee comprises D. H. McDougall, Toronto Eelectric Light Company; J. S. Norris, Montreal Light, Heat & Power Company, Cons.; P. T. Davies, Southern Canada Power Company, Montreal; R. B. McDunnough, Quebec Railway, Light, Heat & Power Company; J. S. Gould, Citizens' Electric Light Company, Smith's Falls, Ont.; H. M. Hopper, St. John, (N.B.) Railway Company; L. Pratt, Dominion Power & Transmission Company, Hamilton, Ont.; J. B. Woodyatt, Southern Canada Power Company, Montreal; W. H. McIntyre, Ottawa Electric Company; R. J. Beaumont, Shawinigan Water & Power Company, Montreal; H. E. Randall, Shawinigan Water & Power Company; A. V. Gale, Hull (Que.) Electric Company; J. F. Nield, Toronto Electric Light Company, and the president of the N.E.L.A.

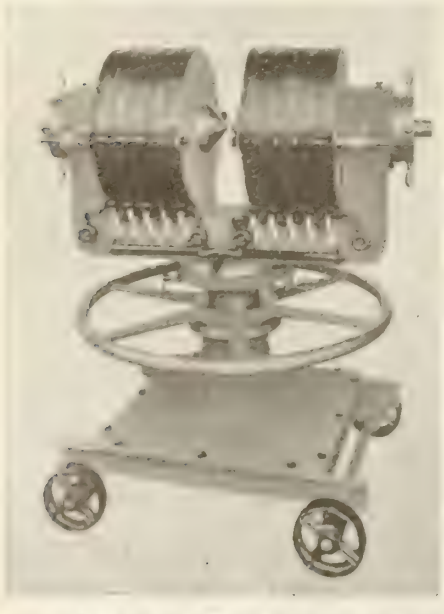
The proceedings ended with a banquet in the Chateau Laurier at which seventy-five were present. Addresses were made by the incoming president, A. Monro Grier, D. H. McDougall and John Murphy, electrical engineer of the Dominion Railway Commission.

A REMARKABLE SWISS HIGH POWER MAGNET

By F. R. A.

THE accompanying illustrations show the construction of a remarkable magnet developed at Oerlikon, Switzerland, by Prof. P. Weiss, of the Ateliers de Construction Oerlikon. This high power magnet, with 200,000 ampere turns, is utilized at l'Institute Fedral de Physique a Zurich, Switzerland. It has a diameter of 15 c. and an attractive force of 2,000 hg.

This powerful magnet has two coils, with 15 sections in each coil, and 1,600 turns of wire supplied with a current of 60 amperes. The resistance of each section is 49 ohms and for the excitation of the magnet about 18 kilowatts are required. The cooling coils may be noted in Fig. 2. The magnet shown in Fig. 3 has 150,000 ampere turns, and is in service at l'Ecole Normalle Superieure de Paris. It has two coils, with 10 sections in each coil and 75 turns on each bobbin, the current required being 25 amperes It will be noted that this magnet, therefore, has a total of 1,500 turns and a resistance of 2.5 ohms. A high power magnet of the Weiss design has been installed by the Department of Commerce and Labor at Washington, D.C. The points of these Swiss magnets are of fere-cobalt inserted in the pole, as indicated in drawing, Fig. 4. The diameter of the poles is 175 millimeters and the diameters of the ferro-cobalt points



HIGH POWER MAGNET OF 200,000 AMPERE-TURNS WITH COOLING COILS.

ITALIAN CHEMIST PROPHESIES "DAY OF LIGHT"

WHEN the rays of the sun strike the green leaves of a plant, carbonic acid gas and water vapor or moisture are gathered in from the air and these within the remarkable laboratory of every green leaf are turned into sugar. At the same time oxygen is set free, back into the air. The reaction requires heat, and the sun's rays provide it.

The plant operates other chemical factories and these transform sugar into starch, which is stored in the seeds to feed each sprouting plant until it gets big enough to grow green leaves and make sugar and starch for itself. Starch is also transformed within the plant into gums and cellulose, and the structural basis of wood is cellulose. Please observe also that the sun provides the heat for all of these reactions.

Fuel Combustion

When we burn wood or coal we reverse the process; we draw upon the oxygen that has been set free into the air when this or some other tree grew and we combine or burn it with the carbon acid gas and water again. That is the great cycle of vegetable life, beginning with carbonic acid gas and water and ending in carbonic acid gas and water. The reversed reaction gives off heat instead of requiring it, and that is why we burn wood or coal: to get the heat back that the sun provided long ago. White smoke is mostly steam and carbonic acid gas. Black smoke is mostly carbon that got frozen out in the fire or couldn't find oxygen enough to combine to carbonic acid gas again.

Professor Giacomo Ciamician, of Bologna, in an address before the Eighth International Congress of Applied Chemistry, asked why we use only the fossil energy of the sun—which is what we do when we burn coal. Why not get the power direct? If plants do this thing, he insisted there must be a way. There is plenty of water, it is easy to make carbon dioxide, and there is the sun. The point is, of course, to make available the radiant energy of the sun's rays and put it to use, which the plants can do and we cannot—as yet--for lack of adequate research

The professor felt sure, however, that this riddle will be solved some day, and then be made computations as to what we may do after the way has been discovered.

Using the sun for only six hours of every twenty - four on desert lands, and making generous allowances for good measure and waste, he concluded that the sun would deliver in energy taken direct from its rays, instead of by our roundabout method of recovering it by burning coal, the daily power value of 2,500 tons of coal per square mile. We mine in the United States about 600 million tons of coal a year. The desert of Sahara alone receives every day in solar energy the equivalent of six billion tons of coal.

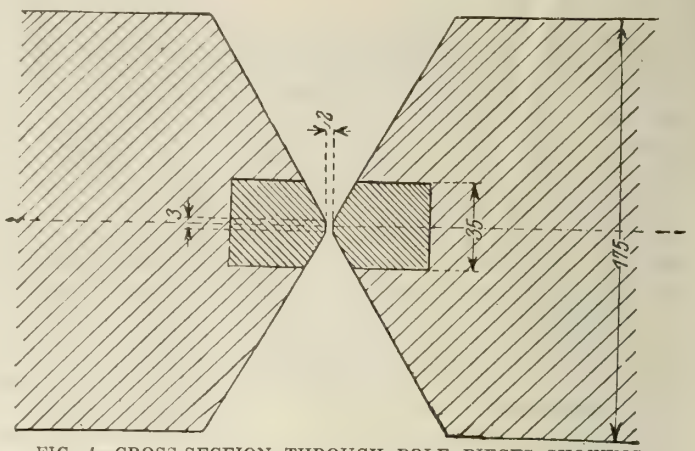
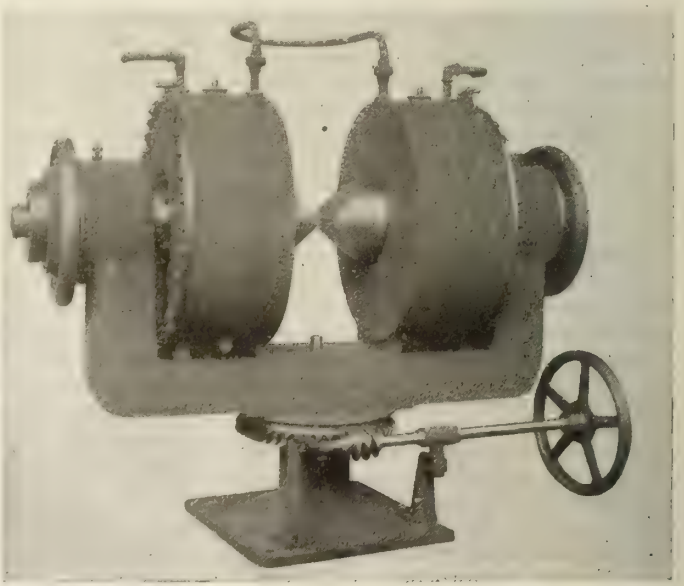


FIG. 4 CROSS-SECEION THROUGH POLE PIECES SHOWING FERRO COBALT POINTS.

Looking Forward

Then he showed a long list of photochemical processes which indicate progress in research towards "The Day of Light,"—towards sun power. He prophesied that in time tropical countries will be thickly populated, that on their arid lands there will spring up industrial colonies without smoke or smokestacks but with forests of glass extending over their plains and glass buildings everywhere. Inside of these will take place those processes that are still the guarded secrets of trees and grass. But when these are mastered human industry will make them bear far more than nature does. Nature is not in a hurry and mankind is. So some day it may not even be necessary to use fuel any more or to worry about the supply or the price.



3—SIDE ELEVATION OF 150,000 AMPERE-TURN WEISS MAGNET.

Steam and Its Generation

THE NIGGER IN THE COAL PILE

By Robert June

THE big industries of Canada have made a discovery. They have learned that the profits of to-day depend very largely upon the economies that can be effected in production, and that the profits of to-morrow will depend entirely upon such economies. The recognition of this fact has come tardily to many, but now that they are "seized with the spirit," they are going after savings in every direction.

This is one reason why Big Business is as big as it is, and why the big fellows are absorbing the little ones.

It would not be correct to say, however, that the big industries are uniformly economical in regard to the operation of their power plants. Many of them are extremely wasteful. With every incentive to scrutinize power costs, and to put their power plants on the same basis as other producing departments of their factories, they have failed to exercise business-like supervision over their boiler rooms.

Neglect in Past

As a general proposition, the manufacturer has been so busy with sales problems and getting volume of production, that he has neglected one of the most important elements of profitable operation. He has wasted 25 per cent. of his fuel, largely because he has regarded his boiler room as a place of mystery, the chief function of which was to consume coal in endless quantities.

He has given his fireman an unlimited supply of coal and told him to go to it, and as long as the fireman has kept steam up, nothing has been said. The fireman, on his part, has considered that he has performed his full duty in keeping the pressure gauge at 150 pounds. It was what he was hired for. Nothing was said when he was engaged, about the quantity of coal he was to burn to keep the gauge at that mark. Coal, to him, has been a heavy black mineral, requiring a great deal of handling—nothing more. The boss has seen to it that it was delivered in whatever quantities he, the fireman, required and the boss has paid for it—so why should he worry.

The United States Bureau of Mines has been for a number of years engaged in obtaining and disseminating scientific information regarding the mining and consumption of coal and the results of the work have been of great value to technical engineers.

Six hundred million tons of coal was mined in the United States last year. It is predicted that 700,000,000 tons will be mined this year, and next year's production will likely be still greater. Of this quantity approximately 37 per cent., or 259,000,000 tons, will be burned in the production of steam and of this amount, fully 10 per cent. or 25,900,000 tons, will be imported to meet the demands of Canadian industry.

Amount of Waste

I have said that 25 per cent. of all coal so burned in the past has been wasted.

It is no secret.

David Moffat Myers knew it when he read his paper, "Preventable Waste of Coal," at the annual meeting of the American Society of Mechanical Engineers in New York, in December, 1917 Walter N. Polakov knew it in April of last year when he brought out the impending danger of a coal famine in a series of brilliant articles in the technical magazines. Jos. W. Hays knew it five years ago when he addressed to power plant operators his remarkable little brochure, "How to Build Up Furnace Efficiency." And scores of our ablest consulting and mechanical engineers, men of the type of F. A. Clark, chief engineer of the Toronto Power Company; A. S. Rutherford, manager Brunner Mond; H. H. Hutchinson, superintendent Canadian Explosives Company; C. W. E. Clarke of Stone and Webster; Frank R. Ford, of Ford, Bacon and Davis, and E. J. Buegler of Westinghouse, Church, Kerr Company, know it and have known it for years.

Each of these men has been successful in building up the operating efficiencies of the plants with which he has been associated and knows what can be accomplished. Each knows that the results attained in his plant could be attained in hundreds of others. It is one of the outstanding wonders in the history of the development of industry in Canada and the United States that a waste running into hundreds of millions of dollars annually should have been permitted carelessly to continue year after year through failure of the business executive to heed the commendations of his consulting engineer.

Preventable Waste

The preventable waste of fuel in the boiler furnaces of one steel mill recently investigated, amounted to 40,000 tons a year, which at $5 a ton would cost $200,000. This was a comparatively modern plant. The efficiency of boilers and furnaces in a 14-day test was 55 per cent. The load factor was unusually favorable to high efficiency and could readily be raised to 70 per cent. or over. This is only one example, and there are many more extreme cases. In one hand-fired plant the evaporation was raised from 6 to 9 pounds of water per pound of coal in a few days of instruction and continuously kept close to this higher mark with the help of coal and water measurements which were inaugurated. The saving was due exclusively to instruction and consequent better operation.

Another large concern, internationally famous, operates several good-sized plants that burn as high as 50,000 tons of coal per year. An elaborate bookkeeping system is in use, and petty expenses are kept down to a minimum, and the same policy is carried out in regard to the wages paid engineers and firemen. Although the cost of manufactured production is down to scientific perfection, but little attention is paid to the cost of the steam generated. The engineers are kept busy outside the boiler room. The master mechanic of the concern has a "test" made once in a while, and if the evaporation does not come up to expectation, the fault is laid to adverse running conditions and let go at that. A general increase of at least two pounds of evaporation per pound of coal could probably be effected in the plants of this concern, which would mean at least $25,000 saved every year—many times what it would cost to equip the different plants with necessary apparatus and pay the salary of a competent combustion engineer to look after their operation.

In two adjoining Ontario towns there are two brick plants. The smaller of the two plants burns eighteen tons of coal per day, the larger five.

In a western city there are two paper plants of approximately the same capacity. One burns three tons of coal per hour, and the other ten tons. The proprietor of the three-ton plant is getting rich and buying more plants. Some day he will buy the ten-ton plant and put it on a three-ton basis.

Increasing Dividends Through Fuel Savings

In another instance, the management of a large plant, facing sharp competition, came to a realization of the fact that every dollar in the coal pile has

to be skinned from the dividend pile, and began to take thought of its boiler room. Such things have happened before, but in this instance the thought was followed by action. The furnaces were placed in proper condition, provision was made for regular cleaning and close supervision, and the firemen were placed on a bonus system. Less than $4,000 was expended in making the change. Coal had cost this company $164.000 the preceding year. In spite of increased prices and increased production, the saving effected the first year amounted to $46 000 in real money, and the company declared its first ten per cent. dividend.

There is the case of the Smith and Jones Refractories Company. By redesigning the furnaces in this plant and adapting them to the fuel used and by substituting machine-fired grates, the consulting engineers succeeded in obtaining the same amount of steam with but 64 per cent. of the coal formerly used. This plant, when completed, was turned back to the same management that it had before with no further instructions. There were installed facilities for continuously determining the weight of the coal, ash and water used as well as the analysis of the furnace gases.

In another large Canadian plant, a similar saving in coal was effected. This plant has an aggregate capacity of over 5.000 nominal boiler horsepower, divided into 12 units. It was formerly operated with hand-fired shaking grates for which machine-fired grates were substituted with properly designed furnaces. The plant is now being operated continuously at 150 per cent. rating and is using no more fuel than it formerly did when being operated at two-thirds of its present output. The boiler-room force required to operate this altered plant is less than half of the number of men formerly employed. No change has been made in the management.

Where We Stand To-day—One Cause of the Car Shortage

The mining and distribution of coal in the United States, from which Canada draws its principle supply, have been placed under the supervision of the War Coal Board, in order more nearly to meet the crying needs of the country, to use the railroad facilities more efficiently, so that the present car shortage may be minimized, to apportion the coal in quantities and to uses deemed most expedient.

While this organized effort to bring about efficiency in the production and distribution of coal is being made, no parallel measures have been adopted to bring about a normal and practicable efficiency in its use, either for the United States or Canada. The hundreds of large plants which are consuming fuel wastefully, in many cases more wastefully and carelessly than ever before, are directly and needlessly causing a large fraction of the existing car shortage.

The saving or wasting of 25 per cent. of the coal consumption of any indus-

efficiency of its operating management. This percentage of saving relates exclusively to the boiler plant, to the production of steam, and does not include the large economies possible in connection with its distribution and use.

I refer to the boiler plant, particularly because it offers the more lucrative field for producing economies, and these with a minimum of alteration in physical equipment.

Under present conditions, a plant which carelessly operates at an efficiency of 40 to 50 per cent. receives from the Government the same consideration in the delivery of coal as the one whose efficiency is 70 to 75 per cent. An awakened public will certainly not permit this condition, with its needless waste of 60,000,000 tons of coal per year to continue.

What Is Coming

Power is one of the largest items of expense in most manufacturing businesses, and the cost of fuel represents on the average 70 per cent. of the cost of power. And the cost of fuel is going up. Nothing short of the discovery of a new source of power can stop the rising tendency of coal prices.

In 1850 our annual coal consumption was 300 pounds per capita. By 1870 it had jumped to 2,000 pounds, and twenty years later it was 5,000 pounds. In 1917 approximately six tons of coal was mined for every man, woman and child. And this was not enough. Our war machine has demanded for 1918 a production equal to seven tons per capita.

Will it get it? It may and it may not.

One Thing Is Certain—Coal Must Be Saved

The mining and distribution of our coal supply, the regulation of prices and the adjustment of financial and labor problems have already largely been placed under official administrative attention. But no parallel measures have been as yet adopted looking towards reduction of waste in connection with the utilization of coal. It is a foregone conclusion that this condition will not continue un-remedied.

The time is coming when the conservation of fuel will be rightfully and generally conceded to be a public, national matter, and the use and waste of fuel subject to regulation. Almost inevitably, a governmental commission will require from users a strict accounting of their stewardship of the B. T. U. intrusted to them; whether two, five or ten times the necessary amount is being used; not whether the individual is satisfied or chooses to waste, but rather the broader view of conservation that with waste the cost of fuel is made proportionately greater, more burdensome to others.

EDITOR'S NOTE.—This is the first in a series of articles by Mr. June, on Power Plant Management. Succeeding articles deal with coal and its selection, combustion of coal, influence of furnace design, various types of stokers, bonus system for firemen, abuse of steam, etc. Later articles sum up the best current practice in the business management of the power plant.

THE INFLUENCE OF THE POWER PLANT IN FACTORY DESIGN

In considering the layout of a factory and the equipment necessary for the generation and transmision of the power used one point is often overlooked. The cost of power is in many cases only a small part of the total cost of the manufactured article and it has been stated on figures obtained from a number of industrial plants that it is only from two to five per cent.

Factors Which Count

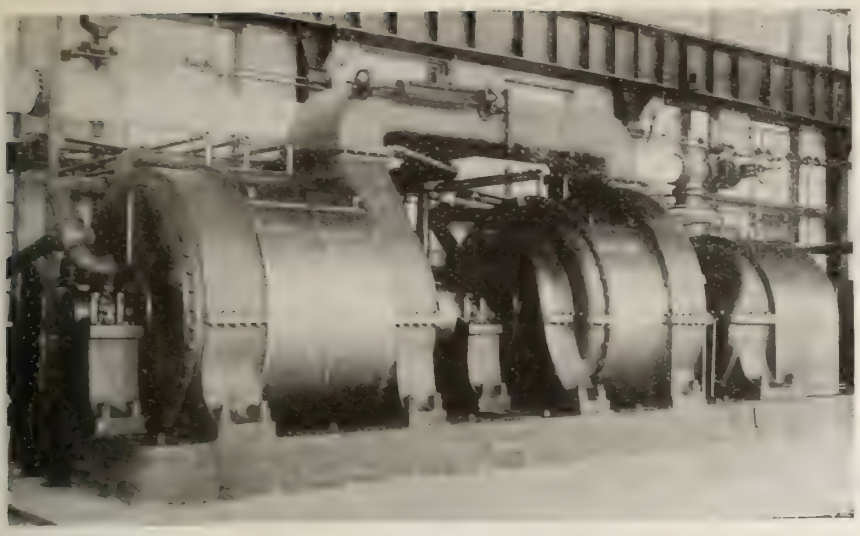
It is commonplace to say that tests and comparisons can be quoted to prove the superior economy of all types of power plant and transmission systems, and it is necessary to keep an open mind when listening to the advocates of particular schemes. The truth is that each system of power generation and transmission has its particular advantages and superior economy, and that maximum economy in works driving in a particular case may be obtained by a combination of two or more systems. Dealing with transmission systems where the plant is compact and conveniently arranged within a radius of 100 or 150 feet from the central power plant, mechanical transmission is most economical, while, with an increased radius, gas or electrical transmission has advantages, the former being the most enticing system from the point of view of thermal efficiency, but meantime having a more limited application. From this it will be understood that in small works and factories the most careful thought ought to be given to the works design in order to ensure a compact arrangement and efficient mechanical transmission. Where tools are set widely apart, electrical transmission with independent motors is economical, although where it is possible to have a group of tools in a works, an independent gas engine or electrical motor driving these through gearing is most economical than independent motors.

Individual and Group Driving

Where the amount of power required for individual machines is small it is almost always advisable to group them. That this conclusion is borne out in practice will be seen by examining the published descriptions of the electrification of several large engineering and shipbuilding establishments. From these descriptions it will be found that the average size of motor is steadily rising. The question of reliability and consequent need for stand-by plant is also important. Practically any one of these systems if properly installed can be regarded as reliable, but the subdivision secured by the use of motors or small gas engines has advantages. The chief advantages of the electrical transmission system are its adaptability and the ease with which it can be extended, and its chief drawback is its cost, a part of which at least is due to the refinements which have been introduced into electrical controlling and operating mechanism.

Prime Movers

The question of power generation like



SOUTHWORK RATEAU TYPE TURBINE OF LARGE CAPACITY.

the question of transmission depends for its solution upon the conditions of service. Where the power demand is very intermittent purchased electrical energy will be found to be the most economical. For a moderately steady demand up to about 100 to 150 b.h.p. the gas engine has no rival. Above this it is possible to purchase steam plants using highly superheated steam and furnishing power at an extremely low cost.

The units in the case of gas engine-driven generators may be of practically any size desired, while steam engine-driven units may be reciprocating engines up to 750 kilowatts, and steam turbines thereafter. Interesting results can be obtained from the combination of reciprocating engines with steam turbines, this combination giving a wide range of economical load at a modest capital cost, this advantage being got by cutting out the turbine from the lower loads and exhausting direct from the reciprocating sets to the condensors.

AMERICAN-RATEAU STEAM TURBINES

By I. N. S.

In the impulse type of turbine, few stages, or nozzle and bucket wheel elements, are required. Buckets are especially formed to economically transmit the energy of the steam through wheels to shaft; principal parts are few in number, and simple in design; delicate parts are avoided; and maximum of strength and reliability is obtained. The Southwark-Rateau turbine here described is built in three types; high pressure, low pressure and mixed flow, made for alternating current or direct current service with the generators either direct or gear-connected to the turbine.

The mixed flow governor maintains the speed of the turbine so nearly constant that it is unrivalled for use on turbo alternators of the mixed flow type. The ordinary speed controlled governor is entirely unsuited for this service, as the generator is invariably allowed to drop its load when the turbine changes from low to high pressure steam. With the Southwark-Smoot governor, however, no appreciable change in speed is observable during changing steam conditions.

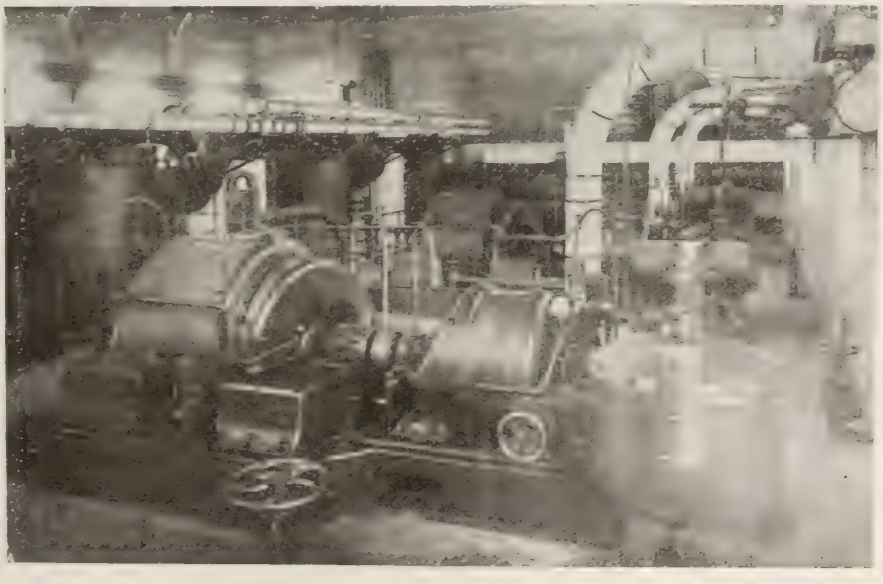
High speed gears, of double spiral or herring bone type ,are used in these turbines. Gears are so carefully cut and assembled that they may be operated at highest speeds without undue noise or vibration; the speed of a high speed turbine may be reduced to that at which the machinery is driven, with economical operation and both driving and driven units, coupled together through medium of gears, will operate under most favorable conditions.

The buckets of the turbines are milled from a solid bar, and the material used is an alloy steel of great toughness and wear-resisting properties. Its design provides exceptional strength and absolutely prevents loss of efficiency even after many years of service. By this construction all strains, due to forging or punching, are avoided. The shrouding is integral with the buckets, and these are so firmly attached to the wheels that the loss of buckets is unknown.

The wheels on which the buckets are mounted are special steel forgings. They are machined all over to exact size, and are balanced with greatest care. Pressure equalizing holes are provided to prevent any end thrust due to unequal steam pressures caused by eddies. After mounting the buckets these wheels are shrunk upon the shafts so as to form practically a single piece of solid steel. The diaphragms are made of iron or steel castings, as may be most suitable. They are held in place by grooves turned in turbine casing, and are thus rendered perfectly solid and steam-tight. Steam leakage around the shaft is prevented by a packing of the latest design.

The nozzles are made in two forms. Where high pressures are encountered, nozzles are of bronze castings finished by hand, so as to present a perfectly smooth surface to steam flow. The larger nozzles, used in low-pressure stages, are of a special grade of sheet iron. They are cast directly into the diaphragms by a special process, which provides the perfectly smooth surface so essential to an efficient nozzle. All nozzles are brought to exact size by gauge before assembling in place. The importance of this feature can hardly be over-estimated, as a seemingly insignificant error here causes a serious loss of efficiency. The oiling system consists of oil rings and forced feed on the larger units, and of oil rings alone on the smaller. The bearings are provided with deep oil wells so as to insure a constant supply of clean oil.

The steam passages are arranged to prevent loss due to eddies and friction. The support provided for the shaft is worked out with great care. The top half of casing is removable with the top halves of all diaphragms without breaking any steam connection. The bearing shells may be removed for inspection or repair without disturbing any other part.



SOUTHWORK RATEAU STEAM TURBINES.

The MacLean Publishing Company
LIMITED
(ESTABLISHED 1888)

JOHN BAYNE MACLEAN - - - - - - - President
H. T. HUNTER - - - - - - - - - Vice-President
H. V. TYRRELL - - - - - - - - - General Manager

PUBLISHERS OF

POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air, and Water Power, and to the design and operation of Refrigerating Machinery.

B. G. NEWTON, Manager. A. R. KENNEDY, Editor

Associate Editors:

A. G. WEBSTER J. H. RODGERS (Montreal) W. F. SUTHERLAND

OFFICES

CANADA—
Montreal—Southam Building, 128 Bleury St., Telephone Main 1004.
Toronto—143-153 University Ave., Telephone Main 7324.
Winnipeg—1207 Union Trust Building, Telephone Main 3449.
Eastern Representative—E. M. Pattison.
Ontario Representative—S. S. Moore.
Toronto and Hamilton Representative, J. N. Robinson.

UNITED STATES—
New York—R. B. Huestis, 111 Broadway, New York, Telephone 8971 Rector.
Chicago—A. H. Byrne, 900 Lytton Bldg., 14 E. Jackson Street. Phone Harrison 1147.
Boston—C. L. Morton, Room 733, Old South Bldg., Telephone Main 1024.

GREAT BRITAIN—
London—The MacLean Company of Great Britain, Limited, 88 Fleet Street, E.C., E. J. Dodd, Director, Telephone Central 11960. Address: Atabek, London, England.

SUBSCRIPTION RATE

Canada, $1.00; United States, $1.50; Great Britain, Australia and other colonies, 4s. 2d. per year; other countries, $1.50. Advertising rates on request.

Subscribers who are not receiving their paper regularly will confer a favor by telling us. We should be notified at once of any change in address, giving both old and new.

Office of Publication, 143-153 University Avenue, Toronto, Ontario.

Vol. XI. JULY 1918 No. 7

PRINCIPAL CONTENTS

Galt Waterworks 195-197
Canada's Waterpowers; Their Relation to the Fuel Situation 198-204
Electricity and Hydraulics 205-208
Principles and Operation of Modern Electrical Equipment ....Canadian Electrical Association Meet in Montreal.... A Remarkable Swiss High Power Magnet....Italian Chemist Prophesies a Day of Light.
Steam and Its Generation 209-211
The Nigger in the Coal Pile....The Influence of the Power Plant in Factory Design....American Rateau Steam Turbines.
Editorial 212
Central Station vs. Isolated Plant....All for Nature and Nature for All.
Association and Personal 213-217
The Twenty-ninth Annual Convention of the Canadian Association of Stationary Engineers.
The Operators' Point of View 218-219
Exhaust Steam vs. Live Steam....Calculating the Economy of Boiler Feed Traps....Heat Resisting Points.
Selected Market Quotations 220
Trade Gossip (Advtg. Section) 44-45

CENTRAL STATION VS. ISOLATED PLANT

THE controversy having to do with the respective merits of the central station and the isolated plant, in supplying power to industrial enterprises, has received a new impetus in the light of the problems of the present war. Centralization may be said to be the keynote of the age and the proposed schemes having to do with the establishing of enormous power plants at the mines and the distribution of the energy so created have much to commend them. This would free a large railroad tonnage for other purposes and would permit the utilization of every pound of coal mined to the best advantage.

The combustion of coal for the generation of power while allowing its valuable nitrogen content and other by-products to go to waste is inexcusable and it is to be expected that in the contemplated plants provision will be made for the conserving of this important natural resource by the establishment of by-product coke-ovens wherever possible.

In a country where fuel is hard to obtain and waterpower abundant it is manifestly to the interest of everyone concerned to make full use of this natural resource. To this extent it is better to take advantage of the central station's facilities for economical generation and distribution of power. But when the question of heating the industrial plant comes to the fore or where large quantities of steam are used in manufacturing processes the central station's advantage is very small indeed.

It is much better engineering practice to generate steam at a high enough pressure to utilize its inherent power in the steam engine or turbine and to use its remaining heat as required than it is to use almost the same amount of coal for heating and to purchase power generated at the cost of an additional amount of fuel.

It is an economic crime to burn coal for heating without taking advantage of its power-giving possibilities and it is this fact that renders the isolated plant successful in spite of its many inherent disadvantages. In this connection the use of induction generators, a recent development in hydraulic plants of small capacity, will probably offer a solution of the problem advantageous to the central station and the isolated plant alike. It is a characteristic of the induction generator that when connected with a central source of energy it needs no synchronizing or speed regulation and has no other complications requiring skilled supervision. A cheap type of prime mover is successful for its operation and its use would render available nearly 100 per cent. of the total heat value of the coal present in the steam at a low capital cost.

The central station would profit by the connection of this type of plant to its mains by being relieved of its winter peak and even in some cases by receiving power while the consumer would have all the advantages of central station energy in the summer months and cheap power during the remainder of the year.

ALL FOR NATURE AND NATURE FOR ALL

BEFORE another winter passes the possibilities attending a real coal famine will be brought home to many of us. It may be that personally we will not be physically inconvenienced but indirectly there will be many things to remind us that conditions are different from what they used to be, and careful thought will impress on us the truth that they never will the same again.

Political crises may come and go, questions involving taxes, tariffs, coinage, and social considerations generally may be decided and re-decided to meet the whims and fancies of parties in power so that ill-effects can be re-adjusted and inconveniences removed. But—interference with and misuse of natural resources bring their own reward. Nature out-Shylocks Shylock because she always gets her pound of flesh even though she may have to wait a thousand years for it.

Indiscretions of humanity in utilizing nature's resources have cost mankind untold sums and it is not putting it too strongly to say that the future conditions of existence of the human race are being decided now, and the decision is in two stages. First, is or is not man going to so conserve naturally recurring sources of power so that the human race will be independent of limited supplies of fuel? Second, are these sources of power to pass into the control of a select circle of individuals or be retained by the State as a national asset for the use of the people?

Suppose some clever, ambitious individual devised a scheme for shutting off sunlight and put up arbitrary rates for its supply irrespective of what his plant investment cost—in other words, got all it would stand. How long would the people stand for it? A reasonable amount of light and heat is necessary for every individual and as long as it can be obtained from any source whatever, it is a moral obligation of all responsible governments to see that it is supplied.

Association and Personal

C. A. S. E. CONVENTION

THE 29th annual convention of the Canadian Association of Stationary Engineers which was held at London, Ont., on June 25, 26, and 27, was generally conceded to have been one of the most successful since its inception, principally by reason of the fact that an important announcement was made by Dr. Riddell regarding the grading of engineers' certificates. The desirability of having graded certificates has been discussed at the conventions for a number of years but only recently has any material progress been made towards the attainment of this object. The announcement by Dr. Riddell was naturally received with much enthusiasm by the engineers who appointed a committee to work out the details in conjunction with Dr. Riddell and the Engineers' Board of Ontario of which body W. C. McGhie is chairman.

Another important matter discussed at the convention was the conservation of fuel. It was felt that the engineers, individually and collectively could do much towards conserving coal owing to the nature of their work and that great good towards this end could be accomplished by co-operating with the manufacturers. It was agreed to get in touch with the Canadian Manufacturers' Association and offer the services of the engineers in this connection in a consulting capacity or otherwise.

The exhibition of power plant equipment and supplies was up to the usual high standard, about twenty-seven firms exhibiting. The sports which were held on Wednesday at Port Stanley passed off successfully and the relaxation was as usual much appreciated. A pleasant evening was spent on Tuesday at Springbank Park, where an excellent supper was served followed by a musical entertainment. There were 60 delegates attending the convention, while about 230 persons went to Port Stanley and 175 to Springbank Park.

Convention Opening

The convention was opened on Tuesday morning at Hymen's Hall by Mayor C. R. Sommerville, with grand president R. F. Gofton in the chair, the mayor being introduced by George E. Moll, a past president of the local branch.

Mayor Sommerville extended a hearty welcome from the council and the citizens of London to the delegates. He hoped that pleasant memories would be with them in the coming year as a result of their visit to this city. He took much pleasure, he said, in promising them, on behalf of the citizens, the freedom of the city.

In a brief address, grand president R. F. Gofton thanked his worship and the council, and the general public of London for the hearty welcome. The city was complimented on its well-kept streets, and the general beauty of its parks and avenues. The strangers present would always maintain a high regard for the hospitality of the "Forest City."

Flight-Lieut. Lloyd Archibald, formerly of Toronto, but, since one year ago, a prisoner of war in Germany, was called upon for a speech. In the unfortunate absence of Lieut. Archibald, who is president of the executive of the Exhibitors' Association, Gordon C. Keith of Toronto addressed the audience. Regrets were expressed at the absence of the member of the Aviation Corps. Tribute was paid to the bravery which he had exhibited over the fields of France. The hope was expressed that his release from Germany would take place in the near future.

On behalf of the local lodge, a cordial welcome was accorded the delegates by W. G. Walters, to which S. Balmfirth of Toronto replied. The efforts which had been put forth by the local members for the entertainment of the visiting delegates were acknowledged by the speaker.

The conservation of coal was handled by F. R. Lowe, Editor of "Power," New York. Many suggestions were presented to the meeting along this line. The question of reciprocity in graded licen-

C.A.S.E. CONVENTION. GROUP OF DELEGATES AT PORT STANLEY.

C.A.S.E. CONVENTION. GROUP OF ENGINEERS, EXHIBITORS AND FRIENDS AT PORT STANLEY.

ses between the provinces of Ontario and Quebec was discussed by Ephraim Valiquet chief engineer of the Montreal water works, and chairman of the Board of Examiners for the Province of Quebec. He expressed the hope that the convention would take some action on the question. He came here at the suggestion of the Minister of Public Works Taschereau, to obtain the co-operation of the C. A. S. E. to this end. He was assured that this would be fully discussed at the meeting on Wednesday night.

A. M. ("Dad") Wickens of Toronto, founder of the C. A. S. E., spoke on organization of the craft in general. A resume of the growth of the organization was given. The progress of the engineering trade during the last few years was noted with a pardonable pride by the speaker.

Secretary J. H. Hale of Hamilton outlined the general business, which will come up before the convention, to the delegates.

C. B. Turner, chairman of the entertainment committee of the Exhibitors' Association, gave a hearty invitation to the engineers and their families to attend the picnic held at Port Stanley on Wednesday afternoon.

Tuesday Afternoon Session

A spirited discussion, dealing with the efficient operation of steam electric power plants occupied much of the time of the business on Tuesday. Several resolutions in reference to the question were formed by a committee and were presented to the convention later for approval.

The fuel situation and conservation in relation to electric energy was also discussed. An effort will be made to secure closer co-operation between the Canadian Manufacturers' Association and the C. A. S. E., with a view to the saving of fuel. A resolution was passed urging that the manufacturers who have electric generating plants, and who have some power to spare, offer their surplus energy to the central stations, where the proper connections can be readily made. A copy of this resolution will be sent to the Dominion Fuel Controller and to all members of the Manufacturers' Association. It was thought that this action would have a tendency to save coal this winter in the steam-operated central stations.

Graded Certificates

Graded certificates for engineers were practically indorsed by the convention. This opens the way for reciprocity in engineers between the several provinces of the Dominion.

The following committees were appointed: Credential — A. Clements, Hamilton; G. F. Galloway, London; M. J. Flood, Owen Sound. Mileage and per diem—D. Laver, Hamilton; W. Corham, Belleville; A. M. Wickens, Toronto. Good of the order—W. Greenless, Montreal; W. G. Walters, London; J. Brown, Toronto; A. D. Ross, Montreal; Charles Berry, Ottawa. Ways and means—F. Harper, Kingston; J. J. Heckman, Stratford; D. L. Webster, Bradford; J. McCaffery, Sudbury; W. Cougdon, Chatham; A. R. Taylor, Toronto. Auditors—I. J. Tait, Montreal; C. Ott, Kitchener; S. E. Cosford, Hamilton.

The financial statement, which was presented by treasurer A. W. Heath, of Hamilton, was very encouraging, and showed a good balance on hand.

New Lodges Proposed

Communications asking that lodges be established in the respective centres were received from Drumhella, Alta.; Leamington, Windsor, Sarnia and Winnipeg. Woodstock and Ingersoll also want a lodge. The organization of these will be proceeded with as soon as possible.

S. E. Wichert, president of the National Association, telegraphed his regrets that he was unable to be present.

F. W. Raven of Chicago, grand lodge secretary, was present and gave a brief address on questions of general interest to the engineers.

Several technical questions were discussed by W. C. McGhie, S. Balmfirth, J. H. Hale, I. J. Tait, A. M. Wickens

Wednesday Morning Session

The session on Wednesday morning opened with a discusion regarding the place for next year's convention, a decision being left over until Thursday.

The proposition to hold the convention biennially, while it had a number of ardent supporters, was turned down by the executive. It was thought that with a meeting every two years, the members would lose interest in the convention. The expense of the annual meeting was thought to be well repaid in the benefits which the individual members received.

Much of the business on Wednesday morning was of a private nature in connection with the various lodges. The meeting adjourned at noon, to meet on Thursday morning.

Concluding Sessions

The session on Thursday morning was devoted to finishing up business left over and the election of officers for the ensuing year. A committee was appointed to work out details in connection with the grading of engineers' certificates. A resolution was also carried appointing a committee to get in touch with the Canadian Manufacturers' Association in connection with conservation of coal. It was unanimously decided to hold the convention next year at Brantford, Ont., to begin on the last Tuesday in June.

A resolution unanimously recommending reciprocity of licenses between the several provinces of the Dominion and the United States, was adopted by the meeting. Copies of the resolution will be sent to the Public Works Department of Ontario.

S. Balmfirth, of Toronto, was chosen to represent the C. A. S. E., at the convention of the N. A. S. E., which is to be held in Cincinnati in September.

Hearty votes of thanks were tendered the Exhibitors' Association for the entertainment at Port Stanley on Wednesday; to the N. A. S. E. for the silk Stars and Stripes which was brought from that body to the C. A. S. E. by secretary F. W. Raven, and to F. W. Raven for his helpful messages to London Local No. 30; Mayor C. R. Somer-

ville, the city council, and the citizens generally for the hospitality shown; the Ladies' Auxiliary, and the press.

Election of C. A. S. E. Officers

The following Grand Lodge officers were elected for the ensuing year: Past president, R. F. Gofton, Kitchener; president, W. M. Cooke, Belleville; 1st vice-president, George E. Moll, London; 2nd vice-president, I. J. Tait, Montreal; 3rd vice-president, Daniel L. Webster, Brantford; secretary, John H. Hale, Hamilton (re-elected); conductor, Charles Berry, Ottawa; door-keeper, A. R. Taylor, Toronto.

A past president's jewel was presented to R. F. Gofton.

All officers were installed in the afternoon by grand installing officer S. E. Cosford, Hamilton and grand tyler F. W. Raven, national secretary of the N. A. S. E., Chicago.

Ladies' Auxiliary

The Ladies' Auxiliary is planning to organize a branch in London among the engineers' wives. A number of applications are already filled out, and it is hoped that a lodge will be started here soon. During their visit to London, the ladies were shown through the factories of the McLary Mfg. Co. and the McCormick Mfg. Co. At both places they were treated to a luncheon by the respective firms.

The Ladies' Auxiliary elected the following officers: Past president, Mrs. W. A. Sweet, Hamilton; President, Mrs. W. G. Blackgrove, Toronto; Vice-president, Mrs. C. W. Fowler, Toronto; Secretary, Mrs. Charles Hooper, Ottawa, Treasurer, Mrs. Edward Grandbois, Chatham; Conductor, Mrs. C. Ott, Kitchener; Doorkeeper, Mrs. A. W. Heath, Hamilton.

Exhibitors' Association Officers

The annual meeting of the Exhibitors' Association was held on Thursday morning with vice-president C. W. Schrag in the chair. The ordinary routine business was disposed of and a message of sympathy was sent to Mrs. Archibald, mother of Flight-Lieut. Lloyd Archibald who is a prisoner of war in Germany. It was agreed to hold the exhibition at Brantford next year, this decision being made after receiving an announcement that the engineers would hold their convention in that city. The officers of the Exhibitors' Association were also elected as follows: Past president Lieut. Lloyd Archibald, Toronto; President, C. N. Schrag, Toronto; 1st vice-pres., James Mock, Montreal; 2nd vice-president, C. B. Turner, Toronto; Treasurer, B. G. Newton, Toronto; Secretary, Gordon C. Keith, Toronto; Assistant secretary, L. H. Rumage, Buffalo; Chairman exhibits committee, A. Betton, Toronto; Chairman reception committee, H. Ramshaw, Hamilton; Chairman entertainment committee, B. Curzon, Montreal.

Entertainment and Addresses

The programme on Wednesday evening in the Exhibition Hall included musical entertainment, distribution of prizes and addresses by Dr. W. A. Riddell, Fred W. Raven, E. F. Valiquet, W. C. McGrie, F. R. Lowe, and a humorous monologue by Jack Armour. During the evening Dr. W. A. Riddell, Fred W. Raven, F. R. Lowe and A. M. Wickens were made honorary members of the C. A. S. E. Grand Lodge. The ceremony was performed on the platform, the obligation being delivered by the retiring grand president, R. F. Gofton, while S. Balmfirth officiated as conductor.

The proceedings opened with the presentation of prizes to the successful contestants at the sports during the afternoon at Port Stanley. Gordon Keith acted as chairman during the evening and performed his duties in a fitting manner. The prizes were presented by C. N. Schrag.

The next item on the programme was the presentation of a handsome case of spoons, knives and forks to Gordon Keith, secretary of Exhibitors' Association in recognition of his services on behalf of the association. The presentation was made by Jack Armour. Mr. Keith in replying thanked the donors for their kindness and intimated that he had filled the position of secretary for nine years. W. C. McGhie, on behalf of the Exhibitors' Association then presented an umbrella to George E. Moll of the London Lodge.

Dr. W. A. Riddell's Address

An important feature of the entertainment was an address by Dr. W. A. Riddell, superintendent of the Trades and Labour Branch of the Ontario Department of Public Works. Dr. Riddell prefaced his remarks by thanking the C. A. S. E. executive for the honor conferred in making him an honorary member of the Grand Lodge. Dr. Riddell then proceeded to give an outline of the history of the Trades and Labour Branch stating the purposes and scope of his department. Reference was made to the employment bureau and its operation in the Province of Ontario. Dr. Riddell stated that a large number of men and women had been placed in positions in factories and on farms. Over 200,000 boys had also been enlisted in the food production campaign. Employment bureaus which have been opened in several cities in the province, have done much to relieve the unemployment situation. The department has also done much towards improving conditions for the employees in various industries and also made investigations in connection with vocational work for boys.

Dr. Riddell's memorandum covering the grading of engineers, certificates read as follows:

Fourth Class Certificate

This Certificate shall be known as a "Fireman's Certificate," and shall be optional on the part of the applicant. This class will include firemen, night watchmen, and other assistants to the engineer. The examination is to be oral, the questions based on the safe handling of steam boilers and feeding apparatus.

Present or Compulsory Certificate

The Certificate which has been known as the "Stationary Engineer's Certificate" since the inauguration of this Board in 1918, shall, after the grading of Certificates, retain its present standard, and it shall be compulsory for all engineers operating stationary steam plants of fifty horse-power or over carrying over 20 pounds steam pressure, to hold this Certificate, irrespective of the Fireman's Certificate which they must obtain before trying this examination, unless they can produce a Certificate of equivalent value issued by another Government Board. The examination is of a purely practical nature.

Second Class Certificate

This Certificate shall be optional and recognized as one grade above the present engineer's Certificate. Examinations are to writen and the questions are to be of a practical and technical nature combined. An applicant for this Certificate must be a holder of the present Stationary Engineer's Certificate issued by this Board, or a Certificate of equivalent value issued by another Government Board.

The holders of the present Certificate may be granted Second Class Certificates providing their experience, standing, character, etc., warrant same; length of experience to be decided on at a later date by the Board.

First Class Certificate

This Certificate shall be optional and one grade above the Second Class Certificate. An applicant for this Certificate must hold a Second Class Certificate issued by this Board, or its equivalent issued by some other Government Board, together with ten years' continuous experience in the handling of steam plants. This Certificate can be obtained by examination only, such examination to be of a highly technical and practical nature.

General Information

On and after the First day of January, 1919, this Board will be open to receive applications for the four grades of Certificates mentioned, and forms for same can be obtained by making application to the office of the Stationary Engineers' Board, 15 Queen's Park, Toronto.

On and after the First day of January, 1920, an applicant for any grade must first obtain the lowest grade, and take all examinations up to the grade they may desire, except they can produce Certificates of equal standard issued by another Government Board.

The present or Compulsory Certificate only will be issued to applicants for a Provisional Certificate.

It is the intention of the Board to have all applicants' forms which have been returned to the Board classified into their respective grades by January 1st, 1920.

A vote of thanks proposed by George E. Moll and seconded by S. Balmfirth, was passed expressing the appreciation of the engineers to Dr. Riddell for his efforts on their behalf.

Fred W. Raven's Address

Fred. W. Raven, of Chicago, secretary of the National Association of Station-

ary Engineers, after being introduced by Gordon Keith addressed the gathering, as follows in part:

"The successful organization is the one where the membership takes enough interest to select the proper men as officers and where the officers realize their duty to the organization by always leaving something of interest at each meeting. Such an organization not only becomes great influence but greater in its usefulness to its members and the community. Try and obtain only those men as members who have ambitions and are willing to attend meetings and take part in the work and discussions. Watch closely those who like an active interest and are willing to do something for the other fellow once in a while, these are the men to advance.

"Officers cannot be too careful in the selection of men on committee, some are more or less adapted for certain work and from such selection comes results. The principal committees outside of the educational, are the employment and sick visitation committees."

Mr. Raven in referring to the conservation of fuel said that there is plenty of coal for everybody in the world. There is enough known to last the world over 1,000 years, but most of it is in the ground and mighty little above. Last winter we had many cold days and fuel was scarce, and it will be scarcer this winter. There needs to be 2,500,000 tons of coal mined every day to fully supply our wants. Statistics show that less than 2,500,000 tons are mined each day. There are approximately 600,000,000 tons of coal mined each year, a third of which are used by the railroads.

"Now it is up to you and me, as engineers, to conserve all the coal we possibly can. We are the men that our governments are looking to and expect much from. Our work as engineers means much these days." Mr. Raven referred to the educational value of conventions and the assistance which is being offered by the Boards of Trade and Chambers of Commerce etc., to induce manufacturers to settle in their respective cities. The advantage of fuel and rail facilities were cited as being valuable in the attainment of success but it also required men with brains and capital, men with courage to invest and produce to make success complete. Mr. Raven spoke of the advantages of good feeling between the employer and the worker, and also of the benefits obtained by having pleasant surroundings in the home and in the factory, such conditions tending to produce a healthy and satisfied community which will bring forth the best type of citizenship.

In connection with the work of engineers' organization Mr. Raven stated that the principal duties of organizations of our character is to educate our membership in the arts and sciences of steam engineering and its allied branches and so develop them as to produce for our profession the finished operator who can go to any city and handle any class of machinery now known to produce heat, light and power at the least possible cost, with that great end in view of saving as much as is possible of our national resources for the generations that follow us. Engineers, license laws are very necessary so as to divide engineers from the so-called engineers. It is therefore one of our greatest duties to devise ways and means to put on our statute books laws that will provide for the examination of men who aspire to be called engineers.

"The fact that to-day we are living in the midst of a brilliant civilization and thus made possible largely by the operating engineer. This organization has done its share in past years and hopes to do greater in the future."

"Ambition, inspiration and knowledge travel together and this organization is striving to bring forth these results. Let each and every one aid one another to make life worth living by pratising true fraternalism and so make this old world a better place to live in. And so it is only by fairness between man and man that we can be successful, remembering that "to arbitrate is wisdom" and "to earn more you must learn more."

Mr. Raven at the conclusion of his address presented the C.A.S.E. executive with a silk American flag, for which act of courtesy Bro. E. R. Grofton returned thanks on behalf of the engineers.

Message From Quebec

E. F. Valiquet of Montreal member of the Stationary Engineers Examining Bureau of Quebec, tendered a message of good will from the engineers in Quebec provinces and referred to the advantages which had followed the grading of certificates in the Province of Quebec. Mr. Valiquet's address was very interesting and was well received.

Engineer's Board Activities

The next speaker W. C. McGhie, chairman of the Engineers Board for Ontario gave an interesting review covering the work of the board since its inception ten years ago and also explained how the Stationary Engineers Act explained the method of gathering information from all sources and using the data as a groundwork for drawing up the new act for grading certificates. Various authorities were consulted in order to obtain the views of the various interests concerned. Mr. McGhie stated that conditions at present owing to the war, did not warrant compulsory grading of certificates but expressed the opinion that ultimately this would be adopted. Mr. McGhie asked the engineers to support the Board in framing the new act, because he wanted it to be the best act in America.

F. R. Lowe, of New York, editor of "Power," spoke on the efforts which are being made in the United States in the prosecution of the war, intimating that 1475 steam boilers had been shipped to France to General Pershing. Mr. Lowe spoke at length on the conservation of coal and also on boiler inspection as it affects the community.

At this stage of the proceedings Jack Armour was called upon to offer a vote of thanks to the C. A. S. E. London Lodge for their hospitality and concluded with a humorous monologue which was much enjoyed.

During the evening a musical entertainment was rendered by Mac's orchestra and songs by Earl Hetherington.

Sports at Port Stanley

On Tuesday the engineers, exhibitors and their friends spent a most enjoyable evening at Springbank Park. About 170 sat down to an excellent lunch which was followed by a musical programme, furnished by the McClary orchestra. The following were responsible for the arrangements: George Moll, chairman; W. Walters, D. F. Campbell and D. Freedy. J. Armour of New York in a humorous speech, gave an account of a "colored" wedding.

A most enjoyable afternoon, favored by fine weather, was spent at Port Stanley on Wednesday where a good programme of sports was carried out. The programme was put on by the Exhibitors Association and the guests numbered 230. A special train of six cars on the London and Port Stanley Railway was required to carry the crowd to the Port. What was described as one of the fastest and one of the most scientific games of baseball was played by teams picked from the engineers and the supply men. The score at the end of the fifth inning, when the last call was made for supper, was 14-10, in favor of the engineers. W. G. Walters captained the engineers and L. F. Mayne led the supply men to a near-victory. The pitchers were L. F. Mayne and George F. Galloway, and the catchers were John Middleton and Geo. Ayrscott.

In the young ladies' race Agnes England led, with Kathleen England and Florence Galloway tying for second place. Mrs. D. R. Laver and Mrs. Dan Freedy demonstrated their speed in the potato race, winning first and second among a number of competitors.

The fat ladies' race was won by Mrs. S. Nash and Mrs. A Clements.

Mrs. D. Freedy with John Whittaker and Mr. and Mrs. D. Laver won the prizes in the thread-and-needle race by a small margin.

In the boot and shoe race G. F. Galloway led, with S. Balmfirth next.

John Whittaker and S. Balmfirth crossed the line ahead of the rest of the fat men.

In the "over 40" class W. L. Roadhouse and John Agroff carried off the honors.

The biscuit-eating contest was won by Mrs. William Middleton and Mrs. D. R. Laver.

G. F. Galloway with J. Whittaker, and C. N. Schrag with S. Balmfirth, after numerous tumbles, headed the list in the wheelbarrow race.

Mrs. D. Laver and Mrs. S. Nash for the ladies, and J. Thompson and C. N. Schrag for the men, displayed their ability in picking clothespins off a line with their teeth and beat all other competitors easily.

J. Williams of Quelph was the oldest engineer on the grounds who is actively

engaged in the operation of a steam plant.

The prize for the largest family was not awarded. Apparently engineers have no families. At any rate, several who intended trying for this prize could not gather their children together at the time of the judging.

C. B. Turner and George E. Moll were the judges, while Earl Hetherington and C. W. Schrag also officiated in a similar capacity. A photograph was taken of the entire party and also of the delegates. After a war luncheon served in the cafeteria, the party left for London in special cars.

Exhibitors, Representatives and Exhibits

Allen General Supplies Ltd., Toronto. E. D. Wilkes, Venturi meters and regulators. Dwight Co., indicator. Eclipse steam specialties.

Geo. W. Cole, Ltd., Toronto.—W. H. Rose and J. E. Farrell, Cole boiler feed trap. Cole check valve.

V. D. Anderson Co., Cleveland.—L. H. Rumage, Steam traps and other power specialties.

Canadian Fairbanks-Morse Co., Toronto and London.— Fred Evans and M. J. Kane of Toronto and R. V. Donaldson of London, Durablo sheet packing, Palmetto packings, Farnsworth Vacuum trap, steam specialties.

Crane Packing Co., Toronto.— R. R. Grant and J. E. Ayrscott, Metallic packing for all purposes.

Darling Bros., Montreal.—E. B. Curzon, Reliance marine reducing valve. Dexter reseating machine. Clarke flexible coupling. Syphon and steam traps. Duplex pump etc.

Deaborn Chemical Co., Toronto.—T. Beebe and J. Thompson. Deaborn boiler feed and water treatment.

Canadian Manufacturer, Toronto.—Gordon C. Keith.

Dunlop Tire & Rubber Co., Toronto.—Packings and mechanical rubber goods.

Dart Union Co., Toronto.—Dart Unions.

Equipment Specialties, Ltd., Toronto.—C. W. Schrag. Literature covering valves and centrifugal pumps, etc.

Empire Mfg. Co., London.—L. F. Mayne. Valves, cocks and brass goods.

The R. Bigley Mfg. Co., Toronto.—E. A. Wilkinson. Lunkenheimer steam specialties, valves, etc.

Garlock Packing Co., Hamilton.—R. A. Lyons and H. J. Ramshaw. Garlock packings, gaskets and pump valves, etc.

France Packing Co., Tacony, Pa.—A. F. France and A. W. France. Metallic packings for marine and stationary service.

Goldie & McCulloch Co., Galt.—Earl F. Hetherington. Photographs and literature descriptive of engine and boiler installations and the "Roturbo" pump.

Green's Economizer Ltd., Toronto.—C. W. Worthington, T. J. Tait. G. C. Usher and T. F. Daggett. Green's fuel economizer, Uehling Co., recorder. "Roto" tube. cleaner. Type "E" underfeed stoker. Custodis radial brick chimneys.

John W. Gates, Montreal.—John W. Gates. Patent Boiler settings and fire brick arch.

International Chemical Co., Toronto.—J. M. Allen. Betson's plastic fire brick. "Protecto" treatment for boiler feed water. "Protectocoat" for concrete. Protecto belt preservative, etc.

James Morrison Brass Mfg. Co., Toronto.—A. Betton and J. Noble—Display of brass goods, valves, lubricators, whistles, injectors, gauges, etc.

National Boiler Seam Protector Co., Toronto.—W. E. Holder. Garth boiler seam protector and blow-off pipe protector.

E. Leonard & Sons, London.—Engines and boilers.

Mason Regulator & Engineering Co. Montreal.—E. T. Jeffrey, W. R. Kay and H. L. Peiler.—Bundy traps and oil separators, Coppus blowers, Stratton steam separators, Everlasting blow off valve, Ashton steam specialties. Mason valves and regulators, etc.

Jenkins Bros., Montreal.—T. S. Mock—Valves and packing.

Mueller Mfg. Co., Sarnia.—F. F. Heximer.—Regulating, reducing and relief valves, fan engine regulating valves, strainers, globe valves, steam cocks and pipe end reamers, etc.

Power, House, Toronto.—A. G. Webster, A. J. Tallman.

Power.—New York. F. R. Lowe and J. Armour.

Quaker City Rubber Co., Philadelphia.—G. M. Wilkinson-Daniels, P.P.P. rod packing. Ebonite sheet and stop valve packing. Full line of high grade mechanical rubber goods.

Thompson-Gordon Ltd., Hamilton. E. Gordon. Packings.

London Engine Supply Co., London. Packings.

C. B. Turner, Montreal.—C. B. Turner. Plastic boiler lining. Myers boiler cleaner.

W. R. Sexton Boiler Setting Co., Toronto. W. R. Sexton. "Nonpareil" shaking grates.

THE DECAY OF METALS

By decay of metals is meant changes of an unfavorable character that take place when in use or in storage, especially those that proceed completely through the mass of the metal. The simplest of these is the disintegration due to molecular change of the kind known in chemistry as allotropic. This is especially observable in tin, which becomes unstable at 644 degrees F. and may gradually change from a tough white metal into a gray powder. This condition is first manifested as small spots at which mounds of gray powder soon appear. In a short time, each spot becomes a hole, which rapidly perforates the metal. A peculiarity of this trouble is that it rapidly spreads from one place to another, like an infectious disease; it is therefore known as the "tin plague." In cold countries like Russia, the tin roofs of the affected areas are quickly destroyed when the process of decay is started. It seems as though the powder must be carried by the wind, and that wherever it settles it starts the tin decaying. Tin is also likely to undergo a molecular change at the temperature of boiling water. This is shown by the columnar structure that is frequently found in pieces of broken condenser worms. Allotropic changes occur also in lead, especially lead sheets subjected to the application of solutions containing lead salts. This change does not appear to be connected with the impurities in ordinary lead, as it seems to occur as readily with common sheet lead and the purest assay foil.

Decay may also be due to the movement of gases dissolved in a metal. This is the cause of the brittleness of nickel wires used as resistances in electric furnaces. The heating of the wire sets free the dissolved gases invariably contained in nickel. As the cooling between two periods of use is too rapid for a complete reversal of the process, a part of the gas remains undissolved between the grains of metal. As this alternate heating and cooling continues, the grains separate and the wire crumbles.

PERSONAL

J. M. Wilson has resigned as editor in chief of POWER HOUSE and allied publications of the MacLean Publishing Co., Ltd., Toronto, to accept a position on the engineering staff of the Standard Parts Co., Inc., Cleveland, O.

The death occurred at Hamilton on Monday, June 24, of John Howard Kerr, secretary of the Canadian Westinghouse Co. The funeral took place in Pittsburg. Mr. Kerr was well known to the electrical and machinery trade in this country.

S. A. Armstrong, deputy minister of the Soldiers' Re-establishment Commission, it is understood, has been offered the position of general manager of the Jones Underfeed Stoker Co., of Chicago. The Chicago position is rated at $25,000 per annum.

J. S. Donal has been temporarily assigned as manager to the Canadian Bond Hanger and Coupling Company, Alexandria, Ont., from one of the associated companies in the United States. R. J. Rose, who was the former manager, is now with the Newport News Shipbuilding Company, Newport News, Va.

Alfred C. Roelfson, vice-president and works manager of the Roelfson Machine Co., Galt, Ont., was married on Saturday, June 15th, to Miss Alberta McBride of Galt, daughter of William McBride, of the safe and vault department of the Goldie & McCulloch Co., Galt. After the ceremony the newly married couple left for New York and Boston.

THERE is an item of expense, in the way of lost heat units, in blowing down a boiler; hence, undue liberality in the operation is to be avoided.

The Operators' Point of View

EXHAUST STEAM vs. LIVE STEAM

MR. BALMFIRTH'S experience with live steam for heating is not an isolated one.

In a district steam heating plant not far from here it was common practice some years ago to run engines with a friction load in order to get exhaust steam for heating in preference to live steam.

The exhaust from an engine running with a friction load must be superheated unless the boiler pressure is very low.

It is therefore in the same condition as the steam which has passed through a reducing valve except that its superheat is not so great, due to the heat required for the friction load and the greater loss through radiation from the cylinder, pipes, etc.

There is not much doubt that the exhaust from Mr. Balmfirth's engines was superheated, as they had no load. I hardly thing that Mr. Balmfirth's explanation is correct.

If it were correct, then a pressure gauge installed at the extreme end of the heating system would show a lower pressure with live steam than with exhaust, which is not probable.

If there was actually more live steam than of exhaust, admitted to the heating system, then there must have been more heat units, and those heat units must have been dissipated before the steam would be condensed. There must, therefore, have been some pretty busy radiators in the area heated, namely, the middle of the lower floor.

As we have no evidence that more steam was admitted, and none that the reducing valve was of sufficient capacity, it leaves an opening for me to make a guess, which is that the pulsations of the engines prevented the bubbles of steam from sticking to the boiler surface and so reducing the efficiency of the boilers.

If Mr. Balmfirth would reepat the experiment and find out if more live steam was used, it might enlighten us, and, perhaps, then another guess would be in order.

St. Catharines. R. McLaren.

CALCULATING THE ECONOMY OF BOILER FEED TRAPS

THE writer has frequently heard discussions regarding the difference in economy of boiler feeding by direct acting boiler feed pumps compared with direct return boiler feed traps, but has never yet met anyone who has actually calculated the savings in favor of feed traps. In view of the wide claims which are made by all trap makers, the writer decided to figure for himself taking for example the feeding of a 100-horse-power boiler at 100 pounds pressure.

The example is based on the pump using 150 pounds of steam per horse-power hour delivered (Babcock on steam) gives very much higher steam consumption.

100 h.p. x 30 equals 3,000 pounds of water per hour, or 50 pounds per minute. 100 pounds pressure equals 230 feet head (approx.).

50 pounds x 230 feet equals 11,500 feet pounds to move the water (actual). Add for friction in pipes and valves, elbows, etc., 25 per cent. additional, 2,900; Add for slipping and losses, 25 per cent. additional, 2,900; total feet pounds of work, 17,300; total feet pounds, 17,300; 33,000 equals ½ h.p.

150 pounds of steam x .5 equals 75 pounds of steam required to do the work.

Steam used per hour to feed boiler by pump, say 75 pounds; 30 pounds of water evaporated, being 1 h.p. (75/30 pounds). This equals 2½ h.p. or 2½ per cent. of the boiler power required to operate the pump. This figure is very conservative, as average tests show about 4-5 per cent.

Feeding the same boiler with a boiler feed trap, using condensation, which returns at say 50 pounds pressure and 300° F. temp., as boiler feed water.

As before, the boiler requires 3,000 pounds of water. This quantity multiplied by 27.7, equals 83,100 cubic inches required per hour for evaporation.

As the trap will operate forty-five times per hour in average practice, it will handle 83100/45 or 1847 cubic inches per operation. For each operation this equals 1.07 cubic feet of water handled by the trap (1847/1728—1.07 c. ft.), and discharged into the boiler.

In practice, this water is displaced by an equal volume of steam admitted to the drum of the trap. The trap is operated under boiler pressure (100 pounds).

After the water is displaced 1.07 cubic feet of steam at 100 pounds pressure remains in the drum. The weight of 1.07 c. feet of steam is .278 pounds (see steam table). Weight of 1 cubic foot at 100 pounds pressure, .26 pound).

As the condensation (or water) is at 50 pounds pressure, the pressure in drum must be reduced to 50 pounds before the water will enter. Some of the steam escapes until the pressure drops to 50 pounds, when there remains in the drum 1.07 cubic feet of steam at 50 pounds pressure. The weight of this volume of steam is .161 pounds (1.07 x .151 (see steam table for this). As the water now enters the trap, this steam which remains is condensed by the water.

The temperature of the water in the drum of the trap is raised by absorbing the heat given up by the steam in condensing to water. The contents are 66.9 pounds of water. The latent heat in the steam at 50 pounds pressure is 904 B. T. U. per pound. There is .161 pounds condensed, containing 145.5 B. T. U. This heat divided by the water contents gives a temperature raise of about 2° F. in the mean temperature of the water, or 6,000 B. T. U. per hour.

The difference between the weight of the original volume at 100 pounds pressure (.278 pounds) and the volume at 50 pounds which is condensed (161) represents the weight of steam which exhausts from the trap at each operation. This amount is .117 pounds of steam.

As the boiler feed trap operates forty-five times per hour, the steam escaping from the trap equals 5.265 pounds of steam per hour in the form of exhaust steam. This represents the amount of steam used to feed the boiler.

With the pump, and boiler feed trap, operating under these conditions, the saving of steam consumed in feeding the boilers is the difference between 75 pounds of steam used by the pump, and 5.26 pounds of steam used by the trap. which is equal to 69.66 pounds of steam which is equal to 69.66 per hour or about 92 per cent. of the steam required by the pump.

The saving of steam in favor of the boiler feed trap operating for ten hours a day is 696 pounds of steam for the same amount of work as developed by the pump.

When steam at 100 pounds is admitted to contact with water in the boiler feed trap at the temperature above 332° F. the steam must superheat the water to approximately the temperature of the steam, before the presure of the boiler is established in the drum of trap. This temperature is about 338° F., and to gain this heat the latent heat of the steam at 100 pounds pressure is given up to the water to the extent of 6° F. to each pound of water, or a total of 401.4 B. T. U., which is the latent heat of rather less than ½ pound of steam

at this pressure. The final temperature of water leaving the boiler feed trap is approximately 8° F. higher than the temperature of the condensate at 50 pounds pressure entering the trap. This is a clear gain, when compared with the boiler feed pump where the water is not affected in temperature.

With a double trap system operating as a boiler feeding apparatus, and using a boiler feed trap above the boiler, and a lifting trap of the "condenser" type below the boiler. The condenser drawing the water from an open heater, and operating under a 50-pound lifting pressure, and about 25 pounds water pressure on the condenser spray. The amount of steam required to feed the boiler would be just about double the above, as the condenser trap would consume about the same as the boiler feed trap, or perhaps slightly less steam.

The total steam consumption for the double trap system would be thus about 10.5 pounds of steam per hour against 75 pounds of steam per hour for the pump. The work would thus be done on 14 per cent. of the steam consumption of the boiler feed pump.

The daily steam consumption for the pump working ten hours is 750 pounds. The daily steam consumption for the double trap system working 10 hours is 105 pounds. The daily steam saving in feeding boiler is 645 pounds.

Assuming the steam is produced at the rate of 8 pounds of steam per pound of coal, the coal saving on feeding the boiler by traps is approximately 80.18 pounds of coal per ten hour a day. The yearly coal saving for 300 days would be twelve tons at least, for each 100 h.p. in the boiler plant by operating an efficient automatic boiler feed apparatus.

From tables prepared by authorities, based on experiment and practice, it has been found that the relative fuel consumption and economies for the different methods of boiler feeding is about as follows: 100 pounds of coal required for pump, feeding cold water taken as standard, or unity.

Boiler Feeding Method	Amount of Fuel Used Lbs.	Saving of fuel over the amount required by pump feeding cold water
Direct acting pump feeding cold water	100	0%
Injector feeding and warming the water, average temp. (150 deg. F)	98	2%
Injector feeding through heater at average temperature (200 deg. F.)	93	7%
Direct acting feed pump feeding through heater	88	12%
Power pump through heater	86	14%
		hot or cold water pump feeding with Over direct acting
Direct return boiler feed traps as before explained	14	86%

Note.—The last figures are the writer's, and based on the previous explanations and his experiences in this line.

Which is the most economical method of boiler feeding?

HEAT-RESISTING PAINTS

By Mark Meredith.

The best heat-resisting paints are made from hardened asphaltum or pitch, dissolved in a fluid solvent; whilst for temperatures below the boiling water, casein, animal albumin and alkali silicates have given good results, writes a German authority. Pyroxylin varnish is very durable, but browns when heated, and can only be used when in admixture with black body colors. The following preparations are worthy of mention.

Roman Prasser's Recipe.—Equal parts (40) of pigment and spirit varnish (compounded of 1 part of bleached shellac in 7 parts of spirit) are intimately mixed with 1 part of camphor and 5 parts of bleached oil varnish. The article to be coated is brushed over several times with a mixture of gypsum and spirit varnish, flatted and painted over with the above preparation, being finally polished lightly with shellac varnish. This paint will stand the heat of boiling water for some time, but browns on prolonged exposure and peels off.

G. M. Neisel's Recipe.—Solid fats or fatty acids are distilled at 250 to 300 deg. C. with superheated steam. The residue being mixed with about 10 per cent. of red lead and 2 per cent. of litharge, treated with superheated steam at 400 to 500 deg. C. and thinned down at 150 to 200 deg. C. to workable consistency with linseed oil. As an alternative method the dilution with linseed oil is replaced by blowing in 25 per cent. of petroleum vapor, and then diluting with the crude benzol or other dilutent when sufficiently cool. The product is said to dry with a glossy surface, and to stand a dry heat of 500 deg. C. or damp heat up to 250 deg. C. As a matter of fact, an asphaltic substance and especially the distillation residues from fats (bone pitch, etc.) are capable of resisting high temperatures, and are used for stoving enamels.

Meyer's Recipe.—Residues from the distillation of fatty acids are heated to about 500 deg. C. with lead oxide and lead peroxide for three to four hours until thoroughly combined, the mass being dissolved in mineral oil and thinned down with turpes.

Bethisy's Recipe.—The mass consists of nitro-cellulose and a solution of calcium chloride in amyl acetate, with an addition of ether, alcohol, alum, talc, asbestos or mica, elasticity being imparted by vaseline oil or lavender. Celluloid varnishes are capable of standing a certain amount of heat.

Selmay Meyer's Recipe.—A heat-resisting varnish for iron ware, especially iron stoves, etc., is prepared by mixing powdered liver of sulphur, cyanide of potash, bicarbonate of soda, and sufficient cassel brown to give the desired color, and the mixture is saturated with alcohol. The pulp is passed through a sieve to remove coarse particles, and after being applied to the metal is exposed to a temperature of 200 to 300 degrees C. Other fireproof pigments may be submitted for the brown. This preparation is an enamel rather than a paint, but will stand heat very well.

Syracuse Tar.—A mixture of finely ground alum, asbestos and borax or boric acid is stirred into melted coal tar, the proportions being 60 to 65 or 40 to 50 parts of tar, 8 to 4 to 2 to 8 of alum, 20 to 5 or 38 to 30 of boric acid, 12 to 5 or 20 to 13 of borax, and 5 to 8 of asbestos. The idea seems to be that the salts will sinter together under the influence of the heat, the tar being presumably carbonized.

Avenarius' Recipe.—Ten parts of alkali silicate are heated under pressure with 25 parts of casein, a pasty mass being formed. This liquid is mixed with 0.2 part of carbonate of magnesia and 0.1 parts of borax, to increase the heat-resisting properties, whereupon 0.15 part of zinc oxide, 0.3 part of sodium phosphate and a suitable quantity of lime and earthly pigment is added to give covering power. For use, the mass is thinned with boiling water, and is said to stand a temperature of 100 deg. C. (212 deg. F.).

Fairweather's Recipe.—Equal parts of silicon carbide and semi-fluid alkali silicate are mixed together, 3 to 10 per cent. of chalk being added.

Hall's Fireproof Recipe.—This paint consists of moist silicate of magnesia, 5½ of dextrin, 5½ of gypsum, 2 of chalk, 2 of alum, and 1 of common salt. Four parts of this powder are mixed with three of boiling water for use. This preparation and the preceding one owe their "fire-resisting" properties to the sintering of the salts when heated.

Eymer's fireproof varnish is compounded of a mixture of alkali silicates with asbestos or other fireproof material and vegetable or mineral oils, or oily substances like glycerine.

Give a couple of coats of a good washable distemper, upon which should be given two coats of oil paint, the first somewhat flat and the last with a little oak varnish added to it. Painting on galvanized iron is at all times difficult, and there are various preparations on the market specially made for the purpose. If you do not care for the water paint plan try the following:—First go over the work with a wire brush so as to roughen the surface, then apply a coat of red lead well brushed out and mixed thin with boiled oil and turpentine. You will, of course, only mix just sufficient quantity of the red lead for the job, and will take care to stir from time to time while in use, as the red lead sets quickly. If there is much of the work to be done, we should recommend you to use orange lead instead of red lead, as although the two are practically of the same nature, the orange lead is a good deal lighter, and hence does not settle so quickly. You may take it that everything despends on the priming coat, and if this is satisfactory, the two or three coats upon it will hold well. The washable distemper in our experience gives as good a result as anything, and is much cheaper than the red lead system.

SELECTED MARKET QUOTATIONS

A Record of Prices Current on Raw, Semi-finished, and Finished Materials Entering Into the Manufacture and Operation of Power Plant Equipment

BOILER TUBES

Size	Seamless	Lap-welded
1 in.	$36 00	$.....
1¼ in.	40 00	.....
1½ in.	43 00	36 00
1¾ in.	43 00	36 00
2 in.	50 00	36 00
2¼ in.	56 00	38 00
2½ in.	55 00	42 00
3 in.	64 00	50 00
3¼ in.	.....	58 00
3½ in.	77 00	60 00
4 in.	90 00	75 00

Prices per 100 feet, Montreal and Toronto.

PLATES

	Montreal	Toronto
Plates ¼ to ½	$10 00	$10 00
Heads	10 30	10 25
Tank plates, 3-16 in.	10 50	10 10

WROUGHT PIPE

Effective Jan. 7, 1918.
Standard Buttweld.

Size	Black Per 100 feet	Galvanized Per 100 feet
⅛ in.	$ 6 00	$ 8 00
¼ in.	5 16	7 29
⅜ in.	5 16	7 29
½ in.	6 55	8 12
¾ in.	8 28	10 41
1 in.	12 24	15 39
1¼ in.	16 56	20 82
1½ in.	19 80	24 89
2 in.	26 64	33 49
2½ in.	42 72	53 53
3 in.	55 85	70 00
3½ in.	70 84	87 86
4 in.	83 93	104 10
	Standard	Lapweld
2 in.	29 60	36 08
2½ in.	44 46	54 70
3 in.	58 14	71 53
3½ in.	72 68	90 62
4 in.	86 11	107 37
4½ in.	97 79	122 56
5 in.	114 00	142 82
6 in.	147 80	185 28
7 in.	192 86	241 57
8 in.	202 50	253 75
9 in.	233 30	292 32
10 in.	279 50	350 18
10 in.	259 20	324 80
10 in.	333 70	418 18

Prices—Ontario, Quebec and Maritime Provinces

WROUGHT NIPPLES

4" and under, 45%.
4½" and larger, 40%.
4" and under, running thread, 25%.
Standard couplings, 4" and under 45%.
4½" and larger, 15%.

IRON PIPE FITTINGS

Malleable fittings, class A, 20% off list; class B and C, net list. Cast iron fittings, 25% off list. Malleable fittings, 25 and 7½%; cast fittings, 25%; unions, 45%; brass goods, 60% off list. Net prices malleable fittings: Class B black, 24½c lb.; Class C black, 15¾c lb.; galvanized, Class B, 34c lb.; Class C, 24½c lb. F.O.B. Toronto.

COLD ROLLED SHAFTING.

At mill ..... list plus 40%
At warehouse ..... list plus 50%
Discounts off new list. Warehouse price at Montreal and Toronto.

FINISHED IRON AND STEEL

Per lb to Large Buyers	Cents
Iron bars, base, Toronto	$5 25
Steel bars, base, Toronto	5 50
Steel bars, 2" to 4" base	6 00
Iron bars, base, Montreal	5 25
Steel bars, base, Montreal	5 50
Reinforcing bars, base	5 25
Small shapes	5 75

SHEETS

	Montreal	Toronto
Sheets, Black, No. 28	$ 8 00	$ 8 25
Sheets, Black, No. 10	10 00	10 00
Canada plates, dull, 52 sheets	9 00	8 65
Canada plates, all bright	9 50	9 50
Apollo brand, 10¾ oz. galvanized	....	....
Queen's Head, 28 B.W.G.	....	....
Fleur-de-Lis, 28 B.W.G.		
Gorbal"s Best, No. 28.		
Colborne Crown, No. 28	....	....
Premier, No. 28 U.S.	....	9 20
Premier, 10¾ oz.	....	9 50

PROOF COIL CHAIN B

¼ in.	$14 35
5-16 in.	13 85
⅜ in.	13 50
7-16 in.	12 90
½ in.	13 20
9-16 in.	12 70
⅝ in.	12 50
¾ in.	12 40
⅞ in.	12 90
1 in.	12 65
Extra for B.B. Chain	1 20
Extra for B.B.B. Chain	1 80

ELECTRIC WELD COIL CHAIN B.B.

¼ in.	$13 00
3-16 in.	12 50
⅜ in.	11 75
5-16 in.	11 40
⅜ in.	11 00
7-16 in.	10 60
½ in.	10 40
⅝ in.	10 00
¾ in.	9 90

Prices per 100 lbs.

FILES AND RASPS

	Per Cent.
Great Western, American	50
Kearney & Foot, Arcade	50
J. Barton Smith, Eagle	50
McClelland, Globe	50
Whitman & Barnes	50
Black Diamond	37½
Delta Files	37½
Nicholson	37½
Globe	50
Vulcan	50
Disston	50
P.H. and Imperial	50

OILS AND COMPOUNDS

Castor oil, per lb.	....
Royalite, per gal., bulk	18
Palacine	21
Machine oil, per gal.	26½
Black oil, per gal.	15
Cylinder oil, Capital	49½
Cylinder oil, Acme	39½
Standard cutting compound, per lb.	06
Lard oil, per gal.	2 60
Union thread cutting oil antiseptic	88
Acme cutting oil, antiseptic	37½
Imperial quenching oil	39½
Petroleum fuel oil	13½

BELTING—No. 1 OAK TANNED.

Extra heavy, single and double	30-5%
Standard	40%
Cut leather lacing, No. 1	$1 95
Leather in sides	1 75

COAL AND COKE.

Solvay Foundry Coke	.....
Connelsville Foundry Coke	.....
Steam Lump Coal	.....
Best Slack	.....

Net ton f.o.b. Toronto.

BOLTS, NUTS AND SCREWS

	Per Cent.
Coach and lag screws	25
Stove bolts	55
Plate washers....list plus	20
Machine bolts, 7-16 and over	net
Machine bolts, ⅜ and less	10
Blank bolts	net
Bolt ends	net
Machine screws, fl. and rd. hd., steel	27½
Machine screws, o. and fil. hd., steel	10
Machine screws, fl. and rd. hd., brass ....add	20
Machine screws, o. and fil. hd., brass ....add	25
Nuts, square blank ....add	$1 50
Nuts, square, tapped....add	1 75
Nuts, hex. blank ....add	1 75
Nuts, hex. tapped ....add	2 00
Copper rivets and burrs, list plus	30
Burrs only list plus	50
Iron rivets and burrs	15
Boiler rivets, base ¾" and larger $8	50
Structural rivets, as above.. 8	40
Wood screws, flat, bright..	72½
Wood screws, O. & R., bright	67½
Wood screws, flat, brass....	37½
Wood screws, O. & R., brass	32½
Wood screws, flat, bronze..	27½
Wood screws, O. & R., bronze	25

MISCELLANEOUS.

Solder, strictly	0 60
Solder, guaranteed	0 70
Babbitt metals ....18 to	1 00
Soldering coppers, 3 to 6 lbs.	0 64
Putty, 100-lb. drums	5 20
White lead, pure, cwt.	16 20
Red dry lead, 100-lb kegs, per cwt.	15 50
Glue, English	0 35
Gasoline, per gal., bulk	0 33
Benzine, per gal., bulk	0 30½
Pure turpentine, single bbls., gal.	1 03
Linseed oil, raw, single bbls.	1 95
Linseed oil, boiled, single bbls.	1 98
Lead wool, per lb.	0 15
Plumbers' oakum, per cwt.	9 00
Sandpaper, B. & A....list plus	20
Emery Cloth....list plus	20
Sal Soda	0 03½
Sulphur, rolls	0 05
Sulphur, commercial	0 04½
Rosin "D," per lb.	0 03
Rosin "G," per lb.	0 03½
Borax crystal and granula.	0 14
Wood alcohol, per gallon	1 80
Whiting, plain, per 100 lbs.	2 20

COPPER PRODUCTS

	Montreal	Toronto
Bars, ½ to 2 in.	$42 50	$43 00
Plain sheets, base 16 oz. and heavier	46 00	44 00
Copper sheet, tinned, 14x60 in., 14 oz.	48 00	48 00
Copper sheet, planished, base 16 oz. and heavier	57 00	45 00
Braziers' in. sheets, 6x4 base	45 00	44 00
Tubing T.P.S., base ¾ in. up to 3 in.	60 00	60 00

Above prices are full sheets and bars. Cut sheets and bars are 5c per lb. higher.

BRASS PRODUCTS.

Brass rods, base ½" to 1" rd.	$0 43
Sheets 24 oz. and heavier base	0 48
Brass tubing, seamless	0 55
Tubin, I.P.S., 1" base	0 55

POLISHED DRILL ROD.

Discount off list, Montreal and Toronto ..... Net

RUBBER BELTING

Standard	10%
Best grades	15%

WASTE

White.	Cents per lb.
XXX Extra	21
Peerless	21
Grand	19¾
Superior	19¾
X L C R	18½
Atlas	18½
X Empire	17¼
Ideal	17¼
X press	16
Colored.	
Lion	15
Standard	13½
No. 1	13½
Popular	12
Keen	10½
Wool Packing	
Arrow	25
Axle	20
Anvil	15
Anchor	11
Washed Wipers	
Select White	11
Mixed colored	10
Dark colored	09

This list subject to trade discount for quantity

MILLED PRODUCTS

	Per Cent.
Set screws	25
Sq. & Hex., Head Cap Screws	20
Rd. & Fil Head Cap Screws	Net
Flat & But. Hd. Cap Screws plus	Net
Fin. & Semi-fin. nuts up to 1 in.	25
Fin. and semi-fin. nuts, over 1 in., up to 1½ in.	20
Fin. and semi-fin. nuts, over 1½ in., up to 2 in., list plus	10
Studs	20
Taper pins	40
Coupling bolts, pins	10
Planer head bolts, without fillets ....list plus	10
Planer head bolts, with fillet list plus 10 and	10
Planer head bolt nuts, same as finished nuts.	
Planer bolt washers	net
Hollow set screws..list plus	20
Collar screws...list plus 30,	10
Thumb screws	20
Thumb nuts	65
Patch bolts ....add 40,	10
Cold pressed nuts to 1½ in. add	$4 50
Cold pressed nuts over 1½ in. ....add	$7 00

METALS

	Montreal	Toronto
Lake copper	$31 00	$29 50
Electro copper	31 00	29 50
Castings, copper	30 00	28 50
Tin	125 00	125 00
Spelter	11 50	11 00
Lead	10 00	10 00
Antimony	17 50	18 00
Aluminum	55 00	58 00

Prices per 100 lbs...

ROPES AND PACKING

Packing, square braided	0 34
Packing, No. 1 Italian	0 40
Packing, No. 2 Italian	0 32
Pure Manila rope	0 39
Transmission rope, Manila	0 45
Drilling cables, Manila	0 41

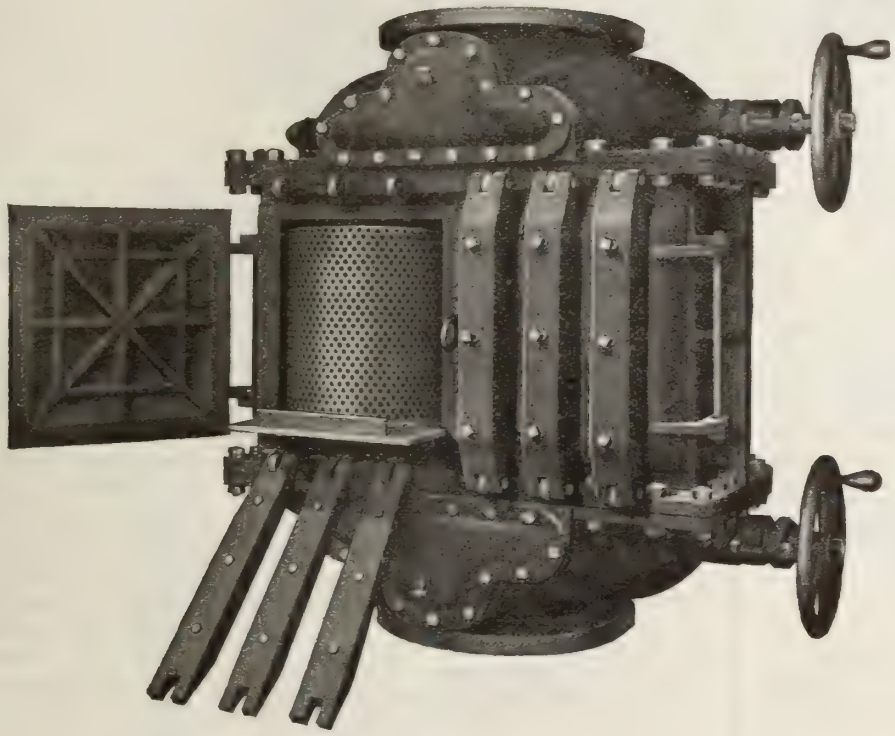
LEAD SHEETS

	Montreal	Toronto
Sheets, 3 lbs. sq. ft. lb.	$12 00	$13 25
Sheets, 3½ lbs.	12 00	13 25
Sheets, 4 to 6 lbs.	13 00	12 50

Cut sheets, ¾c per lb. extra.
Cuts sheets to size, 1c per lb. extra.

TWIN STRAINERS

eliminate clogging of pumps, condensers and other water-handling machinery



A TWIN STRAINER can't be clogged up, for when one basket is fouled with any sort of solid matter, a clean basket is put into service by simply moving two valves. The dirty basket can then be lifted out, carried to a convenient place, cleaned and then replaced in the Strainer—all this without interrupting the flow for an instant.

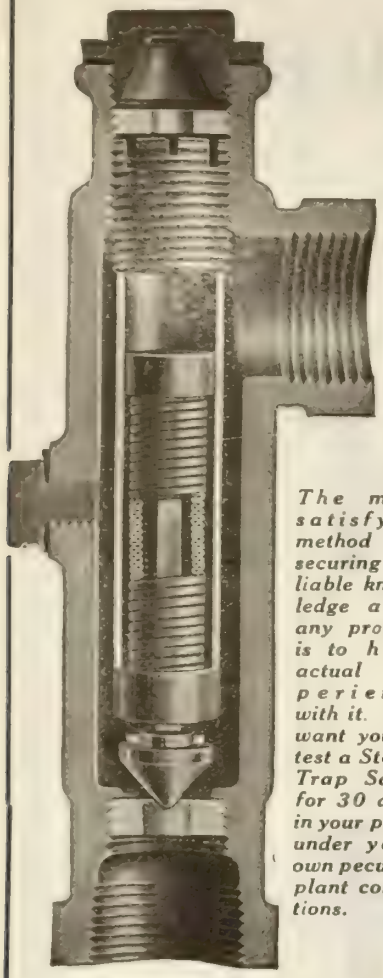
Full particulars in Bulletin "A," which will be sent on request

ELLIOTT COMPANY

435 GRANT STREET - PITTSBURGH, PA.

If any advertisement interests you, tear it out now and place with letters to be answered.

Knowledge Through Experience



The most satisfying method of securing reliable knowledge about any product is to have actual experience with it. We want you to test a Steam Trap Sarco for 30 days in your plant under your own peculiar plant conditions.

Then you'll fully understand the Sarco principle. It is a steam trap deriving its hydraulic impelling force through the expansion and contraction of oil in a hermetically sealed tube contained within the trap.

Then, too, you'll appreciate the small size and large capacity of the Sarco.

You'll understand why it fits anywhere without extra building up or pit digging.

Compared in service, size and price you will know without a trace of doubt that the Steam Trap Sarco is the best "buy" in the market to-day.

Don't forget that it is as good on high pressure as on low pressure.

Special literature sent upon request for folder J-6.

Sarco Company Inc.

Woolworth Building, New York City

Ellicott Square, Buffalo.
New Telegraph Bldg., Detroit.
Drexel Bldg., Philadelphia.
Monadnock Bldg., Chicago.
Williamson Bldg., Cleveland.
and representatives in all principal cities.
Canada: Peacock Brothers, Montreal.

TRADE GOSSIP

Ontario incorporation is granted the Elgin Mfg. Co., to manufacture and trade in all lines of machinery, locomotives, tractors, etc. Capital is $250,000, with head office at London. Directors are: E. G. Yeates, R. C. Macknight, E. D. Parke, D. D. Lethbridge and J. E. Macdougall.

Short of Power.—The rationing of power had to be resorted to again at Galt on account of there being insufficient Hydro to meet the local demands. One circuit was cut out one day and another the following day. Local officials say the rationing may have to continue for several days.

The Canadian S. K. F. Company Ltd., 47 King Street West, Toronto, is now carrying a stock of chrome alloy steel balls in all sizes ready for immediate shipment. These balls, which are hardened clear through, are suitable for the highest class of work and heavy service. They are guaranteed round and true to size within one-ten-thousandth of an inch.

Fuel Economy in the Operation of Hand-Fired Power Plants.—The scarcity of coal last winter and the recent warnings of the fuel administration regarding the possibility of a shortage next winter emphasize the need for greater economy in the use of fuel. The present high rate of production is still insufficient to supply all needs and there seems to be no possibility of an increase in the output of the mines to meet demands.

Ontario incorporation is granted to the Salisbury Electrical Co., Ltd., with capital at $100,000, to carry on the business of electricians, mechanical engineers, manufacturers of and dealers in apparatus for the generation, distribution, supply, acceleration and employment of electricity, electrical supplies and appliances of all kinds, etc. Directors G. E. McCann, J. A. Hammond, A. F. Ball, D. M. Culverwell, G. M. Speers. Head office Toronto.

Dominion incorporation is granted to J. D. C. Forsyth. E. W. Clement, W. P. Clement, R. M. Fisher, E. B. Clemens, Kitchener, under name of John Forsyth, Ltd., to carry on the business of electricians, mechanical engineers, manufacfacturers, workers and dealers in engines, rynamoes, generators, batteries, storage batteries, switch boards, electric lighting plants, electric power plants, electric appliances and accessories of every description, electricity, etc. Capital is $300,000, and head office at Kitchener, Ont.

Change of Address.—Announcement is made of change in address of the Crane Packing Company's New York office to larger quarters in the Park Row Building, and the appointment of Julian N. Walton, manager. A. W. Payne, connected for some time as manager of this district, has been made sales manager of the United States and Canada, with headquarters at the home office in Chicago. The Pittsburgh offices are located in the May Building, Pittsburgh. The Philadelphia office in the Colonial Trust Building.

Calgary.—The coal investigators from Winnipeg have not been satisfied with what they found out about Alberta coal. One of them, J. J. Wallace, makes this statement: "We came here with open mind, and we have made a sincere effort to get at the actual cost of production of a ton of coal, but have been unable to do so. The mine owners would not show us their accounts and give us actual facts. They seemed to prefer not to send any coal to Winnipeg rather than cut the price in any respect. They all say they are paying no dividends, and some even say they are losing money."

Hamilton.—At a meeting of the Hamilton Board of Control tenders were accepted for the construction and installation of the boilers for the beach pumping station. The total cost will be $17,759, which is the lowest tender, and is that of the Goldie-McCullough Company, of Galt. This tender was $10,800 lower than the next lowest. Had the Babcock-Wilcox firm been able to carry out its contract, the cost to the city would have been but $186 lower. The Imperial government stepped in and refused to allow the use of material to construct the boilers in Scotland, with the result that the contract was canceled some months ago. The cost of the boilers was placed at $12,991, according to the tender, the balance being the cost of installation.

Chatham.—A big mass meeting was held in Tecumseh Park late on Saturday afternoon at which the gas problem was discussed. Factories in the city shut down at 5 o'clock because the men walked out to attend the meeting. A resolution just passed by the Mechanic's Board of Trade was brought before the meeting, and unanimously adopted and endorsed, disapproving of the action of the Ontario Railway and Municipal Board in ordering gas shut off in factories and other industrial places, and in thus threatening a bread shortage, with a loss to the bakers in materials, and also stopping the cars of the C., W. & L. E., affecting shipping of stock and interfering wih passenger traffic. The resolution objects to the power given to the Railway Board, objects to the fact that there is no appeal from any action or order of the Board, protests against agreements made in good faith with the city of Chatham being broken, declares that it is contrary to British principles of justice to allow agreements to be set aside, to grant no right of appeals against a Board, and to refuse compensation for losses sustained through an order of the Board.

Had Busy Year.—Much interest is centered in Kingston in the coming financial statement of the Canadian Locomotive Company, which concluded its fiscal year on June 30th. The auditors are working on the figures, and the report will be made public property before a great length of time. The company's plants have been kept very busy throughout the accounting period, and orders on the books are said to be sufficient to keep them work-

ing to capacity for a considerable time ahead. Work is proceeding satisfactorily on the Government contracts calling for locomotives, and the outlook is considered to be bright for the coming fiscal year. For the year ending June 30th, 1917, record earnings were shown, manufacturing profits amounting to $721,254 against $57 in 1916, and net profits of $616,254, after payment of bond interests and sinking fund allotments, was equivalent to more than 7.6 per cent. on the combined preferred and common capital or over 25 per cent. on the common stock, after payment of preferred dividends.

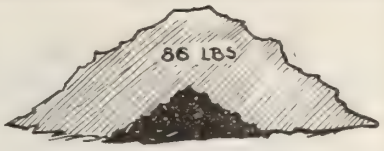
CATALOGUES

Electrical Equipment.— The Ward Leonard Electrical Co., Mount Vernon, N.Y., has issued a pocket size loose leaf bulletin covering an interesting line of electrical equipment such as rheostats, controllers, resistance units, etc. The bulletin contains temporary price and data sheets covering only the apparatus upon which the company can offer reliable delivery dates and assure maintenance of prices. The reason being that the company's facilities are now largely devoted to Government work affecting regular production in the meantime.

The Canadian S K F Company, Ltd., 47 King Street West, Toronto, has made arrangements with the Hess-Bright Mfg. Co., Philadelphia, to be Canadian distributors for the well-known Hess-Bright ball bearings. A large stock in all sizes will be carried in Toronto and engineering designs and recommendations will be given for all classes of applications. The Hess-Bright Mfg. Co. control the Conrad patents under which other firms manufacture under license. The Conrad Patent is a method of assembly which enables a ball bearing to be made with continuous raceways, eliminating the necessity of filling sloths which rob the bearing of end thrust capacity. The "Monarch" series of bearings, of the deep groove type, are also made by the Hess-Bright Mfg. Co. These bearings are used extensively in work where heavy end thrusts are encountered such as in airplane propellers, etc.

The Present Day Applications of Ball Bearings is the title of an interesting bulletin being distributed by the Canadian S F K Co., Toronto, principally among colleges and larger educational institutions. This bulletin is gotten up in the form of an illustrated lecture and the company has prepared sets of lantern slides to accompany the lecture for the purpose of creating interest in one of the latest developments in mechanical appliances and showing the latest applications of ball bearings. The lectures and slides are sent out to universities and colleges for the benefit of the students and others who may be interested in mechanical matters. In addition to illustrating and describing the various applications, the bulletin also contains a brief history tracing the development of ball bearings. It deals with the principal features in the design and construction of the S K F ball bearing and

Study The Piles



Seven Times the Power for the Same Coal

The first pile represents coal used making steam to feed boiler using direct steam pump.

The black part of the second pile shows the relative amount of coal necessary to do the work with a Cole Return Trap.

In other words, you get seven times the power for the same coal—or 86% of the fuel saved.

If you want further proof get our latest folder on boiler feeding—No. 9.

GEO. W. COLE, Ltd. 2002 Dundas St. W. TORONTO

WALTER J. FRANCIS, C.E. M. Can. Soc. C.E. M. Am. Soc. C.E. M. Inst. C.E.
FREDERICK B. BROWN, M.Sc. M. Can. Soc. C.E. Mem. Am. Soc. M.E. Mem. A.I.E.E.

WALTER J. FRANCIS & COMPANY
CONSULTING ENGINEERS
Head Office, 232 St. James St., Montreal
Cable Address, "Walfran, Montreal"—W.U. Code.
Long Distance Telephone, Main 5643.

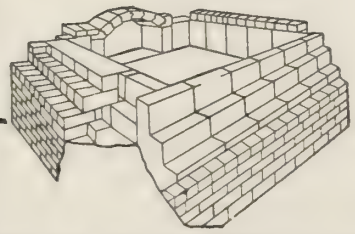
MacKINNON, HOLMES & Co.
Limited
MacKinnon Steel Co., Ltd.
SHERBROOKE QUEBEC

Engineers, Manufacturers and Erectors of Steel Structures

We Specialize in

Bridges, Buildings, Towers, Tanks, Penstocks, Roof Trusses, Columns, Smoke Flues and Stacks, Coal Bins, Ore Bins, Buckets, Refuse Burners, Stills, Air Receivers, etc.

WRITE FOR PRICES.



Gates Boiler Furnace
Patented 1916

Will last three times as long as ordinary good grade Fire Brick. These blocks are inter-locking, and made so that any handy man or fireman can renew them without disturbing any of the other brick work.

WRITE FOR PARTICULARS.

John W. Gates 2 St. James St., MONTREAL, QUE.

GRAPHITE FOR LUBRICATION

Lubrication is a matter of vital importance, yet is apt to be overlooked until something happens. If oil or grease alone are used and the supply unexpectedly fails the resulting damage and trouble will be serious.

DIXON'S FLAKE GRAPHITE

added to oil or grease increases their lubricating value and makes as near a perfect lubricant as is possible. Graphite supplies those qualities that oils lack—endurance and indifference to temperature. Flake Graphite also provides a smooth durable veneer over wearing surfaces that prevents metal-to-metal contact. Write for Booklet No. 222-C.

Made in Jersey City, N.J., by the

JOSEPH DIXON CRUCIBLE COMPANY
ESTABLISHED 1827

Sole Canadian Representative:
CANADIAN ASBESTOS CO.
Montreal, Que.

R.D. Wood & Co.
Philadelphia, Pa., U.S.A.

Water and Gas Work Supplies,
Cast Iron Pipe and Castings,
Mathews Hydrants and Valves,
Hydraulic Presses and Accumulators,
Operating Valves,
Mechanically Operated Gas Producers.

BOILERS FOR IMMEDIATE SALE

Suitable for shipyards, munition works, mines, [illegible] electric power stations, etc.

5450 H.P. of B. & W. Stationary Boilers

with forged steel headers, and superheaters, [illegible]

2—450 H.P. Boilers, 36 wide, 12 high; 2 48" drums each; installed 1902.

3—660 H.P. Boilers, 21 wide, 14 high; 3 42" drums each; installed 1905.

3—330 H.P. Boilers, 16 wide, 12 high; 2 42" drums each; installed 1910.

1—580 H.P. Boiler, 24 wide, 12 high; 3 42" drums installed 1910.

2—615 H.P. Boilers, 21 wide, 12 high; 3 42" drums each; installed 1910.

8 of these 12 Boilers are now allowed 150 pounds steam and 3 are allowed 135 pounds. All are in operative condition.

If it is desired to add to the capacity of any modern boiler plant carrying 200 pounds pressure for supplying steam turbines, these Boilers can be easily altered to 200 pounds pressure by being fitted with new drums.

For sale as they now stand, including grates and the usual boiler connections and fittings attached to them. Purchaser to make his own inspection, to have access to all available records in owner's possession, and to remove Boilers at his own expense.

In order that possession of any or all of these Boilers is desired, time will be saved by Purchaser sending his representative here without delay.

Correspondence desired only with parties who have immediate use for any or all of the Boilers.

Upright closed type feed water heaters and [illegible] belonging to this plant are also for sale.

Winnipeg Electric Railway Co.
WINNIPEG, MANITOBA

Steam Engines for Immediate Sale

Suitable for general mill work, power transmission by belt, rope drive or spur gearing, for driving woodworking, grinding, crushing, or hoisting machinery, or air compressors, in factories, saw mills, pulp and paper mills, shipyards, munition works, mines, grain ele-[illegible]

[illegible] H.P. vertical cross compound, 4-valve [illegible] with shaft governors, cylinders 18 and 24 x 24", 150 r.p.m., with surface con-[illegible] for each engine.

1—900 H.P. vertical cross compound, 4-valve engine with shaft governor, cylinders 20 and 38 x 24", 150 r.p.m., without condenser.

2—600 H.P. horizontal cross compound, Cor-[illegible] x 42" cylinders, 100 [illegible] with separate surface condensing [illegible] for each engine.

1—1200 H.P. cross compound Corliss engine, cylinders 26 and 52 x 48", 85 r.p.m., with [illegible]

[illegible] Wheelock gridiron valve engines, cylinders 27 and 52 x 46", [illegible] condensing equip-[illegible]

[illegible] electric [illegible] owner wishes to keep. Generators to be re-[illegible]

[illegible] wheels for either belt or rope driving, or with [illegible]

[illegible] H.P. [illegible] compound engine, cylinder 16 and 27 x 40",

Purchaser to make his own inspection, to [illegible]

WINNIPEG ELECTRIC RAILWAY CO.
Winnipeg, Manitoba.

WANTED.

WANTED — FIRST-CLASS STATIONARY ENgineer capable of assuming full charge of boiler and engine department of large manufacturing plant in Western Ontario city. Apply stating qualifications and salary expected to Box 452, Power House. (p7h)

FOR SALE

FOR SALE CHEAP—ONE 30 K.W. GENERAtor Set 220 Volt D.C. Ideal Engine—Westinghouse Generator on sub-base—Switchboard; one 20 K.W. Generator Set on sub-base, same as above. These two sets are in perfect condition and we offer decided bargain for quick sale. Winnipeg Machinery Exchange, Sutherland and Gladstone Sts., Winnipeg.

Engines For Sale

1—Allis Tandem Compound, 18 x 32 x 46, 70-75 R.P.M. 350 to 400 H.P. 20' x 38" belt wheel. Run condensing with surface condenser.

1—Goldie & McCulloch, Wheelock Cross Compound Engine, 13 x 23 x 30. Run condensing or non-condensing. 110 R.P.M. 200 H.P. at 90 lbs. steam. Wheel 15' x 20"

1—Brown Corliss L.H. Crank Engine, Simple 12 x 30. 8' x 8" Fly Wheel 100 R.P.M. 80 H.P. at 90 lbs. steam.

1—Inglis Simple Corliss Valve, L.H. Crank Engine, 13" x 30". 12' x 15' belt wheel. 100 R.P.M. 93 H.P. at 90 lbs. steam arranged for condensing with surface condenser

1—Skinner 8" x 12" Center Crank, 60" x 8" belt wheel 150 R.P.M. 15 H.P. at 60 lbs. steam.

1—Robb Armstrong Highspeed Engine, 8½" x 8", Class B Automatic Center Crank, 36" x 8" belt wheel. 350 R.P.M. 42 H.P. at 100 lbs. steam.

All above engines discarded owing adoption electric power. All are in good operating condition and suitable for higher pressures than those mentioned.

We also have a number of large pulleys; several 100 x 125 H.P. Boilers suitable for 90 lbs. pressure.

Ogilvie Flour Mills Co., Ltd.
WINNIPEG

MOTORS for SALE

1—75 H.P Can. Westinghouse Induction Motor, 550 volts, 3 ph. 60 cy. 900 R.P.M. Complete, rebuilt.

1—100 H.P. Westinghouse, 550 volts, 3 ph., 60 cycle, 1200 R.P.M. Rebuilt.

4—30 H.P. Fairbanks Motors, 550 volts, 3 ph., 60 cy., 1200 R.P.M., complete, good as new.

2—3 H.P. Westinghouse Motors, 220 volts, 3 ph., 60 cy., 1700 R.P.M., good as new.

1—5 H.P. Westinghouse Motor, 220 volts, 3 ph., 60 cy., 1700 R.P.M., good as new.

1—2 H.P. Westinghouse Motor, 220 volts, 3 ph., 60 cy., 1700 R.P.M., good as new

1—40 H.P. Gen Electric Motor, 220 volts, 3 ph, 60 cy., 600 R.P.M., slip ring type with controller and resistance starter.

1—15 H.P. Electric Const. Co. D.C. Motor, 500 volts, 850 R.P.M.

1—3.75 D.C. Westinghouse Generator, 125 volts, 1200 R.P.M.

We also have several 220 volt motors from ½ H.P. to 5 H.P. back geared, all in good shape.

KIPP-KELLY-BROWN, Ltd.
151 Bannatyne Ave. E.
Winnipeg, Man.

describes how ball bearings are manufactured. The applications described cover a large number of industries including automobiles, machine tools, textile, tractors, paper making, milling, wood working, etc. Copies of the bulletin may be had on application by any student, mechanic or engineer interested in the subject. For copies apply to the Canadian S K F Co., 47 King Street West, Toronto.

A Study of the Heat Transmission of Building Materials.—An investigation to determine the coefficients of heat transmission of standard building materials for exterior walls has been completed by the Engineering Experiment Station of the University of Illinois under the direction of A. C. Willard, Professor of Heating and Ventilation, and L. C. Lichty, Research Fellow. The tests were conducted according to the so-called "hot-air box" method, the boxes being built of the material to be tested and of such a size as to insure conditions similar to those found in actual practice. The heating was done electrically so that the input of heat could be controlled and accurately measured. The materials tested included various sizes of tile plastered, magnesia board, cork board, wood, concrete, brick, glass with and without an air space, sheet asbestos and asbestos board. The degree to which the transmission coefficients of the various materials are affected by variations in air velocity, by humidity, and by the use of air spaces in wall is discussed, and the results of the tests are given in detail in Bulletin 102 of the Engineering Experiment Station. The publication is illustrated with diagrams and photographs of the apparatus. Copies of Bulletin 102 may be had gratis by addressing the Engineering Experiment Station, Urbana, Illinois.

A BELT should be capable of transmitting from 5 per cent. to 25 per cent. more power than is actually needed, the excess capacity being governed by the type of drive ranging from 5 per cent. for heavy main drives to 25 per cent. for machine belts.

A JAPANESE invention which coats iron or steel with aluminum has been put into successful operation. The metal to be treated is first galvanized, then it is dipped into a bath of molten aluminum at a temperature varying from 1,100 to 1,200 degs. Fahr. To obtain satisfactory results the metal under treatment must be immersed two or three times. It is claimed that the aluminum coating has wonderfully good adhesive properties and will not wear off through abrasion.

MONCRIEFF'S "UNIFIC" WATER GAUGE GLASSES

Stand in a Class by Themselves for Quality, Efficiency and Economy
A trial will convince you. Write for Catalog

W. J. WALL, 134-136 BLEURY ST., MONTREAL
(Canadian Representative)

Saving Coal In the Heating System

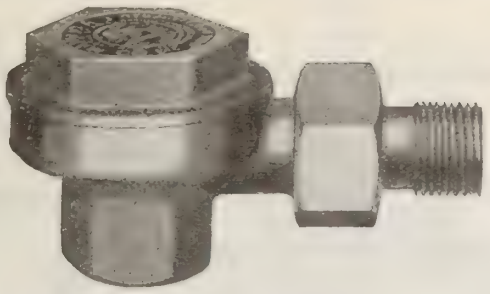
It is entirely possible that the Fuel Controller will enforce the use of electric power. Existing steam plants must then be used only for heating. There will be no more exhaust steam.

Get ready for such conditions by putting your heating system on an economical basis. Heating with live steam is always expensive—and particularly so when the system is inefficient.

The DUNHAM HEATING SERVICE

will enable you to save coal—and get better heat than before—even under such trying conditions. This service is based on the proper control of the radiator and the application of The Dunham Radiator Trap.

Patriotism and economy urge coal saving. Start now! Full details on request.



The Dunham Radiator Trap

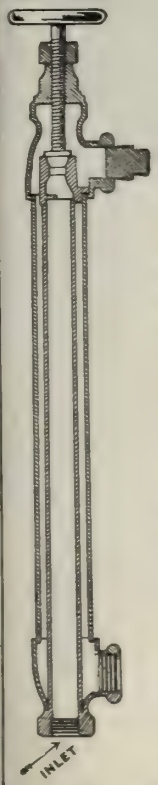
This coal-saving device is the foundation of the Dunham Heating Service. It is attached to the outlet of every radiator.

With the Dunham Radiator Trap you have no broken vacuum due to leaky traps. Superior circulation of steam is easily maintained because all the air and water is automatically eliminated.

Get all the facts!

C. A. Dunham Company, Ltd.
TORONTO, CANADA

Branch Offices:
Halifax Montreal Ottawa Winnipeg Vancouver Calgary



The LONG Patent Steam Trap

Automatically drains jacket kettles, separators and steam mains. Nine hundred to 1,500 feet of one-inch pipe isn't beyond its ability. Also used with splendid success in drying room systems.

Only One Movable Part

Works against 1 and 200 pounds of pressure—no possibility of freezing. Has **two outlets** so it can be installed in any position.

Circular gives full particulars.

Write to-day.

J. T. LONG
84 Adam Street
MONTREAL, CANADA
If your dealer does not sell it, write direct

NON-CORROSIVE
CYLINDER OIL
MANUFACTURED ONLY BY
E. H. KELLOGG & CO.
NOS. 242 & 244 SOUTH ST. NEW YORK, U.S.A.
FRICTION LOSS

An overload is often a necessity. But it is hard on an engine. To successfully carry an overload so that there will be no after effects on the engine a very careful selection of your oil should be made. An oil that is not free from impurities will cause a greater wearing on the bearings, a great friction loss will occur. You will need to fire the boiler more often because the engine will be harder to run. In this manner you lose out. You work harder, have larger operating costs, and less power all because of your oil. Do as a great many Canadian engineers have done—give Kellogg's "Non-Corrosive Cylinder Oil" a trial. Absolutely pure. Write us regarding it.

E. H. KELLOGG & CO.,
New York, U.S.A.

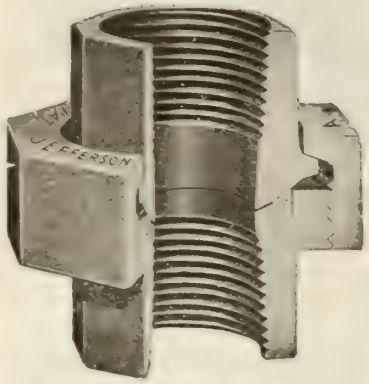
"Belmont" 1903 Special Hydraulic Packing. For Hot or Cold Water Boiler Feed Pumps (Inside or Outside Packed) and for Hydraulic Work It Has No Equal.

Pressures up to 10,000 lbs.

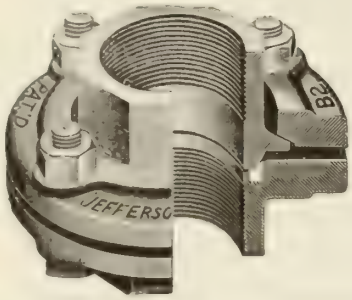
Cannot Split, Swell or Pinch

We guarantee Belmont Special Hydraulic Packing to give absolute satisfaction under the heaviest pressures, and when exposed to acid or alkaline waters. We know that it is made right, and from the best material, and that "Belmont" is absolutely the "last word" in packing arguments.

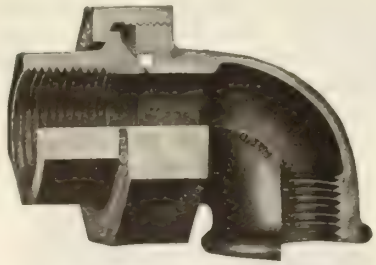
William C. Wilson & Co.
21 Camden St. TORONTO



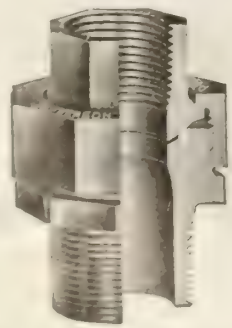
Look for the Name on the Nut



Look for the Name on the Nut



Look for the Name on the Nut



Look for the Name on the Nut

Look for this name

JEFFERSON UNIONS

There are many good reasons why you should insist on "JEFFERSONS." In the first place you protect yourself from disappointment and costly shutdowns on account of "doubtful" unions. The name "JEFFERSON" distinguishes the genuine from the "just as good" union. Easily broken promises will not make tight a leaky line or keep superheated steam from sizzling out at the unions.

You cannot afford to take a chance on the unions because the success or failure of the entire line depends upon the class of unions used. The Patented Brass Ring of the "JEFFERSON" is positive insurance against leaks. The "brass-to-iron" joint cannot rust or corrode, so that it's an easy matter to take down a JEFFERSON UNION regardless of how hard it has been set up.

Your jobber has "JEFFERSONS" in stock and he'll be glad to tell you all about them. Ask him if he ever gets a "kick" on a JEFFERSON UNION. Our Catalog "UNIONS" shows all styles and sizes. Write to-day for your copy.

JEFFERSON UNION COMPANY

Lexington, Mass.

Jefferson Union Co., Lexington, Mass.
Gentlemen: Mail me postpaid, and without any obligation to me, copy of your New Catalog.
Name .....
Firm Name .....
Address .....
P.H. 7-18

THE CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED

FAIRBANKS VALVES

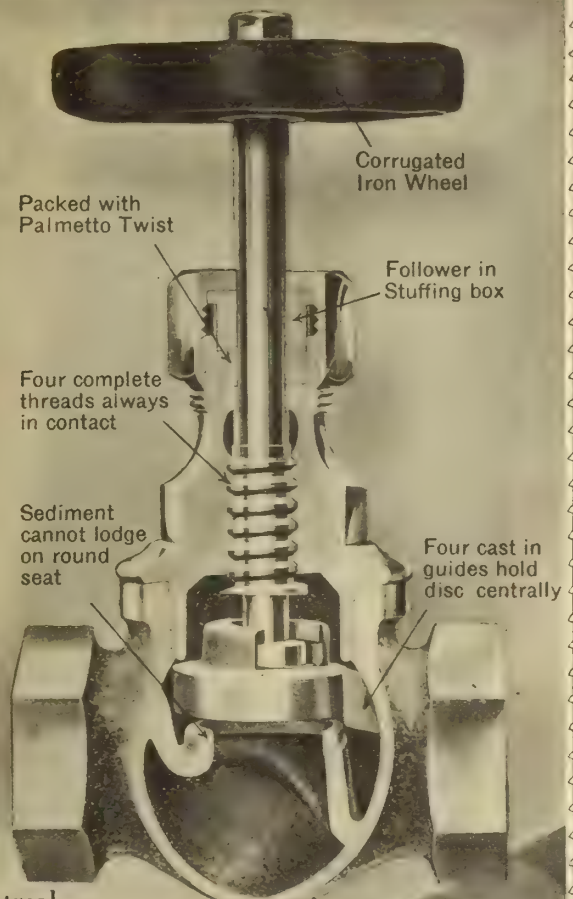
MADE IN CANADA

"Excellent design, high-grade materials, and accurate workmanship."

These are the reasons why thousands of Fairbanks Valves are giving such excellent service, all over Canada, under varying conditions of steam, water and air.

TRY THEM

The Canadian Fairbanks-Morse Company, Limited

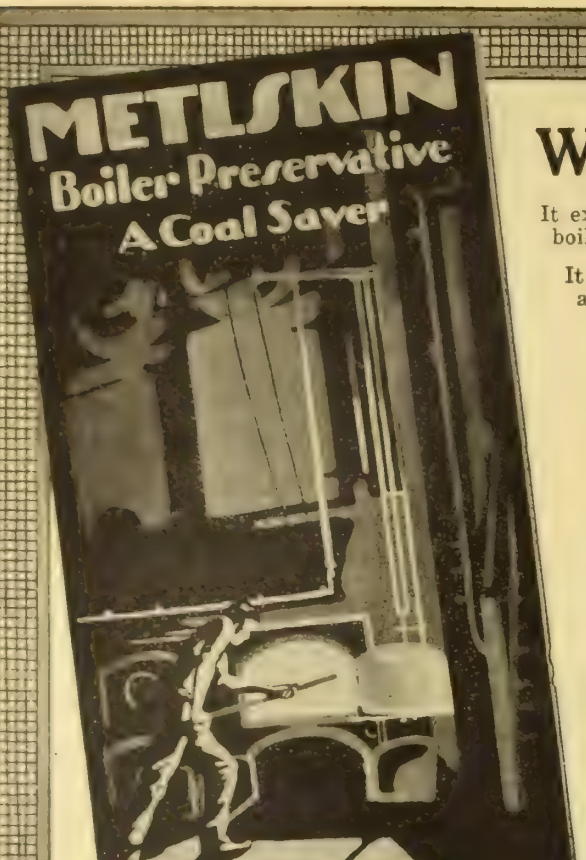

Corrugated Iron Wheel
Packed with Palmetto Twist
Follower in Stuffing box
Four complete threads always in contact
Sediment cannot lodge on round seat
Four cast in guides hold disc centrally

St. John, Quebec, Montreal, Ottawa, Toronto, Hamilton, Windsor, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria.

Fairbanks Renewable Disc

The only tool required is a wrench to remove the bonnet. The disc slips on and off with the fingers.

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED



Write For This Booklet

It explains the vital difference between a "compound" and a boiler preservative.

It describes the method by which METLSKIN operates, and reproduces the Guarantee Bond that backs

METLSKIN BOILER PRESERVATIVE

Neither "Compound" nor "Cure-all"

The 60-day Trial Offer enables any responsible concern to give METLSKIN a thorough-going test, to observe results, to check up our claims. If you, and you alone, are not satisfied with results the account will be cancelled—IMMEDIATELY.

Both Guarantee Bond and Trial Order Blank are so worded as to make your decision final.

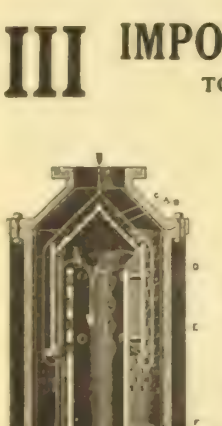
METLSKIN absolutely will not contaminate steam. Send post card for the booklet to-day.

The CANADIAN FAIRBANKS-MORSE CO., Limited

St. John, Quebec, Montreal, Ottawa, Hamilton, Toronto, Windsor, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria.

III IMPORTANT THINGS

TO CONSIDER ABOUT A SEPARATOR.



I. **THE PLAN**—Is it sensible, will it work, no matter how large the Separator or how well made?

II. **THE SIZE**—Is it big enough regardless of plan, will it hold a good dose of water?

III. **THE CONSTRUCTION**—Is it strong enough, are flanges heavy, how will it look by the side of a nicely finished engine? Send for catalog and note these points in

Sweet's Separators

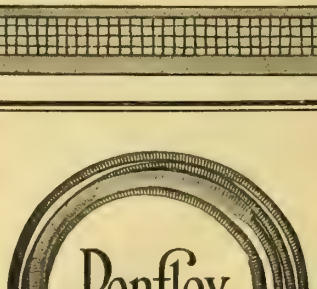
DIRECT SEPARATOR COMPANY

820 Geddes Street - SYRACUSE, N.Y.

General Sales Agents:

Canadian Fairbanks-Morse Company, Limited

St. John, Montreal, Quebec, Ottawa, Toronto, Hamilton, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria



FOR Steam or Air Drill, Pneumatic Tools, Boiler Flue Cleaning, Syphon Connections, Suction Lines.

For all kinds of Oil, Gasoline, Paints, Hydraulics, Gas.

"PENFLEX" METAL HOSE

INTERLOCKING

An all Metal Flexible Hose. Manufactured in Bronze or Galvanized Steel. Will withstand highest pressures. Is unsurpassed for durability and pressure resisting qualities.

Large Stock Carried in Canada

Pennsylvania Flexible Metallic Tubing Co.

Philadelphia, Pa.

Canadian Agents:

The Canadian Fairbanks-Morse Co., Limited

St. John, Quebec, Montreal, Ottawa, Toronto, Hamilton, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

GRATON & KNIGHT

Standardized Series
LEATHER BELTING

Tanned by us for belting use

In times like these you have no right to waste one ounce of power

With all costs shooting skyward, the need of economy is greater every day. Above all, stop power-wastes.

WORN-OUT belts, belts of inferior material—even good belts at the wrong work mean needless waste.

Low first-cost of material doesn't always indicate economy. To us, the largest belt makers in the world, all materials are open for use; but sixty years of experience has impressively convinced us that for power transmission, well-tanned leather is the most durable, efficient, economical belting material. Its natural friction *grip* gives it the maximum *pull* on the pulley.

Careful selection of hides together with scientific tanning and currying processes have given Graton & Knight leather belts the necessary combination of flexibility, firmness, and elasticity to transmit the full power load—*without waste.*

In reality, power economy is simply a matter of using the right belt for every drive. There is a Graton & Knight Standardized Leather Belt for every transmission requirement, a belt scientifically constructed to transmit the utmost power for the longest period of time.

It will *save you money* to let us recommend belts for every drive in your plant. Then, in buying, specify "Graton & Knight—Brand or equal." This does not commit you to buying our belts. It does put your buying on the one economical basis—that of *the work to be done.*

Write for information about Standardization as applied to Belting

The Graton & Knight Manufacturing Company
Worcester, Massachusetts, U. S. A.

Oak Leather Tanners, Makers of Leather Beltings Lace Leather, Packings and Specialties

The Canadian Graton & Knight Ltd., Montreal

Canadian Representatives: The Canadian Fairbanks-Morse Co., Ltd., St. John, Montreal, Ottawa, Toronto, Hamilton, Quebec, Calgary, Saskatoon, Vancouver, Windsor, Winnipeg, Victoria.

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

DURABLA

DURABLA
TRADE MARK REGISTERED

Durabla is a Giant in Strength

Many of the largest industries have adopted Durabla Gasket Material as a Standard for all new Construction Work and Repairs, using it on Steam, Air, Oil, Ammonia, Benzol and Alkalies at various temperatures and pressures, on All Flanges where a Permanently Tight Joint is required.

Claims of Superiority are easily made—comparative tests establish facts.

Durabla Manufacturing Company
NEW YORK

Distributors for Canada:
The Canadian Fairbanks-Morse Co., Limited
Montreal, Toronto, St. John, Quebec, Ottawa, Hamilton, Winnipeg, Saskatoon, Calgary, Edmonton, Vancouver, Victoria

During the Warm Weather Plan for the Winter

STEAM MUST BE SAVED

Keep Steam Lines free from condensation by using

AMERICAN IDEAL STEAM TRAPS

Large Capacity
Tight Valve
Powerful Valve Leverage

Let us help you save Steam, Coal, Money

Canadian Agents: CANADIAN FAIRBANKS-MORSE CO., Ltd. Montreal, Quebec

AMERICAN STEAM GAUGE & VALVE MANUFACTURING COMPANY

NEW YORK CHICAGO BOSTON ATLANTA PITTSBURGH

P&C CO

Valves—Asbestos Packed Cocks

for Every Purpose and Pressure

Pratt & Cady valves and cocks make good where others fail because they remain leak-proof under the most severe strains. Put your toughest job up to Pratt & Cady valves and cocks. Get our catalog and full information.

Pratt & Cady Co., Inc., Hartford, Conn.

Canadian Agents:

Can. Fairbanks-Morse Co., Ltd., Toronto, Montreal

St. John, Quebec, Ottawa, Hamilton, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria.

THE CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED

THE MAN SHORTAGE

caused by the war

should lead you to avoid the frequent repacking of engines, pumps, globe and other small valves, as this useless labor can be avoided by using a packing that has great lasting qualities, such as

TRADE MARK

"PALMETTO" PACKING

the materials of which have great tensile strength and carry the lubricant that does away with rod friction.

Use Palmetto packing when you are short-handed. You don't have to repack so often.

Let us prove the great lasting qualities of "Palmetto" by sending you working samples of both braides for rods and twist for globe valves. No charge.

GREENE, TWEED & CO.

Sole Manufacturers

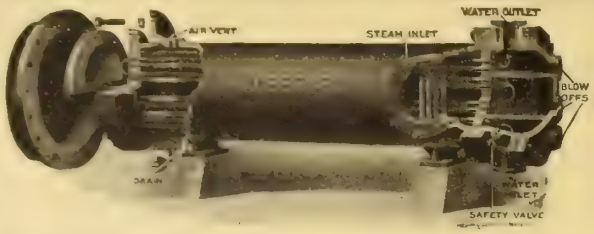
109 DUANE STREET NEW YORK

Canadian Agents:

The Canadian Fairbanks-Morse Co., Limited, St. John, Toronto, Quebec, Hamilton, Montreal, Ottawa, Vancouver, Victoria

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS



Heats the Water Just as Fast as it Can be Drawn

Alberger Heater

You have heard about this better heater—about how it absolutely overcomes all danger from expansion and contraction strains. Because the pure copper tubes expand into floating heads that are entirely independent of the cast iron shell. Study well the illustration of this horizontal type Alberger Multi-Head Water Heater.

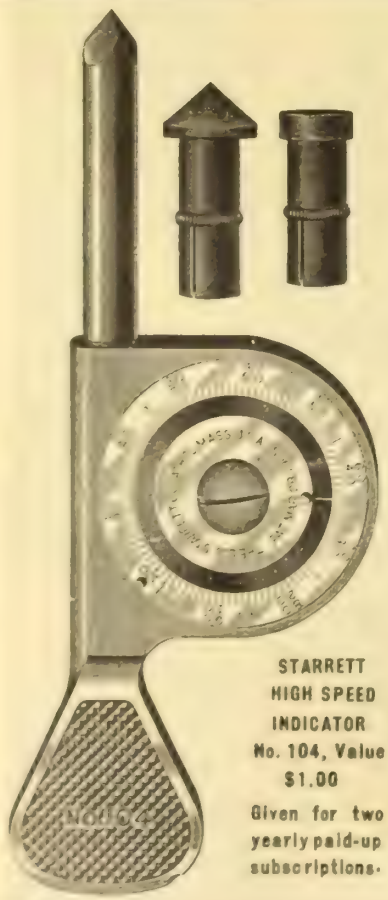
And note the larger illustration of an Alberger corrugated tube. Exact duplications of this tube in every Alberger Heater enable us to claim—and prove our claim—that Alberger Heaters transmit 50% more heat than plain tube heaters of corresponding size. Vertical and Horizontal Types of adequate capacities for every service. **Ask for Bulletin 201.**

ALBERGER HEATER COMPANY

BUFFALO, N.Y. Manufacturers of Alberger Multi-Head Heaters

GENERAL SALES AGENTS:
CANADIAN FAIRBANKS-MORSE COMPANY, Limited

St. John, Montreal, Ottawa, Toronto, Hamilton, Quebec, Calgary, Edmonton, Vancouver, Winnipeg, Victoria.



STARRETT HIGH SPEED INDICATOR No. 104, Value $1.00

Given for two yearly paid-up subscriptions.

You May Have This Speed Indicator without Spending a Cent

if you are a subscriber to "POWER HOUSE." If you are not a subscriber, send in your own subscription together with two others, and the indicator you are entitled to will be mailed to you immediately.

To subscribers who send us two NEW yearly paid-up subscriptions we will send this $1.00 indicator.

"POWER HOUSE" is designed to give Canadian Engineers, Superintendents and Power Users all the latest and best information in the engineering field. A little work among your engineer friends and acquaintances will earn for you this handy indicator without any trouble. Try it and see how easy it will be.

PUBLISHED MONTHLY AT $1.00 PER YEAR
Start in TO-DAY to earn one of these Handy Tools

POWER HOUSE 143 University Ave., **Toronto**

THE CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED

SKF

BALL BEARING HANGERS

(Self-Aligning)

Use More Ball-Bearings and Less Coal

WHAT a fallacy for a manufacturer to spend enough money on his coal pile each year to start a fair-sized bank and yet hesitate to invest the interest on the sum in ball-bearing hangers.

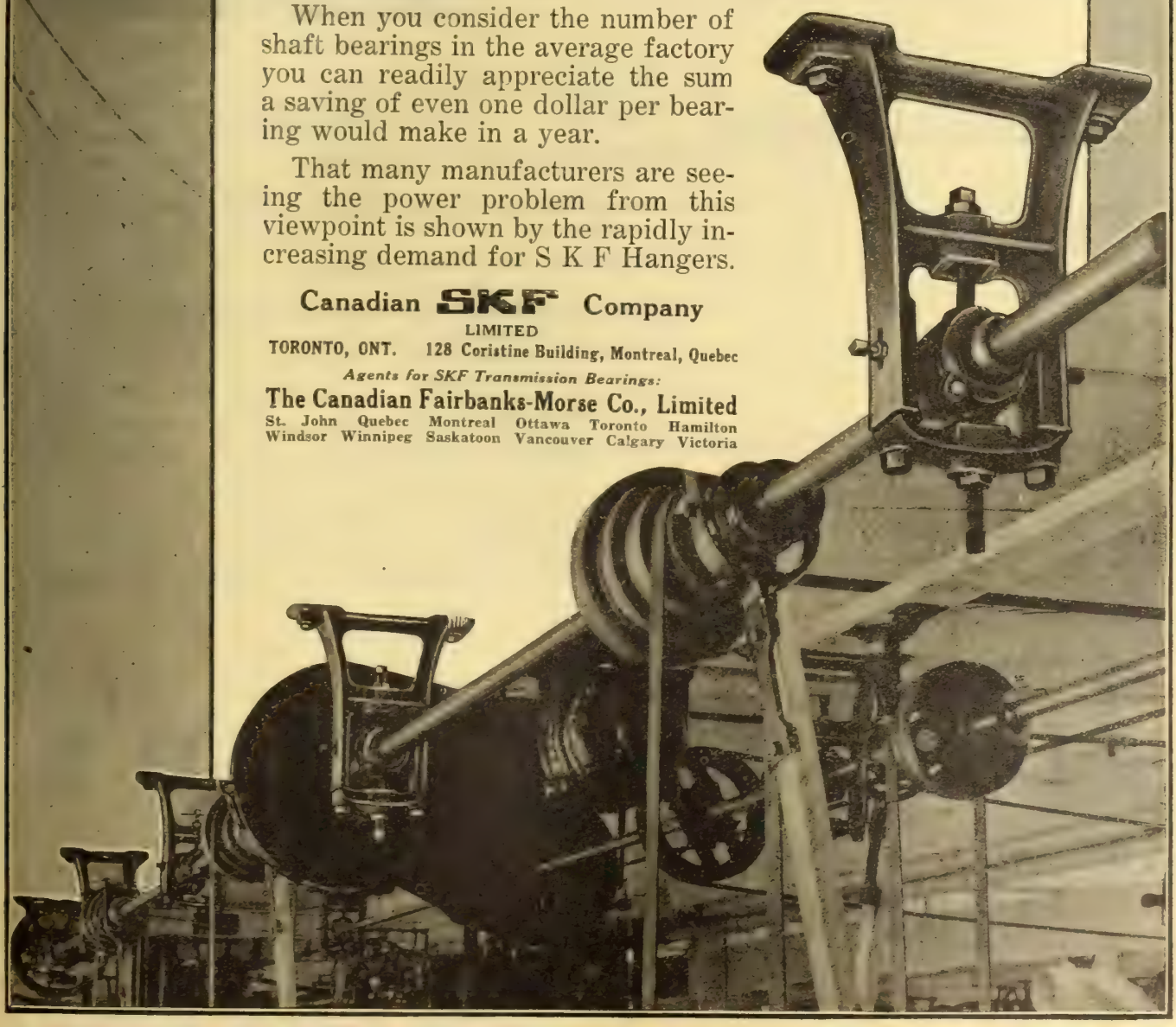
When you consider the number of shaft bearings in the average factory you can readily appreciate the sum a saving of even one dollar per bearing would make in a year.

That many manufacturers are seeing the power problem from this viewpoint is shown by the rapidly increasing demand for S K F Hangers.

Canadian SKF Company
LIMITED
TORONTO, ONT. 128 Coristine Building, Montreal, Quebec

Agents for SKF Transmission Bearings:

The Canadian Fairbanks-Morse Co., Limited
St. John Quebec Montreal Ottawa Toronto Hamilton
Windsor Winnipeg Saskatoon Vancouver Calgary Victoria



Just where do we stand?

CANADIANS are beginning to wonder where we stand with reference to our place in the Empire after the war. Are we to rank as full partners in this grand, big, going concern? Are we to pay our share of the upkeep of the navy? If not, what is to be our status?

Recognizing the growing interest in this problem, the editors of MACLEAN'S decided to devote the July issue to Imperial topics. It offers articles on various phases of our Imperial problem—articles which will have a particular interest at this time when Sir Robert Borden is in London in consultation with the leaders of the Imperial Government.

The July issue contains, besides, a cluster of other big features—readable, fearless and strong. Here are a few of the best:

Field-Marshal Sir Douglas Haig.

Imperial Topics

- "Pocketing Our Imperial Pride" — By H. G. Wells
- "Canada's New Place in the Empire" — By Prof. P. M. Kennedy
- "Living Up to Our Reputation" — By Agnes C. Laut

The War - -

- "Your Old Uncle Sam is Coming Right Back of You" — By Lieut.-Col. J. B. Maclean
- "Stemming the Teuton Tide" — By Geo. Pearson

Fiction - - -

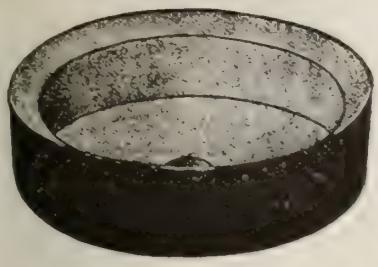
- "The Strange Adventure of the Open Door" - By Arthur Stringer
- "The Three Sapphires" - - By W. A. Fraser
- "The Torby Tragedy" - - By A. C. Allenson
- "The Magic Makers" - - By Alan Sullivan
- "Lennix Ballister—Diplomat" By Archie P. McKishnie

All the regular features as well: Review of Reviews, The Best Books, The Business Outlook, The Investment Situation, Women and Their Work.

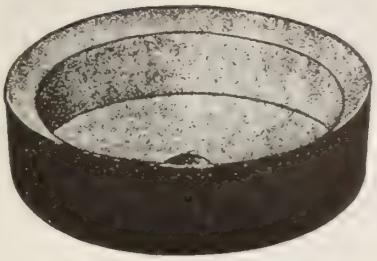
July MacLean's

"Canada's National Magazine"

At All News Stands - 20 Cents



"VIM" MECHANICAL LEATHERS



"Double the Wear" Guarantee on Vim Leather Packings Over Any Others Made

There is a difference of 15 per cent. between the Production of a Machine on which the Packings are giving Perfect Service and one on which the Packings should be replaced.

Consider the following factors:

1—Gain or Loss in Production.

2—Gain or Loss in Power by Friction.

3—Gain or Loss in non-leakage or leakage.

4—Loss of service of Machine while Packing is being replaced.

5—Loss of Service of Machines and Labor due to idle Press.

6—Cost of Labor in replacing.

7—Cost of Packing.

"Double the Wear" Guarantee Cuts the Cost of the First Six Items in Half

Send Us Your Blueprints.

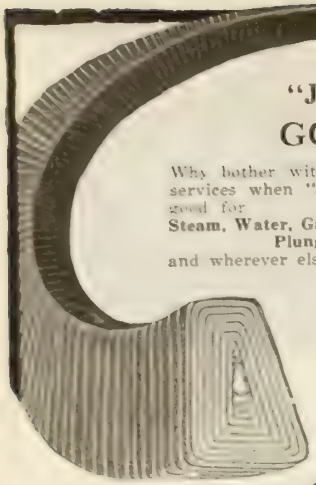
ORDERS FILLED IN 3 DAYS.

CANUCK SUPPLY COMPANY LIMITED

MONTREAL TORONTO WINNIPEG

CANUCK SUPPLY COMPANY LIMITED

If any advertisement interests you, tear it out now and place with letters to be answered.



"John Crane" Flexible Metallic Packing is

GOOD FOR EVERY SERVICE

Why bother with a dozen or more different kinds of packings for as many different services when "John Crane" is the only kind you need in your plant? It is equally good for

Steam, Water, Gasoline, Oil, Gas, Air, Ammonia, Vacuum, Acids, Piston Rods, Valve Rods, Plungers, Shafts, Condenser Tubes, Steam Traps, Valve Stems.

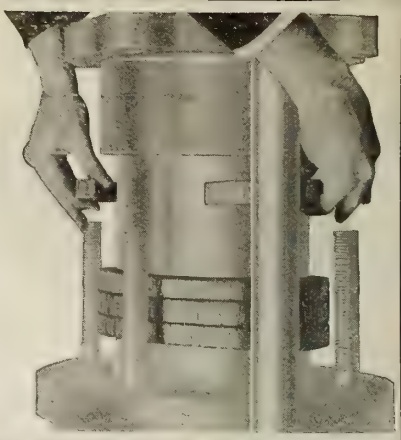
and wherever else packing is needed.

"John Crane" is made of spirally wound layers of smooth babbitt foil, thoroughly saturated with lubricant, making it practically frictionless. Because of its construction it stops every leak, is perfectly flexible, is compressible, conforms easily to the gland and cuts with a pocket knife as easily as fibre

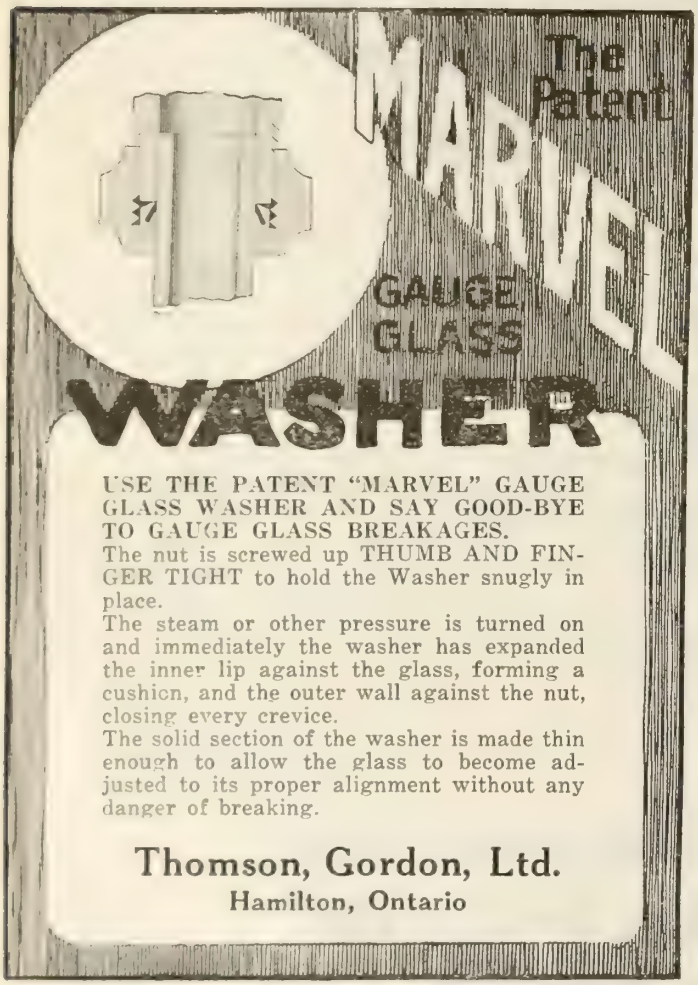
"John Crane" cannot score or cut any rod and lasts for years. If the rod is good in the first place, the packing need never be taken out.

We have a liberal trial offer for those who will give "John Crane" a square deal in trying it out.

Booklet No. 1 tells all about it.



Crane Packing Co. Box 241, Windsor, Ont.—General Office and Factory, Chicago, Ill.



USE THE PATENT "MARVEL" GAUGE GLASS WASHER AND SAY GOOD-BYE TO GAUGE GLASS BREAKAGES.

The nut is screwed up THUMB AND FINGER TIGHT to hold the Washer snugly in place.

The steam or other pressure is turned on and immediately the washer has expanded the inner lip against the glass, forming a cushion, and the outer wall against the nut, closing every crevice.

The solid section of the washer is made thin enough to allow the glass to become adjusted to its proper alignment without any danger of breaking.

Thomson, Gordon, Ltd.
Hamilton, Ontario

BOILER INSPECTION

The Steam Boiler Act, Chapter 252 R.S.O., 1914 With Amendments Chapter 58—6, George V.

STEAM BOILERS.

All Steam boilers constructed for use in Ontario must be built from designs which have been approved and allotted a registration number by the Steam Boiler Branch.

Used boilers, boilers sold or exchanged, and unregistered boilers brought into the Province must be inspected prior to being put into operation.

Notice of repairs to steam boilers, stating the nature and extent of same, must be sent to the Steam Boiler Branch, and should such repairs be considered extensive by the Chief Boiler Inspector, the boilers will require to be inspected.

In each and every case the inspections must be made by Inspectors authorized to inspect boilers under the Steam Boilers Act, who are employed only by the Steam Boiler Branch of the Department of Public Works. Official certificates with the maximum working pressure stated thereon are issued to the owners of the boilers so inspected.

STEAM PIPING.

Drawings and Specifications of all high pressure steam piping must be approved and registered by the Steam Boiler Branch before any work of installation is commenced. The drawings submitted should show clearly the dimensions and layout of the main steam lines. Full particulars should be given as to the material used in the construction of the piping, and all valves and other fittings used in connection therewith must be of approved make.

Any deviation from the above requirements shall be deemed a violation of the Steam Boilers Act.

All communications in this respect should be addressed to the Steam Boiler Branch, Department of Public Works, Parliament Buildings, Toronto.

HON. F. G MACDIARMID, Minister of Public Works and Highways

W. A. RIDDELL, M.A. Ph.D., Supt. Trades & Labour Branch

D. M. MEDCALF,
Chief Inspector of Steam Boilers.

Self-Lubricating

In Bulk

SAFETY PLASTIC

METALLIC PACKING

FOR STEAM, WATER, AIR, GAS, ETC.

Pat. Dec. 22, 1903 Highest Award World's Fair, St. Louis, 1904

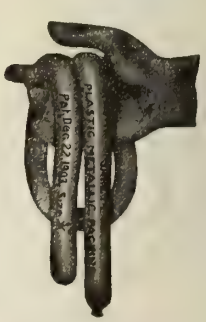
GUARANTEED TO LAST THREE YEARS

WITHOUT RENEWAL

Drop us a line and let us tell you all about this Remarkable Packing.

STEEL MILL PACKING CO., WINDSOR, ONT. Established 1899

Practically Frictionless



In Cotton Tubes

This book should be in the hands of every pump user. A postal will bring your copy promptly

MARSH and AMERICAN

Steam and Power Driven Pumps and Air Compressors

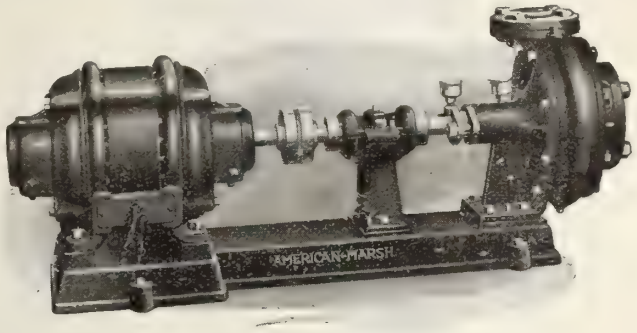
Marsh and American Pumps are especially adapted for long, hard service because they are *extra heavy* in design and of *extremely rigid construction.* Every unit is built amply strong to withstand 24-hour-a-day service and to stand up under any unforeseen strain which may be placed upon it. Piston rods on the steam pumps are extra large and made of solid bronze. The water ends are equipped with heavy cast bronze removable bushings.

This superior construction not only insures continuous and satisfactory operation, but practically ***eliminates expensive shut-downs.*** Marsh and American Pumps are the product of over 25 years' experience in the design and construction of high grade pumping machinery. Over 135,000 in actual service throughout the world.

The AMERICAN-MARSH LINE OF CENTRIFUGAL PUMPS is composed of both single and double suction types which are designed for heads up to 125 feet. They are equipped with wide ring oiled bearings and the single suction type has overhanging casing enabling the discharge to be taken at any angle desired.

CANADIAN AGENTS

A. R. Williams Machinery Co., Toronto.
Williams & Wilson, Montreal.
London Engine Supplies Co., London, Ont.
Stuart Machinery Co., Winnipeg.
Mechanics' Supply Co., Quebec, Que.
Gorman, Clancy & Grindley, Limited, Edmonton and Calgary.
Taylor Engineering Co., Ltd., Vancouver, B.C.

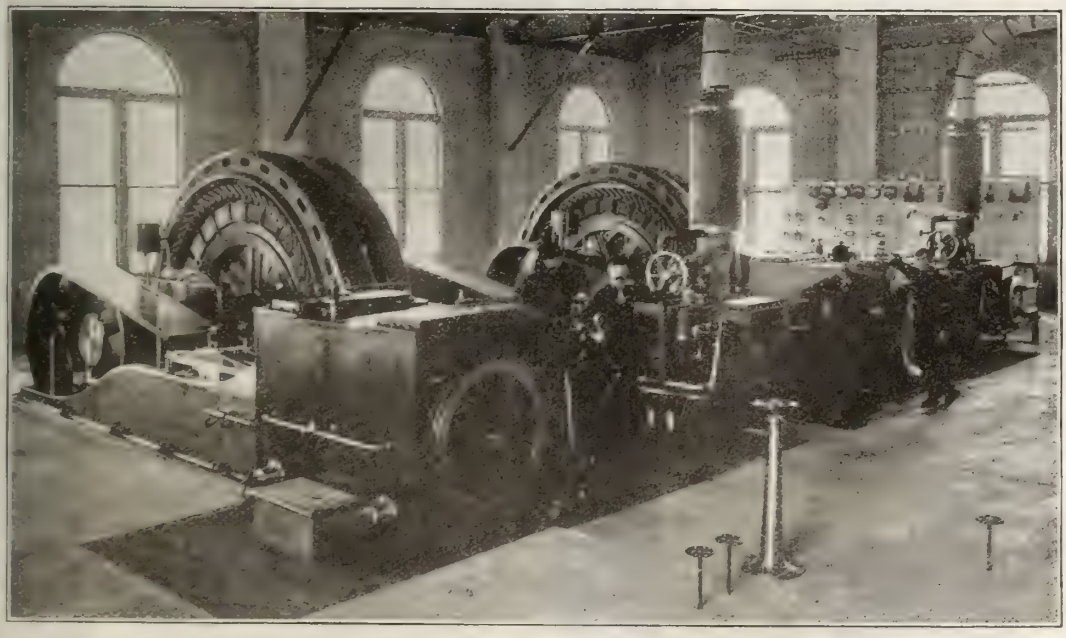


American-Marsh Centrifugal Pump.

American Steam Pump Company

Battle Creek, Mich.

25 Cycle Engine Generator Sets For Sale



1—250 KW.
1—300 KW.

25 Cycle
3 phase
Westinghouse
Generators
Direct
connected to
McIntosh &
Seymour Cross
Compound
Gridiron Valve
Engines 150
R.P.M.

These units were in use only seven months and are in first class condition.
Write for further particulars and quotations.

Power Plant Equipment Co., Dominion Bank Building Toronto, Ont.

"Save the Coal"

You save coal by saving power.

You save power by stopping leaks.

You can stop any kind of pipe-joint leak with a Yarway (formerly Simplex) Pipe-Joint Clamp.

And the leak is stopped instantly—and permanently, if you wish to leave the clamp in place rather than put in a new pipe or joint.

Don't permit costly leaks to sap the energy of your power plant. Let us send you one of these serviceable clamps for 30 days' trial.

When you receive the clamp, put the packing ring on first, follow it with the inner iron ring (see illustration); then bolt on the clamp and tighten the screws. That's all there is to it—simple, but highly effective.

A user writes:

"We had a steam leak on a coupling in an 8-inch steam line which was 30 feet long. The Yarway stopped the leak and prevented our having to take the line down. We also have one of these clamps on an 8-inch hot water line, clamp having been in service for six years and still giving perfect satisfaction."

Write to-day, stating size of line

YARNALL-WARING CO.

7604-20 Queen St. Chestnut Hill, Philadelphia

Canadian Representatives Carrying Stock

A. McLellan, 301 Read Bldg., Montreal
Cunningham Hdwe. Co., New Westminster, B.C.
Jas. Robertson Co., Montreal

YARWAY PIPE-JOINT CLAMP

Formerly the SIMPLEX

Take a Leaf

out of the book of the experience of others who have tried

VULCABESTON

RED FIBRE SHEET PACKING

and found it unexcelled as an all-'round packing, with special virtues of its own.

It is the most lasting packing known, keeping joints tight longer than any other, and under all conditions. Resists heat, moisture and chemical action, seats perfectly and saves the user a world of trouble and expense.

You would find a trial convincing. Get some from your dealer, or ask us. REMEMBER: the Red Fibre Sheet Packing with this trade-mark:

The Johns-Pratt Company

Hartford, Conn., U.S.A.

Montreal, Que., Ross & Greig; Toronto, Ont., James Morrison Brass Mfg. Co., Ltd.; Vancouver, B.C., Fleck Bros., Ltd.; Winnipeg, Man., Crane Co.

J-P J-P

Distribution All Over the World in Two Years

When placed on the market two years ago the *Babbitt Adjustable Sprocket Rim* met with instant acceptance and success. Engineers everywhere realized it was a mighty handy little device.

YOU, too, should realize this. Then you can stop carrying a ladder when operating overhead valves. Pamphlet on request.

BABBITT STEAM SPECIALTY CO.
New Bedford, Massachusetts 93-14

Manufactured in Canada, under Canadian Patents, exclusively by the Engineering Specialties Company, Limited, 1080 King Street West, Toronto, Ont.

Johns-Manville
Protective Devices

Dominion of Canada: $12.00 East of Calgary. $12.50 Calgary and West.

Why this extinguisher instead of some other?

THERE might be some excuse for fires if they were hard to prevent, but they are not. Most fires in your stations, sub-stations and other properties start small. You will be adequately protected if a Johns-Manville Fire Extinguisher is in easy reach at every danger point.

But be sure it is a Johns-Manville because then you have the option of two methods of operation. The Johns-Manville is the only extinguisher you can discharge either by pumping or by compressed air previously pumped and temporarily stored. This latter method enables you to pump up the pressure as you run to the fire and then to shoot the stream without further pumping—a big advantage in close quarters.

The extinguishing liquid which immediately smothers any incipient blaze, including electric arcs and burning gasoline, is a chemical of a dielectric strength greater than transil oil. It is non-corrosive and harmless to skin or fabric.

THE CANADIAN
H. W. JOHNS-MANVILLE CO., LTD.

Montreal Toronto Vancouver Winnipeg
Hamilton London Ottawa

COVERS THE CONTINENT

Furnished in all amperages and all voltages.

NOARK
Approved Fuses *Safe!*

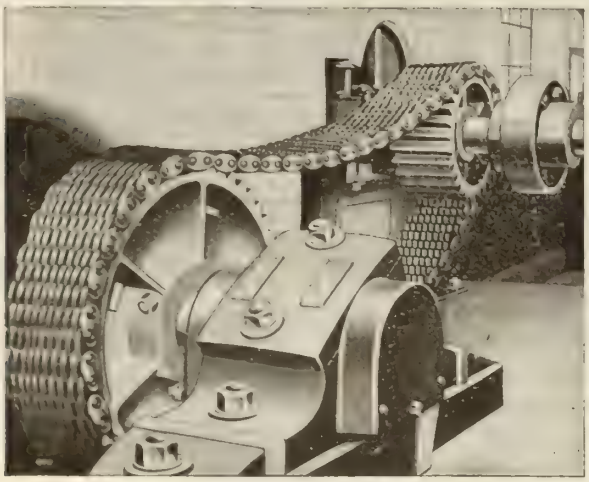
IF it pays to spend a thousand dollars to ground a system, doesn't it pay to select a fuse which will give positive protection to your feeders—particularly when its cost is negligible compared with the equipment value it protects?

"Noark" Approved Fuses assure this protection because each fuse is an accurately calibrated reliable product. You place it in a circuit satisfied that it will blow when, and only when, its rating is reached.

Manufactured by the Johns-Pratt Co.,
Hartford, Conn.

H. W. Johns-Manville Co., Sole Selling Agents.

If any advertisement interests you, tear it out now and place with letters to be answered.



COVENTRY NOISELESS CHAINS

For all kinds of power transmission — Main and Countershaft Drives, Pumps, Fans, Air Compressors, and at all times 98 per cent. of power being transmitted.

Write for our handbook C-3 on chain gearing, post free for the asking.

Head Office and Works:

"THE COVENTRY" CHAIN CO., LTD.
COVENTRY, ENGLAND

Cables: Chains, Coventry.

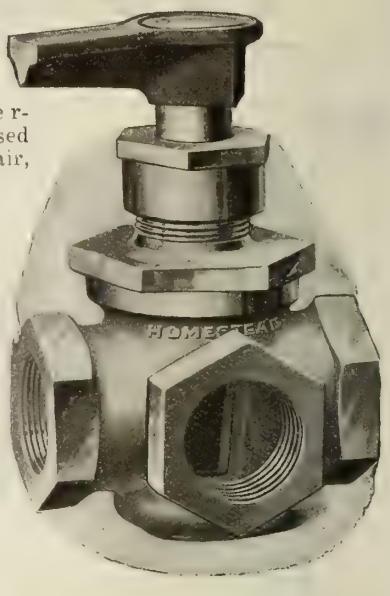
Codes: A.B.C., 4th and 5th editions. Western Union.

London Office: 47 Victoria St., S.W. 1.

Agencies in all the principal countries in the World.

HOMESTEAD QUARTER TURN - - VALVE

For Hard Service



Homestead Quarter-Turn Valves can be used for any service — air, steam, oil, water, acids or anything, and are made for any pressures up to 3,000 lbs. Thousands of industrial and power plants are using them to-day in place of the globes and gates. Why? Because they give better service — that's all.

All Homestead Valves are constructed with the patented Homestead principle which makes them seatless while the pressure is passing through.

HOMESTEAD VALVE MFG. CO.
HOMESTEAD, PA.

Williams' Superior Drop-Forged Wrenches
FOR ALL PURPOSES

We have been making drop-forged Wrenches for nearly half a century and now carry in stock about 1,000 sizes in 40 patterns, 90 per cent. of which can be shipped the day order is received.

J. H. Williams & Company
"THE WRENCH PEOPLE"

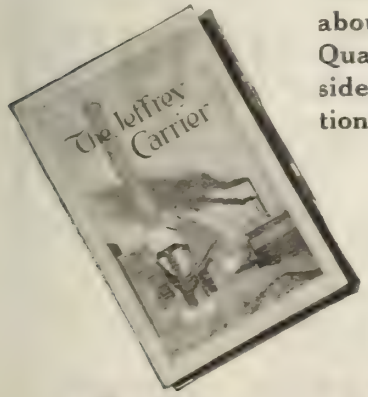
Western Office and Warehouse: 78 So. Clinton St., Chicago, Ill. The A. G. Low Co., Ltd., 78 Pacific Avenue, Saskatoon, Saskatchewan, Agents for Manitoba, Saskatchewan, Alberta and British Columbia.

And—By All Means Insist Upon A Jeffrey Carrier says the Chief Engineer

'It is imperative that we install some method of handling our Coal and Ashes mechanically, for we cannot spare men to shovel coal and push wheelbarrows. With the right equipment we can move all our Coal and Ashes by machinery, effect big savings on our present handling costs, and move these men into the factory, where they are badly needed.

"I have investigated the merits of all the leading makes of Pivoted Bucket Carriers—have seen them in actual operation, and am convinced that the Jeffrey Carrier is the RIGHT EQUIPMENT for our requirements.

"The Jeffrey people have recently issued their new Bulletin No. 237, which will tell you all about the Rugged Construction and Enduring Qualities of their Improved Carrier, and besides shows a number of interesting installations."



Write to the

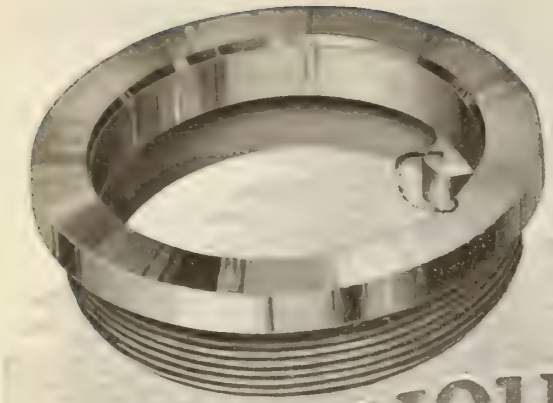
Jeffrey Mfg. Co.

Canadian Branch and Warerooms

MONTREAL, CANADA

Handle it Mechanically

If any advertisement interests you, tear it out now and place with letters to be answered.



Continuous Service

with minimum up-keep are virtues of Lunkenheimer "Renewo" Valves.

The SEATRING and DISC — the parts subjected to the most wear—are made of Lunkenheimer "Valve Nickel," a material which gives exceptional results in service; the seating surfaces are regrindable, and all parts including the seatring and disc are renewable.

Take advantage of these features, peculiar to the "Renewo," and repair or replace a worn or broken part rather than discard the entire valve. To repair means to conserve. To conserve means to economize. CONSERVATION and ECONOMY are absolute essentials to our success in the war.

Our "War Period" Appeal

Engineering Appliances Are Prime War Essentials.

Stocks of distributors and facilities of manufacturers must be adjusted to care for essential needs.

Lunkenheimer patrons are earnestly requested to assist in the common cause by confining their War Period specifications to requirements for essential plants, craft, vehicles or equipment.

THE LUNKENHEIMER CO.

"QUALITY"

Largest Manufacturers of
High Grade Engineering Specialties
in the World.

CINCINNATI, O., U.S.A.

New York Chicago Boston London

1-16-43

Morehead

Back to Boiler

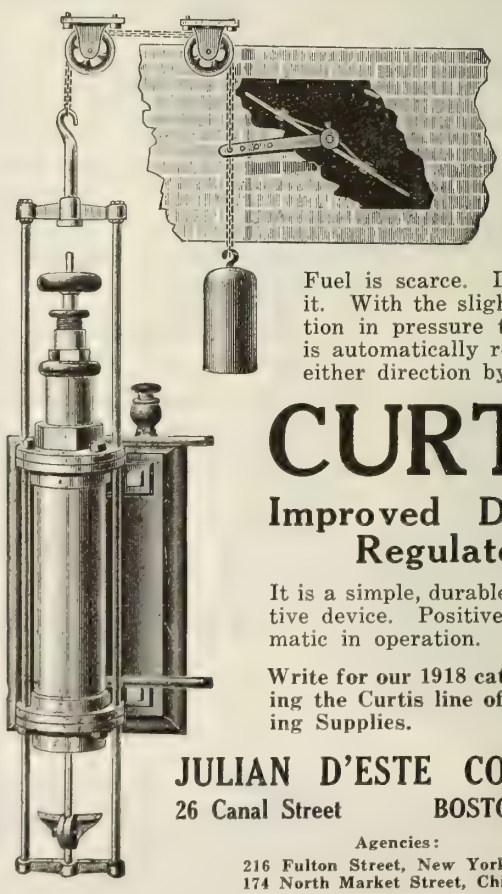
SYSTEM

Drains Your Steam Lines Back to Boiler Automatically Without Pumps

After steam's expansive energy is exhausted, there are heat units left. These the Morehead System returns to your boiler as pure HOT feed water. It lowers your fuel cost by 10 per cent.

It would pay you to talk with the owner of a plant in which the Morehead System is installed. **Write.**

Canadian Morehead Mfg. Company
Dept. A
Woodstock, Ontario



Save Fuel

Fuel is scarce. Don't waste it. With the slightest variation in pressure the damper is automatically regulated in either direction by the

CURTIS

Improved Damper Regulator

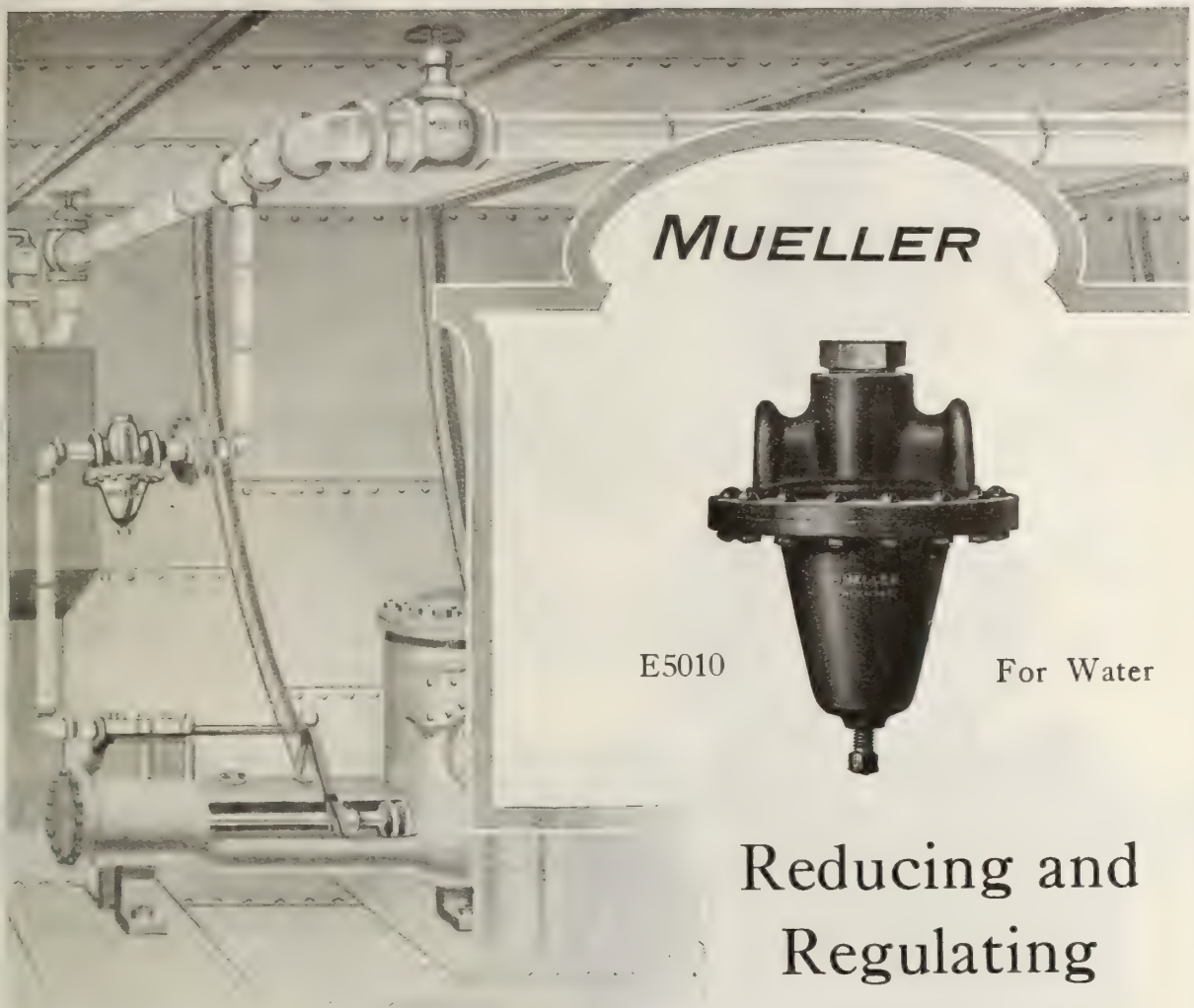
It is a simple, durable and effective device. Positive and automatic in operation.

Write for our 1918 catalog showing the Curtis line of Engineering Supplies.

JULIAN D'ESTE COMPANY
26 Canal Street BOSTON, MASS.

Agencies:
216 Fulton Street, New York City
174 North Market Street, Chicago, Ill.

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.



MUELLER

E5010 For Water

Reducing and Regulating Valves

Before you install your valve, be absolutely sure on these three points.

1. **The right kind** of valve is the one that is adapted to your particular service. No one type will answer all purposes. Different service and at times different conditions in the same kind of service necessitates different types of valves.

2. **The right size** of valve is the size that will make the proper reduction and regulation and has a wide enough seat opening to prevent obstruction and cutting out of the seat. *A general fault is using a valve that is too large.* Ordinarily they should be smaller than the pipe to which they are attached.

3. **Proper assembling** means that valves should have working parts suitable to service, and diaphragms and springs suitable to pressure range.

Don't guess. Consult us. When valves are installed under MUELLER supervision, we fully warrant them to perform the service for which we recommend them.

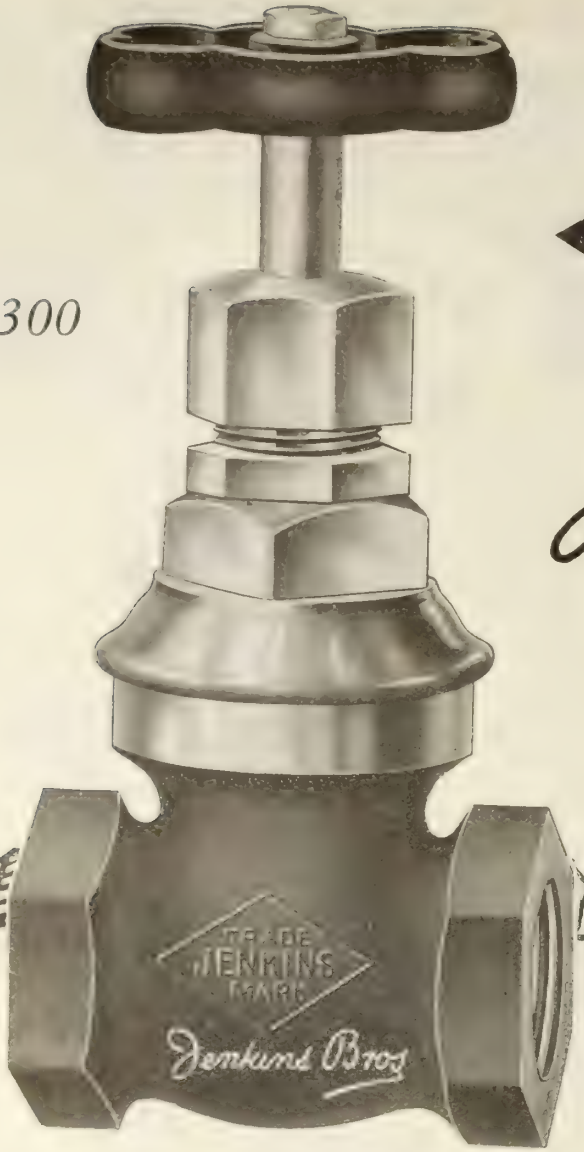
We make valves for water, steam, gas, air, oil and ammonia. There is a stock valve in our catalog that will meet your needs. If you have a specially intricate problem to solve, our experts are at your command.

H. MUELLER MFG. CO., LIMITED
SARNIA, CANADA

MUELLER

If any advertisement interests you, tear it out now and place with letters to be answered.

Fig. 300



TRADE JENKINS MARK

Jenkins Bros

Dependable and economical valve service is assured when you install valves with the Diamond trade-mark.

If It's a Gate Valve You Want---Ask for the Type "K"

For over half a century Jenkins Bros.' Valves have been depended upon for every kind of service in all parts of the world. Type K Brass and Iron Body Gate Valves have attained popularity wherever they have been tried.

Catalogue No. 8 tells you all about them and is free for the asking.

TRADE JENKINS MARK Jenkins Bros

Jenkins Bros. LIMITED

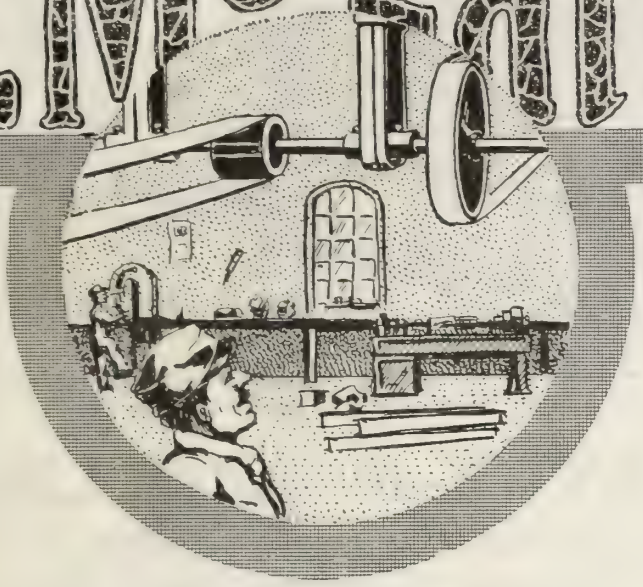
TRADE JENKINS MARK Jenkins Bros

Head Office and Works: 103 St. Remi Street, Montreal, Canada

Agencies in all the Principal Countries of the World

European Branch: 95 Queen Victoria Street, London, E.C. 4, England

D. K. McLaren's



GENUINE OAK

Genuine British

GENUINE OAK

Oak-Tanned

Leather Belting

Flawless back leather of selected hides tanned by our Genuine British Oak Method—made so pliable, so durable, so tough as to be practically slipless, stretchless and unbreakable—that is McLaren's Leather Belting

The Obvious Right Road for Power

Truly the royal road from the source of power to pulley, for McLaren's Belting is without stretch, without slippage or friction. It delivers power with least loss of power—that we can prove.

Write for our catalog to-day.

D·K·McLAREN LIMITED

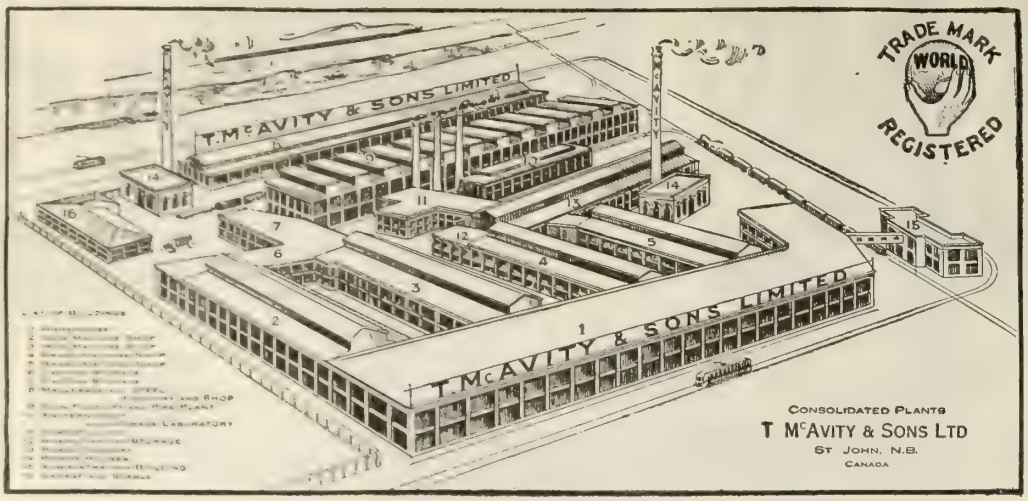
HEAD OFFICE AND FACTORY

351 ST. JAMES STREET, MONTREAL, P.Q., CANADA

TORONTO, ONT.
194 King St. West

ST. JOHN, N.B.
90 Germain St.

VANCOUVER, B.C.
849 Beatty St.



The Home of "WORLD" Brand Valves, Cocks, Fittings and Supplies

We make a specialty of Marine and Railway Brass and Iron Valves, Cocks, Fittings and Injectors. Please send for complete catalogue and put us on your mailing list and send us enquiries for prices and deliveries.

Established 1834

T. McAVITY & SONS, LIMITED

Incorporated 1907

BRASS AND IRON FOUNDERS
WHOLESALE AND RETAIL HARDWARE

ST. JOHN, N.B., CANADA

TORONTO
T. McA. Stewart
157 St. James St.

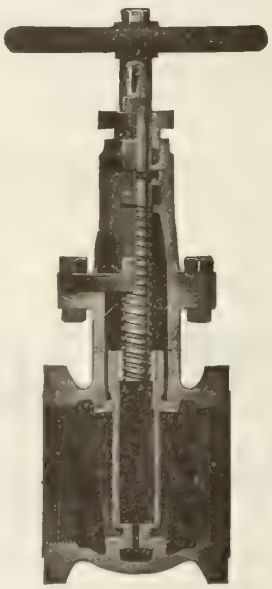
WINNIPEG

VANCOUVER

MONTREAL
Harvard Turnbull & Co.
207 Excelsior Life Bldg.

KERR
("New KEYSTONE" Pattern) GATE VALVES

If you have not used any of these New Pattern Valves, specify "KERR" in your next order. We want you to get acquainted with the most reliable valve on the market.



If you have been using them, we are confident that our satisfaction will bring us your repeat orders. These valves will never cause you or your customer the slightest trouble. Their high quality is consistent.

When you buy a "KERR" Valve you get a guaranteed article that is backed by a reliable firm. Many of the largest distributers of valves in Canada have sold "KERR" Valves for over 25 years, and are still recommending them as the "Best Valve." Write us for particulars.

Kerr Engine Co., Ltd., Valve Specialists **Walkerville, Ont.**

If [illegible] is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

A HALF CENTURY

of useful work is celebrated by Albany Grease. During the past 50 years Albany Grease has always given perfect lubrication service on engines, pumps, motors, generators and gears in power and industrial plants.

ALBANY GREASE

has proven in many instances to be very efficient and most economical. It will keep bearings running cool and easy at all times. Should you not be using Albany Grease send for samples and try it.

Albany Lubricating Co.
708-10 Washington St.
NEW YORK, U.S.A.

Established 1868

The Gripping Power of a Giant

is the gripping power of "Spiro" couplings; in fact, they have a 50% greater gripping force than any other compression coupling. The tigher the pull on the two halves of the coupling the tighter the grip on the entire length and circumference of the sleeve on the shaft.

A spiral slot in the sleeve is a patented Bond feature that allows a tremendous gripping force to be applied. There are no keys to break or work loose and cause time and labor to be wasted in fixing it.

"SPIRO" Couplings Cannot Slip

Write for our catalog on Power Transmission Machinery to-day.

Canadian Bond Hanger & Coupling Co., Ltd.
ALEXANDRIA, ONTARIO

WHEN a certain manufacturer bought his belts, the salesman told him to "run them at just the right tension."

So once a month every belt was tested, and if not tight enough it was taken up, this work being done on Sundays and holidays, at "time-and-a-half."

But this made his friction load high. Bearings required too much oil, and when his belts slipped, men and machines had to stand idle until they were taken up. So finally they used belt dressings, rosin, soap or "a little castor oil" to stop the slipping, and now his belts give him more constant trouble than anything else in the plant.

* * * * * * *

There is another man in his town whose belts are old. He hasn't tried the tension for many years, because there isn't any tension. They run easy or slack, and when called upon for extra duty they respond cheerfully.

For this man has long since learned the CLING-SURFACE way. His belts never slip, even when running heavy, and the friction load is very small. About once a month or oftener, depending upon how long the belt has been treated, one of his men takes a stick with a rag wrapped around one end, and dipping it in the CLING-SURFACE he places it against the face of a belt, passing it across until a very light stain appears on the pulley faces. Then he stops; that belt is trouble-proof.

Simple, isn't it? Yet the greenest workman can apply the new semi-liquid "easy-to-use" CLING-SURFACE safely, economically and correctly.

Instead of tying up the shop with "belt trouble," wearing out men and equipment, and having overtime charges to meet, ONE MAN, with a bucket of CLING-SURFACE, treats the belts. Oil, coal and time is saved, more power is delivered, and the drives become cheerful workers instead of disagreeable kickers in your factory.

Let us prescribe for YOUR drives; our service is free. CLING-SURFACE is guaranteed, and we have a plan 10,000 firms have found successful.

Remember, use CLING-SURFACE and you won't need belt dressings

Cling-Surface Co.

1057 Niagara Street
Buffalo New York

If any advertisement interests you, tear it out now and place with letters to be answered.

FIVE LINKS in the chain that joins a modern steam plant with highest efficiency.

LINK No. 1—Garlock Style No. 200 is unsurpassed for use on rods working against high pressure and superheated steam, for expansion joints and rods running in oil, grease and acids.

LINK No. 2—Garlock Style No. 5 will give excellent service for low pressure steam and hot water.

LINK No. 3—Garlock Style No. 285, when used with Style No. 286, which is cut sectional, will give excellent service on ammonia rods.

LINK No. 4—Garlock Style No. 333 is unequalled for medium pressure steam, hot water, etc.

LINK No. 5—Garlock Style No. 336 is adapted to rods not running true or that are badly scored.

The Garlock Packing Co.

Hamilton, Canada

Branches:

Montreal, Que., 409 Shaughnessy Bldg.
Toronto, Ont., 404 Continental Life Bldg.
Winnipeg, Man., Galt Bldg.

If any advertisement interests you, tear it out now and place with letters to be answered.

MORSE ROCKER JOINT SILENT CHAIN DRIVES vs BELTS

LARGE POSSIBILITIES OF REDUCED TRANSMISSION COSTS ARE OPEN TO THOSE WHO WILL INVESTIGATE **MORSE DRIVES** — MADE RIGHT, PROVIDE MAXIMUM DURABILITY AND EFFICIENCY.

Positive as Gears. Flexible as a Belt.

Deliver full power and speed and deliver RIGHT ALONG

THE LARGEST MANUFACTURERS AND STOCK OF SILENT CHAIN DRIVES IN THE WORLD. CONSIDER THE ADVANTAGE OF THIS AND OUR PROMPT DELIVERIES. THESE ARE VITAL FACTORS OF

MORSE ENGINEERING SERVICE

OUR ENGINEERS, SPECIALISTS IN THE ART OF DESIGNING CHAIN DRIVES, ARE CONVENIENTLY LOCATED AT ADDRESSES BELOW, AND WILL GLADLY CALL AT YOUR REQUEST AND ASSIST IN SOLVING ANY POWER TRANSMISSION PROBLEM WITHOUT OBLIGATION.

WE ARE ALWAYS GLAD TO FURNISH SPECIAL INFORMATION AND WELCOME INQUIRIES. FEEL FREE TO WRITE US AT ANY TIME.

Morse Rocker Joint Silent Gear Drive

is the only chain drive not dependent on Oil Baths for Service, Silence and Durability.

THE MORE SEVERE THE DUTY THE MORE NEED OF "MORSE"—THE PERFECT, DURABLE, POSITIVE TRANSMISSION, WITH 99 PER CENT. EFFICIENCY.

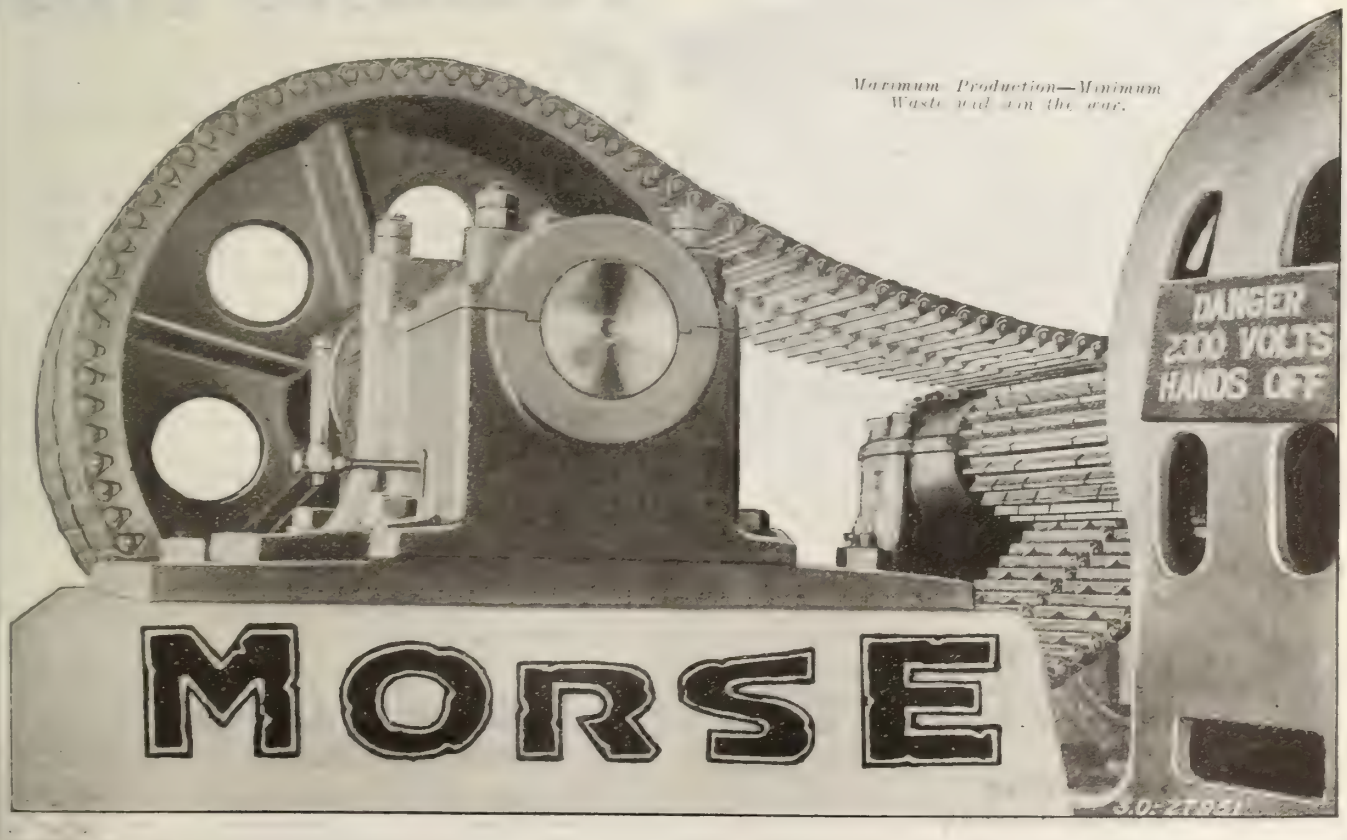
Morse Drives have great mechanical strength. Made of the best material available and with the perfection of modern cost manufacturing methods, assuring 100 per cent. overloads.

LOSS OF SPEED WITH HIGHER PRODUCTION COSTS AND SHUT DOWNS ARE EXPENSIVE. FAULTY BELT TRANSMISSION IS A BIG COST ITEM.

MORSE CHAIN CO. Largest Manufacturers of Silent Chains in the World Ithaca, N.Y.

ADDRESS NEAREST OFFICE:

BOSTON, MASS., 411 Milk St.
CHICAGO, ILL., Merchants L. & T. Bldg.
CLEVELAND, OHIO, Engineers Bldg.
DETROIT, MICH. 1003 Woodward Ave.
GREENSBORO, N.C., 805 Ashboro St.
ATLANTA, GA., Earl P. Scott, M.E., Candler Bldg.
NEW YORK CITY, 50 Church St.
PITTSBURGH, PA., Westinghouse Bldg.
SAN FRANCISCO, CAL., Monadnock Bldg.
CANADA Jones & Glassco, Reg'd., Montreal, St. Nicholas Bldg. Toronto, Traders' Bk. Bldg.
KANSAS CITY, MO., Morse Engineering Co., R. A. Long Bldg.
MINNEAPOLIS, MINN., Strong-Scott Mfg. Co., 413 Third St., S.
ST. LOUIS, MO., Morse Engineering Co., Chemical Bldg.
LICENSEES FOR EUROPE, The Westinghouse Brake Co., Ltd., 82 York Road, King's Cross, London, N.



If any advertisement interests you, tear it out now and place with letters to be answered.

POTATO SCALE POWDER

A Simple, Inexpensive Means of Saving Fuel

Canada will face a serious fuel shortage next winter. Every pound of coal should be conserved—right now. A little POTATO SCALE POWDER in the feed water of your boilers each day will save many tons of coal for Canada in the course of a few months. POTATO SCALE POWDER removes old scale from the boilers and prevents any new scale formations, thus your boilers are able to do maximum duty with a minimum amount of fuel. No pitting, foaming or other troubles, due to impurities in feed water, where POTATO SCALE POWDER is used.

Made to suit feed water conditions and contains nothing that will cause the slightest injury to boiler metal or fittings.

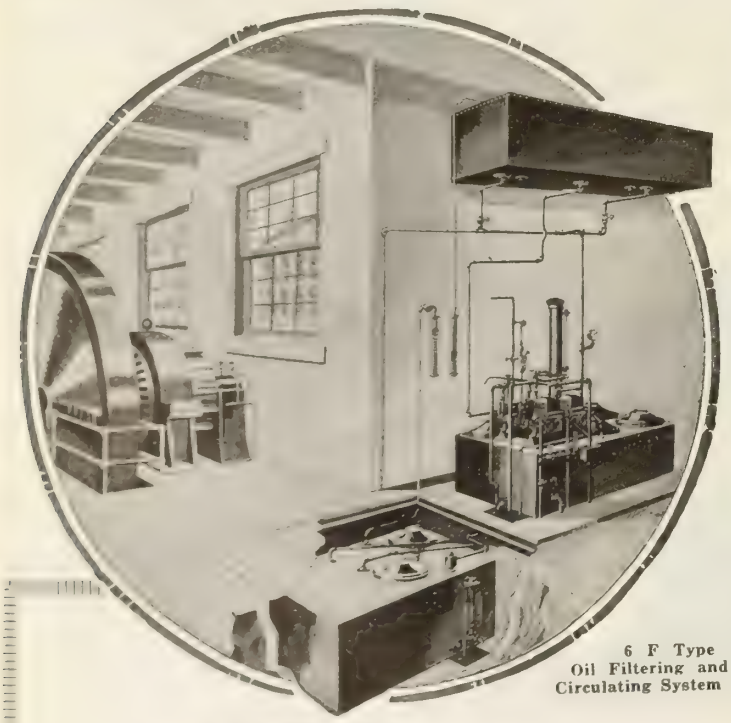
Large power plants in Canada and United States are constant users of POTATO SCALE POWDER. Positively guaranteed. Try a barrel and watch the result.

BOILER CLEANSER

C. C. SNOWDON

Oils Refiner, Manufacturer and Importer, Pennsylvania, Lubricating and Refined Oils, Gasoline, Potato Scale Powder, Liquid Soap, Disinfectants, Polish, Waste, Oil Tanks, etc.

Winnipeg—Cor. Notre Dame and Pine Streets, P.O. Box 1984. **Vancouver**—823 Powell Street. **Calgary**—1810-1840 Eleventh St. East, P.O. Box 1384, P.O. Drawer 166. **Edmonton**—Cor. 13th Ave. and 83rd St., P.O. Box 877.



6 F Type Oil Filtering and Circulating System

Results that Count

Wherever it is installed there is more uniform lubrication of machines, without loss of oil; less depreciation of equipment; fewer repair bills; a better spirit among employees, and—increased profits, all of which are good, strong reasons why the Bowser should be in your plant.

The Bowser stores and supplies new oil—collects dirty oil—purifies it, makes it good as new—returns the proper supply to points of use wherever located. Its simplicity, durability, and ease of operation are reasons for its popularity in all well regulated plants.

"Results that Count" always follow its use—we'll be glad to tell you more about it if you drop us a line.

BOWSER ESTABLISHED 1885

The Bowser System makes good results a sure thing.

Oil Circulating and Filtering Systems

S. F. Bowser & Co., Inc.

TORONTO, ONTARIO

Sales Offices in All Centers

Representatives Everywhere

BOWSER SERVICE

"We have been using this belting on practically every kind of drive throughout our shop and have no hesitation in saying that same has given us entire satisfaction."—A Pembroke Superintendent.

Plays a Big Part in Shell Production

Three years ago it was unusual to find any belting except leather in machine shops.

To-day hundreds of Canadian shops are using Extra Power Belting. Some are belted entirely with Extra Power. One of the largest shell shops in the Dominion has used over 20,000 feet—practically every drive belt is Extra Power.

In fact, Extra Power Belting is playing an increasingly big part in Canada's shell production.

It is true that engineers and factory superintendents first discovered the merits of Extra Power Belting on hard, unusual drives.

But experience in shell shops has shown that Extra Power Belting is not a bit too good for ordinary drives.

The proven qualities of Extra Power Belting—long life, pulley-gripping flexibility, freedom from stretch—make it the best and most economical belt for high-speed lathes and every other type of machine.

Don't think you have paid for a belt when you have bought it. That's only the beginning of the belt cost.

To that first cost must be added the cost of every repair or adjustment on the belt—every hour machinery and men are idle—every dollar of the product's value lost by that idleness—every pound of coal wasted in inefficient transmission.

The Goodyear Belting man has a real story to tell you. He is a trained expert on belting problems. To use his service involves no obligation, adds nothing to the cost of your belting. But we *may* be able to show you a new road to increased production and lower belting costs.

Write or phone the nearest Goodyear branch—to-day.

The Goodyear Tire & Rubber Co. of Canada, Limited

Branches: **Halifax, St. John, Montreal, Ottawa' Toronto, Hamilton, London, Winnipeg, Regina, Calgary, Edmonton, Vancouver**

Service Stocks in Smaller Cities

EXTRA POWER BELTING

If any advertisement interests you, tear it out now and place with letters to be answered.

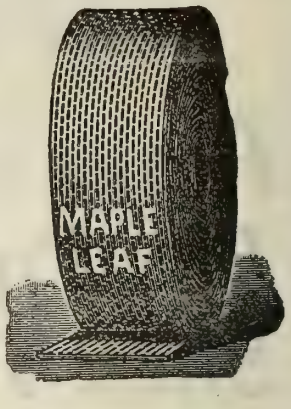
Dominion Belting Company, Limited

Hamilton, Canada

Sole manufacturers of the celebrated "MAPLE LEAF" Brand Stitched Cotton Duck Belting and Belt Dressing.

The demand for our products has steadily increased because the standard of quality has been maintained.

We make only one grade, the best that can be produced.



"MAPLE LEAF" is the strongest, truest running, most economical and efficient belt on the market for transmission of power, conveying, etc.

Being thoroughly waterproof it is suitable for running in wet or dry places. **"MAPLE LEAF"** Belt Dressing is different to others offered in that it is equally good for all kinds of belting, leather, rubber or Balata, as well as our own make.

Write us for prices, and if desired we will be pleased to furnish samples and further information.

A trial order will convince you of their utility.

DOMINION BELTING CO. Ltd., Hamilton, Canada-Quebec Branch: 51 Duluth Bldg., Montreal

UNIFORM AND DURABLE

ROOT, NIELSON & CO.,
UNION IRON WORKS,

Magnolia Metal Co. Sacramento, Cal., Aug. 15, 1917.

Gentlemen:

We have been using Magnolia Metal continuously during the past ten years, on all of our work, including Automobile repair work, Ammonia Machines, Electric Motor and Motor Boat work.

The fact that Magnolia Metal is always uniform in quality, runs freely, and shows great durability, are reasons enough to warrant its use in all of our work. It has always given utmost satisfaction.

Yours very truly,

ROBERT McNAIRE, Supt.

PRACTICAL ENGINEER POCKET BOOK:
Over 600 pages. A valuable reference work imported from England and sold as an advertising medium at the low price of 40c post paid.
Address Montreal Office.

SOLD BY LEADING DEALERS EVERYWHERE OR BY

MAGNOLIA METAL CO.

OFFICE AND FACTORY:
225 St. Ambroise St., MONTREAL

CONDUIT PIPE FITTINGS

Made in Canada

TYPE A

TYPE B

TYPE F

TYPE V
Vapour, Gas and Dust Proof

In introducing to the trade C.G.E. Conduit Pipe Fittings, we desire to call particular attention to the following points, in connection with their manufacture:

All C.G.E. Pipe Fittings are made of pure metal, carefully selected to ensure proper tapping and threading, well-japanned on the inside and electro-galvanized on the outside.

The cover openings are ground thoroughly flat and screw holes well centred.

All covers are fitted to castings before shipment, to avoid possible drilling error or extreme shrinkage of porcelain.

In general quality, high finish and uniformity of product, C.G.E. Fittings compare most favorably with any other make on the market.

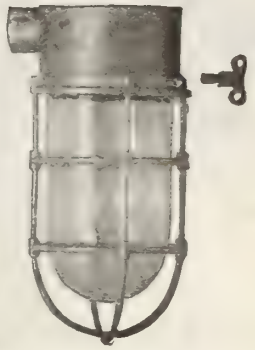
Every shipment is warranted to maintain this high standard—samples will gladly be forwarded free of charge, on request.

C.G.E. Fittings comprise all standard types.

C.G.E. Fittings are approved by the National Board of Fire Underwriters and by the Hydro Electric Power Commission of Ontario.

——AND THEY COST LESS MONEY.

Bulletin No. 618, describing these fittings, will be mailed on request to our nearest office.



TYPE VH
Vapour, Gas and Dust Proof

CANADIAN GENERAL ELECTRIC CO.

LIMITED

Head Office: Toronto. Sales Offices: Montreal, Halifax, Sydney, Ottawa, Cobalt, South Porcupine, London, Winnipeg, Calgary, Edmonton, Nelson, Vancouver.

HINTS TO BUYERS

DOMINION COAL COMPANY LIMITED

"Dominion" and "Springhill" BITUMINOUS STEAM and GAS COALS

GENERAL SALES OFFICE

112 St. James St. Montreal

NOTICE

TO

Stationary and Hoisting Engineers

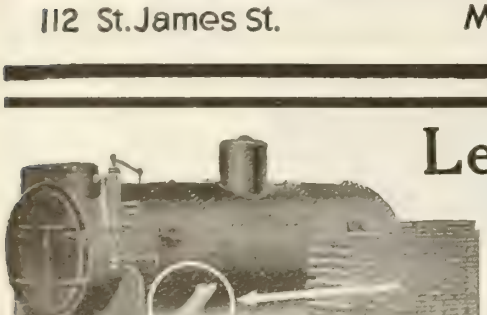
Everyone operating a STATIONARY steam plant of 50 h.p. or over in the Province of Ontario must hold a Stationary Engineer's Certificate from the Board of Stationary and Hoisting Engineers. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary and Hoisting Engineers' Act.

Everyone operating a HOISTING steam plant working at a pressure of 20 pounds or over, irrespective of horse power, and used for hoisting in structural operations or excavating purposes, in the Province of Ontario, must hold a Hoisting Engineer's Certificate from the Board of Stationary and Hoisting Engineers. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary and Hoisting Engineers' Act.

Application forms for obtaining STATIONARY or HOISTING Engineers' Certificates, may be had upon applying to the Chairman.

HON. F. G. MACDIARMID, Minister of Public Works and Highways. W. C. McGHIE, Chairman of Board.

W. A. RIDDELL, M. A. PH. D., Superintendent, Trades & Labour Branch.



Leakage Stopped

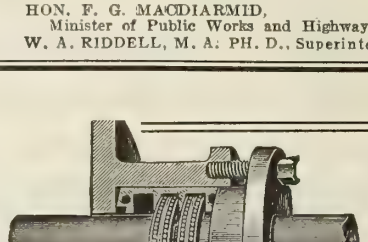
Permanently stopped by the National Boiler Seam Protector, which anyone can attach in 30 minutes. It will also save your boiler from fire cracks, mud cracks and blisters. Write for long list of pleased users.

Free trial on request.

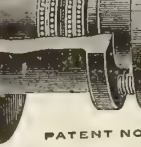
NATIONAL BOILER SEAM PROTECTOR CO. OF CANADA

Head Office: 910 New Birks Bldg., Montreal.

Toronto Office: 568 Manning Ave., Toronto.



PATENT NO. 318,400



PAT. NO.	500,899	PAT. NO.	829,116
" "	534,104	" "	830,530
" "	602,328	" "	856,103
" "	654,541	" "	878,238
" "	654,542	" "	894,537
" "	725,368	" "	895,791
" "	774,490	" "	898,088
" "	775,193	" "	905,103
" "	775,194	" "	934,629
" "	791,300	" "	979,206
" "	805,689	" "	1000,75

Why not Buy the Best, when in market for Packing?

HOLMES' Metallic Packing

Is Guaranteed 3 Years

Lasts many times longer. 30 days' trial. Less oil. No cutting. Easily applied to any Steam Engine, Air Compressor or Gas Engine. Satisfaction or no pay. Write us.

HOLMES METALLIC PACKING CO., Wilkes-Barre, Pa.

Incorporated 1897

McDANIEL IMPROVED STEAM TRAP

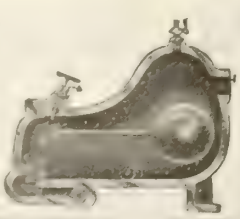
FOR HIGH OR LOW PRESSURE.

Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

MAY WE SEND ONE FOR TRIAL?

Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators.

SEND FOR CATALOGUE.



THE GARTH COMPANY

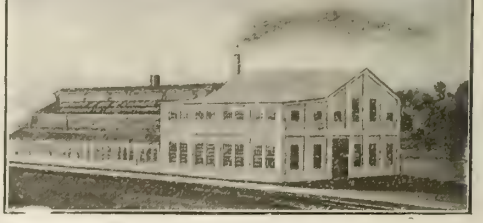
26 Craig Street MONTREAL, CAN.

WATSON & McDANIEL CO.

No. 146 N. 7th Street, PHILADELPHIA, Pa.

Water Turbines, Hydraulic Governors, Centrifugal Pumps

OUR LINDSAY WORKS



Boving Hydraulic & Engineering Co., Limited

Lindsay, Ontario

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

MILL SUPPLY DEPARTMENT

BEVERIDGE PAPER COMPANY LIMITED, MONTREAL

Plibrico — One-Piece Plastic Firebrick
For Boilers, Burners, Smelters.

Plibrico Bond — High Temperature Cements

SHELL BAR GRATES
Anti-Clinker—Revolving
Enables you to use cheaper fuel.

BOICO
Scientific Water Treatment

Stormtight — Cements Liquid and Plastic
For Roofs, Walls, Foundations.

Cemcoat
Washable, Enamellike Coating.

Hydrocide
Damp-proof for Acid Tanks, etc.

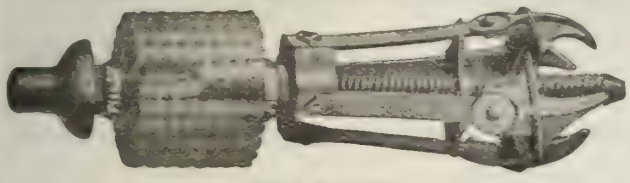
LapidoLith — "Makes Concrete Hard as Granite"
For Floors—Chests, etc.

VULCANIZED FIBRE
Everything in Hard and Flexible

Noiseless Trucks, Gears, Etc.

Why not use these guaranteed materials?

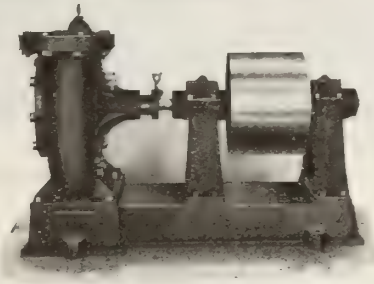
The Simplest and Best Cleaner on the market is



PILLEY'S

Combination Flue Brush and Scraper.
Guaranteed not to break or the wires to pull out or lay over. A simple turn of the hand adjusts it to the tube, and the brush removes what the scraper loosens.
For sale by leading Canadian jobbers
Manufactured by

PILLEY PACKING & FLUE BRUSH MFG. CO.
623 South Third Street ST. LOUIS, MO.
Eastern Office: 71 Fulton St., New York.



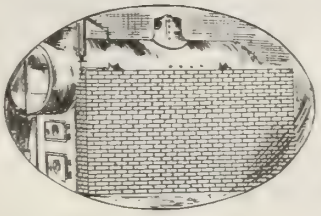
Send that PUMP inquiry to

The Smart-Turner Machine Co.
LIMITED
HAMILTON, CANADA

JAMISON COLD STORAGE DOOR CO.
formerly
JONES COLD STORE DOOR CO.
CLOSE TITE
Manufacturers of the
ORIGINAL "JONES" AND "NOEQUAL" TYPES
HAGERSTOWN, MD. P.O.BOX 93 U.S.A.

FIRE-BRICK WORK

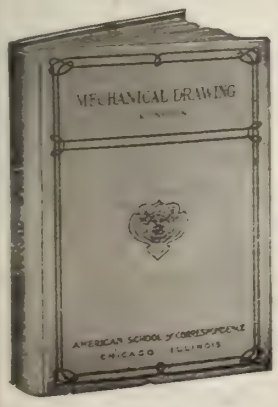
in all its Branches



Your boilers need protection. Let me brick them up for you; this is my specialty. First-class, durable work—moderate cost.

Write for prices and particulars.

J. H. Wenting, Toronto, Ont.
Mason Contractor Phone Beach 1353 256 Lee Ave.



Mechanical Drawing

By Ervin Kenison, S.B.

Instructor in Mechanical Drawing, Massachusetts Institute of Technology

176 pp., 140 illus. Cloth binding. Gives a course of practical instruction in the art of Mechanical Drawing, based on methods that have stood the test of years of experience. Includes orthographic, isometric and oblique projections, shade lines, intersections and developments, lettering, etc., with abundant exercises and plates.

Price, $1.00

MacLean Publishing Co.
Technical Book Dept.
143-153 University Ave., Toronto

THE LADD VERTICAL WATER TUBE BOILER

The Goldie-McCulloch Co., Ltd.
Galt, Ontario

Canadian licencees under patents 162401 and 162402 dated May 4, 1915.

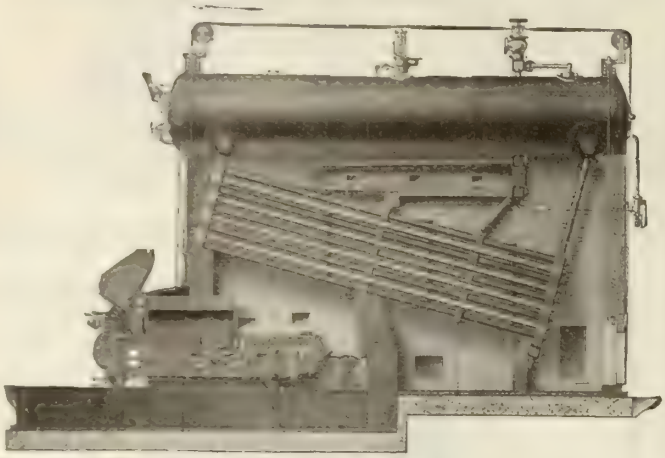
The George T. Ladd Company,
Pittsburgh, Pa.
Owners and manufacturers for the United States.

Write for new Catalogue No. 17.

"ALL BRITISH"

"B.&W." PATENT WATER TUBE STEAM BOILERS

HIGHEST ECONOMY, SAFETY, DURABILITY. OVER 20,000,000 H.P. IN USE.



Babcock & Wilcox Patent Water Tube Steam Boiler, Superheater and Mechanical Stoker.

ALSO

Steam Superheaters
Mechanical Stokers
Coal-Handling Machinery
Piping, Feed Water Heaters
Water Softeners and Purifiers
and **ELECTRIC CRANES**

BABCOCK & WILCOX, Limited

HEAD OFFICE FOR CANADA - COLLEGE ST. (ST. HENRY), MONTREAL
TORONTO OFFICE, TRADERS BANK BUILDING

Starrett
Hack Saw Chart
The Right SAW for the Job
With the Starrett Hack Saw Chart hanging above your bench you know exactly what number blade to use on any job. Send for free chart CD.
HACK SAWS
THE L. S. STARRETT CO., ATHOL, MASS., U.S.A.

The Wrench of 25% Greater Efficiency

TRIMO PIPE WRENCH

Two new features have been recently added to the Trimo Pipe Wrench, namely Nut-Guards, in all sizes, and unbreakable steel frames, in leading sizes.

The Nut-Guards prevent the accidental rotation of the nut while in use.

These improvements add 25% to the usefulness of the tool.

The Trimo Pipe Wrench is made with wood handles in 4 sizes, 6-in., 8-in., 10-in., 14-in. and in steel handles in all sizes, 6-in. to 48-in. inclusive.

All Trimo Pipe Wrench parts are interchangeable.

The inserted jaw in the handle can be readily replaced when worn, thus adding to the life of the tool.

Nut with Nut-Guards

Inquiries from Importers and Dealers Solicited. Send for Catalogue No. 55.

TRIMONT MANUFACTURING CO.

CableAddress: Triwrench
Code: Western Union

Roxbury (Boston) Mass., U.S.A.

POWER HOUSE BUYERS' DIRECTORY

If what you want is not listed here write us, and we will tell you where to get it. Let us suggest that you consult also the advertisers' index facing the inside back cover, after having secured advertisers' names from this directory. The information you desire may be found in the advertising pages. This department is maintained for the benefit and convenience of our readers. The insertion of our advertisers' names under proper headings is gladly undertaken, but does not become part of an advertising contract.

ACCUMULATORS, HYDRAULIC
Bawden Pump Co., Toronto.

AIR COCKS
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

AIR VALVES
Mueller Mfg. Co., H., Sarnia, Ont.

ALTERNATORS
Lancashire Dynamo & Motor Co., Toronto, Ont.

AMMETERS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. H. W. Johns-Manville Co., Toronto, Ont.

AMMONIA VALVES AND FITTINGS
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Frick Co., Waynesboro, Franklin Co., Pa.
Homestead Valve Mfg. Co., Pittsburgh, Pa.
York Mfg. Co., York, Pa.

AMMONIA PURIFIERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Mfg. Co., York, Pa.

AMMONIA TANKS
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford, Ont.

ANTIMONY
Dominion Metal Co., Sherbrooke, Que.

ARCHES, COMBUSTION CHAMBER
Canadian Fairbanks-Morse Co., Ltd. Montreal.

ASH CARRYING SYSTEMS
Babcock & Wilcox, Ltd. Montreal.
Waterous Engine Works Co., Brantford, Ont.

ASBESTOS SPECIALTIES
Durabla Mfg. Co., New York, N.Y.
Garlock Packing Co., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

AUTOMATIC ICE RECORDING DOORS AND CHUTES
Jamison Cold Storage Door Co., Hagerstown, Md.

BABBITT AND ANTI-FRICTION METAL
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Dominion Metal Co., Sherbrooke, Que.
Hoyt Metal Co., Toronto.
Magnolia Metal Co. Montreal.
Wm. C. Wilson & Co., Toronto.

BALL BEARINGS
Can. S K F Co., Toronto, Ont.

BALLCOCKS
D'Este Co., Julian, Boston, Mass.

BATTERIES AND ACCESSORIES
Can. H. W. Johns-Manville Co., Toronto, Ont.

BELT CEMENT
Graton & Knight Mfg. Co., Montreal.

BELT DRESSING
Cling Surface Co., Buffalo.
Jos. Dixon Crucible Co., Jersey City.
Dominion Belting Co., Hamilton, Ont.
Graton & Knight Mfg. Co., Montreal.

BELT LACING, LEATHER
Graton & Knight Mfg. Co., Montreal.

BELT TIGHTENERS
Waterous Engine Works Co., Brantford, Ont.

BELT PULLEYS
American Pulley Co., Philadelphia, Pa.
Waterous Engine Works Co., Brantford, Ont.

BELTING, BALATA
Federal Engineering Co., Toronto, Ont.

BELTING, LINK
Graton & Knight Mfg. Co., Montreal.
Waterous Engine Works Co., Brantford, Ont.

BELTING, STITCHED COTTON DUCK
Dominion Belting Co., Hamilton, Ont.

BELTING, LEATHER
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Garlock Packing Co., Hamilton, Ont.
Goodyear Tire & Rubber Co., Toronto.
Graton & Knight Mfg. Co., Montreal.
Main Belting Co., Montreal.
D. K. McLaren Ltd., Montreal.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

BELTING, RUBBER
Can. H. W. Johns-Manville Co., Toronto, Ont.
Goodyear Tire & Rubber Co., Toronto.
Jeffrey Manufacturing Co., Montreal.
Thomson-Gordon, Ltd., Hamilton, Ont.
United States Rubber Co., New York.

BELTING, WOVEN COTTON
Federal Engineering Co., Toronto, Ont.

BINS, COAL, COKE AND ORE
Jeffrey Manufacturing Co., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford, Ont.

BLOWERS
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Can. Sirocco Co., Windsor, Ont.
Coppus Eng. & Equip. Co., Worcester, Mass.
Green's Economiser, Ltd., Toronto.

BOILER COVERING
Beveridge Paper Co., Montreal, Que.

BOILER COMPOUNDS
Beveridge Paper Co., Montreal, Que.
Can. Economic Lubricant Co., Montreal, Que.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Metlskin Mfg. Co., Rochester, N.Y.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Wm. C. Wilson & Co., Toronto.

BOILER COMPOUND FEEDERS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Morehead Mfg. Co., Woodstock.
Lunkenheimer Co., Cincinnati, O.

BOILER FEED PUMPS
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Steam Boiler Equipment Co., Toronto, Ont.
Darling Bros., Ltd., Montreal, Que.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Laurie & Lamb, Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

BOILER FEED REGULATORS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Beveridge Paper Co., Montreal, Que.
Mason Regulator & Engineering Co., Montreal.
Northern Equipment Co., Erie, Pa.

BOILER GRAPHITE
Joseph Dixon Crucible Co., Jersey City, N.J.

BOILER MOUNTINGS
Babcock & Wilcox, Ltd. Montreal.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Ltd., Montreal, Que.
Inglis Co., The John, Toronto, Ont.
Lunkenheimer Co., Cincinnati, O.
Mason Regulator & Engineering Co., Montreal.

BOILER PRESERVATIVES
Johns-Pratt Co., The, Hartford, Conn.
Metlskin Co., Inc., Rochester, N.Y.

BOILER AND FURNACE BRICK WORK
Wenting, J. H., 256 Lee Ave., Toronto, Ont.

BOILER HOUSE ACCESSORIES
Babcock & Wilcox, Ltd. Montreal.
Canadian Griscom-Russell Co., Ltd., Montreal.
Cole, Ltd., Geo. W., Toronto.
Mason Regulator & Engineering Co., Montreal.

BOILER SEAM PROTECTOR
National Boiler Seam Protector Co., Montreal.

BOILER SETTINGS
Beveridge Paper Co., Montreal.
Gates, John W., St. James St., Montreal.

BOILERS, HORIZONTAL, RETURN, TUBULAR AND WATERTUBE
Babcock & Wilcox, Ltd. Montreal.
Cole, Ltd., Geo. W., Toronto.
Goldie & McCulloch Co., Galt.
Frick Co., Waynesboro, Franklin Co., Pa.
Inglis Co., The John, Toronto, Ont.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Jones Underfeed Stoker Co., Toronto.
Leonard & Sons, E., London, Can.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Ladd, The Geo. T., Co., Pittsburgh, Pa.
McAvity, T., & Sons, Ltd., St. John, N.B.
Waterous Engine Works Co., Brantford, Ont.

BOILERS, MARINE, LOCOMOTIVE AND VERTICAL
Babcock & Wilcox, Ltd. Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Goldie & McCulloch Co., Galt.
Inglis Co., The John, Toronto, Ont.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Leonard & Sons, E., London, Can.
John McDougall Caledonian Iron Works, Montreal.
Waterous Engine Works Co., Brantford, Ont.

BOOKS
Audel & Co., Theo, New York, N.Y.
MacLean Publishing Co., Toronto.

BOXES, FUSE AND METER
Johns-Pratt Co., The, Hartford, Conn.

BRASS FOUNDERS
McAvity, T., & Sons, Ltd., St. John, N.B.
D'Este Co., Julian, Boston, Mass.
Mueller Mfg. Co., H., Sarnia, Ont.

BRINE COOLERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

BRINE TANKS
Frick Co., Waynesboro, Franklin Co., Pa.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford, Ont.
York Manufacturing Co., York, Pa.

BUSHINGS
Steel Mill Packing Co., Windsor, Ont.

CABLE
Wm. C. Wilson & Co., Toronto.

CALORIMETERS
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Taylor Instrument Co., Rochester, N.Y.

CANS, OILY WASTE
Jas. Morrison Brass Mfg. Co., Toronto.

CAST IRON FITTINGS
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.

CASTINGS, BRASS AND IRON
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Hamilton Co., Wm., Peterboro, Ont.
Lunkenheimer Co., Cincinnati, O.
John McDougall Caledonian Iron Works Co., Ltd., Montreal.
McAvity, T., & Sons, Ltd., St. John, N.B.
Mueller Mfg. Co., H., Sarnia, Ont.
Victoria Foundry Co, Ottawa, Ont.
Waterous Engine Works Co., Brantford, Ont.
Wood & Co., R. D., Philadelphia, Pa.

CELLAR DRAINERS
Morrison Brass Mfg. Co., James, Toronto, Ont.
Mueller Mfg. Co., H., Sarnia, Ont.

CEMENT HARDNER & WATERPROOFER
Beveridge Paper Co., Montreal, Que.

CEMENT, HIGH TEMPERATURE
Beveridge Paper Co., Montreal.
Gates, John W., St. James St., Montreal.
Green's Economiser, Ltd., Toronto.

CEMENT, PIPE JOINT
Wm. C. Wilson & Co., Toronto.

CEMENT MACHINERY
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Waterous Engine Works Co., Brantford, Ont.

CEMENT, INSULATING, REFRACTORY
Green's Economiser, Ltd., Toronto.

CHAIN DRIVES
Coventry Chain Co., Coventry, England.
Morse Chain Co., Ithaca, N.Y.

CHAIN WHEELS
Babbitt Steam Specialty Co., New Bedford, Mass.

CHIMNEYS, STEEL
Babcock & Wilcox, Ltd. Montreal
MacKinnon, Holmes & Co., Sherbrooke, Que.

CHUTES, COAL
Can. Allis-Chalmers, Ltd., Toronto, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.

CLEANERS, BOILER TUBE
Babcock & Wilcox, Ltd., Montreal.
Can. H. W. Johns-Manville Co., Toronto.
Cole Ltd., Geo. W., Toronto.
Beveridge Paper Co., Montreal, Que.
Garlock Packing Co., Hamilton, Ont.
Green's Economiser, Ltd., Toronto.
Liberty Mfg. Co., Pittsburgh, Pa.
Laurie & Lamb, Montreal, Que.
Pilley Packing & Flue Brush Mfg. Co., St. Louis, Mo.
Roto Co., Hartford, Conn.

CLOCKS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Foxboro Co., The, Foxboro, Mass.

CLOSETS
Mueller Mfg. Co., H., Sarnia, Ont.

CLUTCHES
Waterous Engine Works Co., Brantford, Ont.

COAL
Dom. Coal Co., Montreal.

COAL AND ASH CONVEYORS
Babcock & Wilcox, Ltd. Montreal.
Jeffrey Manufacturing Co., Montreal.
Waterous Engine Works Co., Brantford, Ont.

COAL HANDLING MACHINERY
Babcock & Wilcox, Ltd. Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Jeffrey Manufacturing Co., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford, Ont.

COAL HOLE COVERS
Can. Allis-Chalmers, Ltd., Toronto, Ont.

COILS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

COLD STORAGE INSULATION
Armstrong Cork & Insulation Co., Montreal, Que.
Beveridge Paper Co., Ltd., Montreal, Que.

COMMUTATOR TRUING DEVICES
Jordan Bros., Inc., New York, N.Y.

CONDENSERS
Alberger Heater Co., Buffalo, N.Y.
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Toronto.
Belliss & Morcom, Birmingham, Eng.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Darling Bros., Ltd., Montreal, Que.
Goldie & McCulloch Co., Galt.
Laurie & Lamb, Montreal.
John MacDougall Caledonian Iron Wks., Montreal
Waterous Engine Works Co., Brantford.

CONDENSERS, AMMONIA AND STEAM
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

COLLECTORS, PNEUMATIC
Sturtevant Co. of Canada, B. F., Galt, Ont.

CONSULTING ENGINEERS
Walter J. Francis, Montreal.
Laurie & Lamb, Montreal.

COLD STORAGE DOORS AND WINDOWS
Jamison Cold Storage Door Co., Hagerstown, Md.

COMPRESSORS, AIR
American Steam Pump Co., Battle Creek, Mich.
Belliss & Morcom, Birmingham, Eng.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Darling Bros., Ltd., Montreal, Que.
Inglis Co., The John, Toronto, Ont.
Laurie & Lamb, Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Smart-Turner Machine Co., Ltd., Hamilton.
Taylor Instrument Co., Rochester, N.Y.

COMPRESSORS, GAS
Can. Allis-Chalmers, Ltd., Toronto, Ont.

CONDUITS
Can. H. W. Johns-Manville Co., Toronto, Ont.

CONDENSATION RECEIVER
Cole, Ltd., Geo. W., Toronto.
G. M. Davis Regulator Co., Chicago.

CONDENSER AND SMOKESTACK PAINTS
Beveridge Paper Co., Montreal, Que.

CONNECTIONS, FLANGED
Jefferson Union Co., Lexington, Mass.
Dart Union Co., Ltd., Toronto, Ont.

CONTRACTORS' STRUCTURAL STEEL
Canadian Fairbanks-Morse Co., Ltd. Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.

CONVEYOR MACHINERY
Babcock & Wilcox, Ltd. Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Jeffrey Manufacturing Co., Montreal.
Milton & Prentiss, Toronto, Ont.
Waterous Engine Works Co., Brantford.
Victoria Foundry Co., Ottawa, Ont.

COOLER, DOORS
Jamison Cold Storage Door Co., Hagerstown, Md.

CORK INSULATION
Armstrong Cork & Insulation Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.

COTTON HOSE
Garlock Packing Co., Hamilton, Ont.

COUNTERS
American Steam Gauge & Valve Mfg. Co., Boston Mass.
Foxboro Co., The, Foxboro, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

COUNTERSHAFTS
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Victoria Foundry Co., Ottawa, Ont.

COUPLINGS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Beveridge Paper Co., Montreal, Que.
Jeffrey Manufacturing Co., Montreal.
McAvity & Sons, T., St. John, N.B.
Victoria Foundry Co., Ottawa, Ont.

COUPLINGS, BOILER, FLANGED PIPE, JOINT PIPE, UNION, STEAM PIPE
Jefferson Union Co., Lexington, Mass.
Dart Union Co., Ltd., Toronto, Ont.

COUPLINGS, SHAFT
Can. Bond Hanger & Coupling Co., Alexandria, Ont.

CRANES, ALL KINDS
Babcock & Wilcox, Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

CRANES, ELECTRIC
Babcock & Wilcox, Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

CRANES, HAND POWER
Babcock & Wilcox, Ltd., Montreal.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Jenkins Bros., Pa.
Smart-Turner Machine Co., Ltd., Hamilton.

CRANES, OVERHEAD TRAVELLING
Babcock & Wilcox, Ltd., Montreal.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Smart Turner Machine Co., Ltd., Hamilton.

CRANES, POST JIB
Babcock & Wilcox, Ltd., Montreal.

CRANES, SWING JIB
Babcock & Wilcox, Ltd., Montreal.

CRANES, WALL
Babcock & Wilcox, Ltd., Montreal.

CRANE MOTORS
Lancashire Dynamo & Motor Co., Toronto, Ont.

CRANK AND CROSSHEAD PIN OILERS
Lunkenheimer Co., Cincinnati, O.

CRIMPS, LEATHER
Graton & Knight Mfg. Co., Montreal.

CRUSHING MACHINERY
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Jeffrey Mfg. Co., Columbus, Ohio.

CYLINDER OIL
E. H. Kellogg & Co., New York.

DAMPER REGULATORS
Babcock & Wilcox, Ltd., Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Darling Bros., Ltd., Montreal, Que.
G. M. Davis Regulator Co., Chicago.
D'Este Co., Julian, Boston, Mass.
Elliott Co., Pittsburgh, Pa.
Mason Regulator Co., Boston, Mass.
Jas. Morrison Brass Mfg. Co., Toronto.

DISCS, FIBRE
Beveridge Paper Co., Ltd., Montreal, Que.
Johns-Pratt Co., The, Hartford, Conn.

DISCS, LEATHER
Graton & Knight Mfg. Co., Montreal.

DISTILLING APPARATUS
Canadian Griscom-Russell Co., Ltd., Montreal.
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

DOORS, COLD STORAGE AND FREEZER
Jamison Cold Storage Door Co., Hagerstown, Md.

DOUBLE PIPE CONDENSERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

DRAFT APPARATUS SYSTEMS, MECHANICAL
Green's Economiser, Ltd., Toronto.

DRYING MACHINERY
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Sirocco Co., Windsor, Ont.

DUST SEPARATORS
Sturtevant Co. of Canada, B. F., Galt, Ont.

DYNAMOS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Sturtevant Co. of Canada, B. F., Galt, Ont.

ECONOMIZERS
Babcock & Wilcox, Ltd., Montreal.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Green's Economiser, Ltd., Toronto.

EJECTORS
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.
Smart-Turner Machine Co., Ltd., Hamilton.

ELECTRICAL ACCESSORIES AND MACHINERY
Can. H. W. Johns-Manville Co., Toronto, Ont.
Beveridge Paper Co., Ltd., Montreal, Que.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Economy Fuse & Mfg. Co., Montreal, Que.
MacGovern & Co., Inc., New York.
Milton & Prentiss, Toronto, Ont.

ELECTRICAL SUPPLIES
Can. General Electric Co., Toronto, Ont.
Can. H. W. Johns-Manville Co., Toronto, Ont.

ELEVATORS
Beveridge Paper Co., Montreal, Que.
MacKinnon, Holmes & Co., Sherbrooke Ont.
John MacDougall Caledonian Iron Works, Montreal.

ELEVATING MACHINERY
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Beveridge Paper Co., Montreal, Que.
Goldie & McCulloch Co., Galt.
Hamilton Mfg. Co., Wm., Peterboro, Ont.
Jeffrey Manufacturing Co., Montreal.
Waterous Engine Works Co., Brantford.

ENAMELWARE
H. Mueller Mfg. Co., Sarnia, Ont.

ENGINEERS' SUPPLIES
Beveridge Paper Co., Ltd., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Ltd., Montreal, Que.
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.
Jas. Morrison Brass Mfg. Co., Toronto.

ENGINES, AUTOMATIC AND DROP VALVE
Frick Co., Waynesboro, Franklin Co., Pa.
Waterous Engine Works Co., Brantford.

ENGINES, CORLISS AND ROCKING VALVE
Bawden Pump Co., Toronto.
Frick Co., Waynesboro, Pa.
Goldie & McCulloch Co., Galt.
Green's Economiser, Ltd., Toronto.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Waterous Engine Works Co., Brantford.

ENGINES, DIESEL
Can. Allis-Chalmers, Ltd., Toronto, Ont.

ENGINES, GAS AND GASOLINE
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Laurie & Lamb, Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

ENGINES, STEAM
Belliss & Morcom, Birmingham, Eng.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Can. Sirocco Co., Windsor, Ont.
Goldie & McCulloch Co., Galt.
Hamilton Mfg. Co., Wm., Peterboro, Ont.
Inglis Co., The John, Toronto, Ont.
Laurie & Lamb, Montreal.
Leonard & Sons, E., London, Can.
John MacDougall Caledonian Iron Works, Montreal.
Waterous Engine Works Co., Brantford.

ENGINES, HOISTING, LOGGING, CABLEWAY
Can. Allis-Chalmers, Ltd., Toronto, Ont.

ENGINES, MARINE
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.

ENGINES, SAW MILL
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Laurie & Lamb, Montreal.
Waterous Engine Works Co., Brantford.

ENGINES, SINGLE COMPOUND AND TRIPLE EXPANSION
Canadian Griscom-Russell Co., Ltd., Montreal.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Laurie & Lamb, Montreal.
John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Kerr Engine Co., Walkerville.
Waterous Engine Works Co., Brantford.

ENGINES, VERTICAL
Laurie & Lamb, Montreal.

ENGINEERING BOOKS
MacLean Publishing Co., Toronto

EXHAUSTERS
Green's Economiser, Ltd., Toronto.

EXHAUST HEADS
Can. Sirocco Co., Windsor, Ont.
Darling Bros., Ltd., Montreal, Que.
Direct Separator Co., Syracuse, N.Y.
Jas. Morrison Brass Mfg. Co., Toronto.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Watson & McDaniel Co., Philadelphia.

EXPANSION JOINTS
Alberger Heater Co., Buffalo, N.Y.
Direct Separator Co., Syracuse, N.Y.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.

FANS, VENTILATING
Can. Sirocco Co., Windsor, Ont.
C. T. Coe Co., 10 Johnson St., Newark, N.J.
Coppus Engr. & Equip. Co., Worcester, Mass.
Green's Economiser, Ltd., Toronto.
Sturtevant Co. of Canada, B. F., Galt, Ont.

FEED WATER HEATERS
Alberger Heater Co., Buffalo, N.Y.
Babcock & Wilcox, Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Stewart Heater Co., Buffalo, N.Y.
Waterous Engine Works Co., Brantford.

FEED WATER PURIFIERS
Stewart Heater Co., Buffalo, N.Y.

FEED WATER REGULATORS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Chaplin, Fulton Mfg. Co., Pittsburg, Pa.
Beveridge Paper Co., Montreal, Que.
Elliott Co., Pittsburgh, Pa.
Laurie & Lamb, Montreal.

FIBRE, VULCANIZED
Beveridge Paper Co., Montreal, Que.

FILTERS
Bowser & Co., Inc., S. F., Toronto, Ont.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.

FILTERS, WATER
Canadian Griscom-Russell Co., Ltd., Montreal.
Darling Bros., Ltd., Montreal, Que.
Frick Co., Waynesboro, Franklin Co., Pa.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Scaife & Sons, Wm. B., Pittsburgh, Pa.
York Manufacturing Co., York, Pa.

FIREBRICK—JOINTLESS
Beveridge Paper Co., Montreal, Que.

FIRE BRICK, PLASTIC
Gates, John W., St. James St., Montreal.
Wenting, J. H., Toronto.

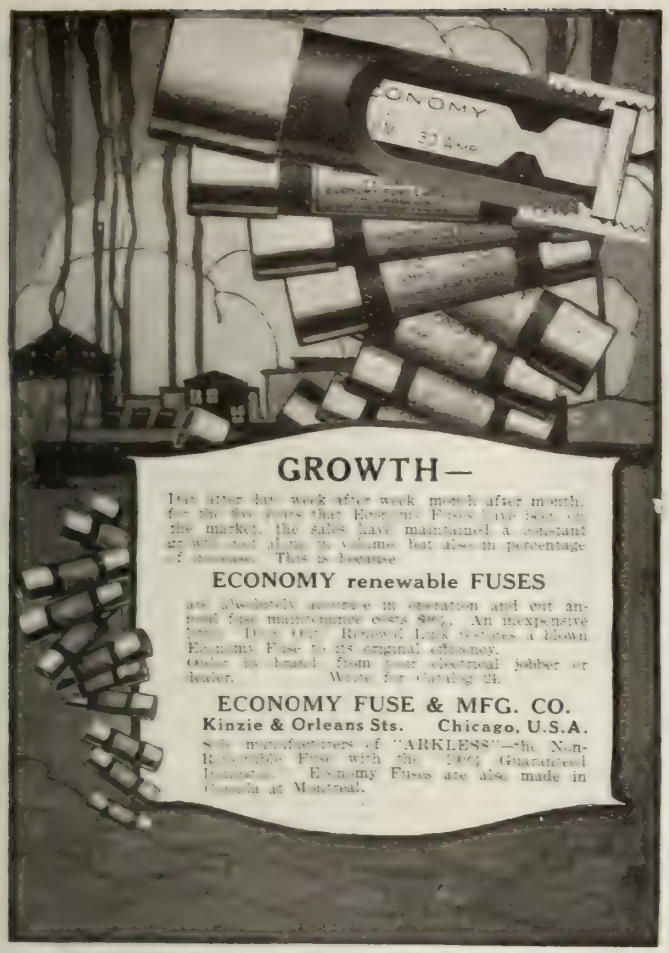
FIREPROOF COLD STORAGE DOORS AND WINDOWS
Jamison Cold Storage Door Co., Hagerstown, Md.

FITTINGS, AIR, AUTOMOBILE, GAS, HYDRAULIC, PIPE, PIPE FLANGED, SCREWED PIPE, STEAM
Jefferson Union Co., Lexington, Mass.
Dart Union Co., Ltd., Toronto, Ont.
H. Mueller Mfg. Co., Sarnia, Ont.

FLANGED STEAM FITTINGS
Direct Separator Co., Syracuse, N.Y.
McAvity, T., & Sons, Ltd., St. John, N.B.

FLANGES
Dart Union Co., Ltd., Toronto, Ont.
Jefferson Union Co., Lexington, Mass.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.

FLOORING COMPOSITION
Armstrong Cork & Insulation Co., Montreal, Que.



GROWTH—

Day after day, week after month, for the five years that Economy Fuses have been on the market, the sales have maintained a constant gain—not alone in volume but also in percentage of increase. This is because

ECONOMY renewable FUSES

are absolutely accurate in operation and cut annual fuse maintenance costs 80%. An inexpensive Time Delay Renewal Link restores a blown Economy Fuse to its original efficiency.

Order to-day from your electrical jobber or dealer. Write for Catalog 24.

ECONOMY FUSE & MFG. CO.
Kinzie & Orleans Sts. Chicago, U.S.A.

Sole manufacturers of "ARKLESS"—the Non-Refillable Fuse with the 100% Guaranteed Interrupting. Economy Fuses are also made in Canada at Montreal.

Scandinavia Belting

Works Well In Hot Places

A NUMBER of instances have been brought to our attention where for transmission work in hot places Scandinavia was the only belt that would stand up. Even our competitors frequently recommend their customers to come to us when other kinds of belting have failed.

The dressing with which the belt is impregnated in the process of manufacture resists the action of heat and keeps the belt soft; this dressing, if the air is hot, will eventually dry out, and in cases of this kind the belt should be treated with a proper dressing occasionally to keep the belt soft and pliable.

We are often asked about the stretch in this belt. Yes, it does stretch and when hot there is quite a little stretch. If the belt is to be run where hot, leave the belt for some time where it can become well heated, then put on with a belt stretcher. Most of the stretch can be taken out in this way. Lots of Scandinavia belts are running fans in drying kilns, and are doing the work more satisfactorily than any belt previously used.

If you are in doubt about the purchase of a belt, write us.

NOTE.—Do **not** use "bar" or "stick" belt dressing on textile belts.

FEDERAL ENGINEERING CO. Ltd.,
172 JOHN STREET, TORONTO

More than Half the Oil You Buy is Wasted.

Anderson Pressure Oil Filters

Subject drip-pan-collected oil to the same cleansing and purifying treatment as that of oil refiners. By no other method can used oil be rendered absolutely clean and pure.

Anderson Pressure Filters of the type illustrated have dropped to one-half and less the oil bills of hundred of firms in the United States and Canada. Consider that more than half the oil you buy is wasted, unless you have an Anderson Filter to prevent waste, and at once it is apparent you should

Write to-day for Catalog.

The V. D. Anderson Co.
West 96th St., Cleveland, Ohio

FLUE CLEANERS
Babcock & Wilcox, Montreal.
Liberty Mfg. Co., Pittsburg, Pa.
[illegible] Packing and Flue Brush Mfg. Co., St. Louis, Mo.
William B. Pierce Co., Buffalo, N.Y.
[illegible] Hartford, Conn.
Wm. C. Wilson & Co., Toronto.

FLUE GAS ANALYSIS INSTRUMENTS
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y
Uehling Instrument Co., New York.
Precision Instrument Co., Detroit, Mich.
Penberthy Injector Co., Windsor, Ont.

FLUES, GAS AND SMOKE
[illegible] Ltd., Toronto.

FLUMES, STEEL
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.

FREEZER DOORS
Jamison Cold Storage Door Co., Hagerstown, Md

FRICTION LEATHERS
Graton & Knight Mfg. Co., Montreal.

FURNACES, BOILER
Gates, J. W., Montreal, P.Q.
Green's Economiser, Ltd., Toronto.

FURNACES, SMOKELESS
Babcock & Wilcox, Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Detroit, Mich.

FURNACE GRATE BARS
Beveridge Paper Co., Montreal, Que.

FUSES
Can. H. W. Johns-Manville Co., Toronto, Ont.
Economy Fuse & Mfg. Co. of Canada, Montreal.
Johns-Pratt Co., The, Hartford, Conn.

GAS ANALYSIS INSTRUMENTS, ETC.
Penberthy Injector Co., Windsor, Ont.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y
Uehling Instrument Co., New York, N.Y.

GASKETS, RUBBER, ASBESTOS
Can. H. W. Johns-Manville Co., Toronto, Ont.
Durabla Mfg. Co., New York, N.Y.
Frick Co., Waynesboro, Franklin Co., Pa.
Garlock Packing Co., Hamilton, Ont.
Johns-Pratt Co., The, Hartford, Conn.
Peerless Rubber Mfg. Co., New York, N.Y.
Sarco Co., Inc., New York, N.Y.
Thomson-Gordon, Ltd., Hamilton, Ont.

GASKETS, LEAD, COPPER AND LEATHER
Graton & Knight Mfg. Co., Montreal, Que.
Shell Bar Boico Supply Co., Toronto, Ont.
Sarco Co., Inc., New York, N.Y.
Wm. C. Wilson & Co., Toronto, Ont.

GAS COLLECTORS
Precision Instrument Co., Detroit, Mich.

GAS PRODUCER PLANTS
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Laurie & Lamb, Montreal.

GAUGE COCKS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Garlock Packing Co., Hamilton, Ont.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.
W. J. Wall, Montreal.

GAUGE GLASSES
Wm. C. Wilson & Co., Toronto.

GAUGES, AMMONIA, OIL, GAS, AIR
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y

GAUGES, PRESSURE, VACUUM, DRAFT AND RECORDING, AND MICROMETER
Babcock & Wilcox, Montreal.
Foxboro Company, Foxboro, Mass.
Green's Economiser, Ltd., Toronto.
Lunkenheimer Co., Cincinnati, O.
[illegible] & Pressure, Toronto.
Precision Instrument Co., Detroit, Mich.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.

GAUGES, WATER
Babcock & Wilcox, Montreal.
Jenkins Bros., Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
Penberthy Injector Co., Windsor, Ont.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

GEARS, FIBRE CUT
Beveridge Paper Co., Ltd., Montreal, Que.

GEARS, CUT, WORM, MORTISE
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

GENERATORS, DIRECT CURRENT
Lancashire Dynamo & Motor Co., Toronto, Ont.

GENERATORS, STEAM TURBO
[illegible] Toronto, Ont.
[illegible] & Laurie, Montreal.

GENERATORS AND CONVERTORS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
[illegible] Toronto, Ont.

GOVERNORS, ENGINE
[illegible] & Co., Montreal, Que.
McAvity, T., & Sons, Ltd., St. John, N.B.
[illegible] Works Co., Brantford.

GRAPHITE, BOILER
[illegible] Co., Jersey City.
Wm. C. Wilson & Co., Toronto

GRATES, DUMPING, ROCKING, STATIONARY
Babcock & Wilcox, Montreal.
Boiler Repair & Grate Bar Co., Toronto, Ont.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
C. T. Coe Co., 10 Johnson St., Newark, N.J.
Can. Steam Boiler Equipment Co., Toronto, Ont.
Galt Foundry Co., Galt, Ont.
Mason Regulator & Engineering Co., Montreal.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Waterous Engine Works Co., Brantford.

GREASE CUPS
Albany Lubricating Co., New York City.
Detroit Lubricator Co., Walkerville.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

GREASE AND OIL EXTRACTORS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Canadian Griscom-Russell Co., Ltd., Montreal.
Elliott Co., Pittsburgh, Pa.
Laurie & Lamb, Montreal.

GREASES
Albany Lubricating Co., New York City.
Can. Economic Lubricant Co., Montreal, Que.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Jos. Dixon Crucible Co., Jersey City.
Wm. C. Wilson & Co., Toronto.

HAND LEATHERS OR PADS
Graton & Knight Mfg. Co., Montreal.

HANGERS
Can. General Electric Co., Toronto, Ont.
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Can. S K F Co., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Goldie & McCulloch Co., Galt.
Waterous Engine Works Co., Brantford.

HEATERS
Alberger Heater Co., Buffalo, N.Y.
Babcock & Wilcox, Ltd., Montreal.
Can. Sirocco Co., Windsor, Ont.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
Hamilton Mfg. Co., Wm., Peterboro, Ont.
Laurie & Lamb, Montreal.
McAvity & Sons, T., St. John, N.B.
Scaife & Sons, Wm. B., Pittsburgh, Pa.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Waterous Engine Works Co., Brantford.

HEATERS, EXHAUST STEAM
Can. Allis-Chalmers, Ltd., Toronto, Ont.

HEATERS, METERING
Can. Allis-Chalmers, Ltd., Toronto, Ont.

HEATING SYSTEMS, FANS
Can. Sirocco Co., Windsor, Ont.

HOISTS, GRIP
Jordan Bros., Inc., New York, N.Y.

HOISTING AND CONVEYING MACHINERY
Babcock & Wilcox, Ltd., Montreal.
Hamilton Mfg. Co., Wm., Peterboro, Ont.
Waterous Engine Works Co., Brantford.

HOSE, METALLIC
Pennsylvania Flexible Metallic Tubing Co., Boston, Mass.

HOSE, STEAM, SUCTION AND WATER
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Asbestos Co., Montreal.
Garlock Packing Co., Hamilton, Ont.
Goodyear Tire & Rubber Co., Toronto.
Peerless Rubber Mfg. Co., New York, N.Y.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

HYDRANTS
Wood & Co., R. D., Philadelphia, Pa.

HYDRAULIC ACCUMULATORS
Smart-Turner Machine Co., Ltd., Hamilton.

HYDRAULIC MACHINERY
Bawden Pump Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Hamilton Mfg. Co., Wm., Peterboro, Ont.
John McDougall Caledonian Iron Wks., Montreal.

HYDRAULIC PRESSES
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

ICE MAKING MACHINERY
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Griscom-Russell Co., Ltd., Montreal.
Frick Co., Waynesboro, Franklin Co.
Linde Canadian Refrigeration Co., Montreal.
York Mfg. Co., York, Pa.

INDICATORS, ELECTRIC—ALL TYPES
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Uehling Instrument Co., New York, N.Y.

INDICATORS, STEAM AND GAS ENGINE
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Canadian Fairbanks-Morse Co., Montreal.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Green's Economiser, Ltd., Toronto.
Uehling Instrument Co., New York, N.Y.

INDICATORS—AMMONIA, HYDRAULIC
Can. Detroit Lubricator Co., Walkerville, Ont.

INDICATORS, SPEED
L. S. Starrett Co., Athol, Mass.

INJECTORS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

INSTRUMENTS, RECORDING
Green's Economiser, Ltd., Toronto.
Taylor Instrument Companies, Rochester, N.Y.

INSULATING BRICK
Armstrong Cork & Insulation Co., Montreal, Que.
Beveridge Paper Co., Ltd., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.

INSULATING COMPOUNDS
Johns-Pratt Co., The, Hartford, Conn.

INSULATORS
Ed. Bennis & Co., Little Fulton, Bolton, Eng.
Beveridge Paper Co., Ltd., Montreal, Que.
Johns-Pratt Co., The, Hartford, Conn.

IRON FILLER
Can. H. W. Johns-Manville Co., Toronto, Ont.

KILNS
Green's Economiser, Ltd., Toronto.

LACE LEATHERS
Graton & Knight Mfg. Co., Montreal.
Wm. C. Wilson & Co., Toronto.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Can. B. K. Morton Co., Toronto, Montreal.
Canuck Supply Co., Ltd., Montreal, Que.
Crane Packing Co., Chicago, Ill.

LAMPS, ARC
Canadian Fairbanks-Morse Co., Montreal.
Can. General Electric Co., Toronto, Ont.
Can. H. W. Johns-Manville Co., Toronto, Ont.

LAMPS, ELECTRIC
Wm. C. Wilson & Co., Toronto.

LAMPS, INCANDESCENT
Canadian Fairbanks-Morse Co., Montreal.
Can. General Electric Co., Toronto, Ont.
Can. H. W. Johns-Manville Co., Toronto, Ont
Can. Laco-Philips Co., Ltd., Toronto, Ont.

LAMPS, NITRO
Can. Laco-Philips Co., Ltd., Toronto, Ont.

LAMPS, TUNGSTEN AND NITRO
Can. General Electric Co., Toronto, Ont.
Can. Laco-Philips Co., Ltd., Toronto, Ont.

LEAD
Dominion Metal Co., Sherbrooke, Que.

LEATHER STRAPPING
Graton & Knight Mfg. Co., Montreal.

LININGS, FIRE BRICK, STEEL STACK
Green's Economiser, Ltd., Toronto.

LUBRICANTS
Albany Lubricating Co., New York City.
Canadian Economic Lubricant Co., Montreal.
Jos. Dixon Crucible Co., Jersey City.

LUBRICATORS, CYLINDER
Albany Lubricating Co., New York City.
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

LUBRICATORS, FORCE FEED
Can. Detroit Lubricator Co., Walkerville, Ont.
Darling Bros., Montreal.
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

LUBRICATORS, PLAIN
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

MACHINERY INSULATION
Armstrong Cork & Insulation Co., Montreal, Que.
Beveridge Paper Co., Ltd., Montreal, Que.

MANGENESITE PASTE
Wm. C. Wilson & Co., Toronto.

MASON CONTRACTOR
Wenting, J. H., 256 Lee Ave., Toronto.

MECHANICAL STOKERS
Babcock & Wilcox, Ltd., Montreal.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Dertoit, Mich.

METERS, ELECTRIC
Can. H. W. Johns-Manville Co., Toronto, Ont.

METERS, STEAM
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Green's Economiser, Ltd., Toronto.

METERS, WATER
Allen General Supplies, Toronto, Ont.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Foxboro Company, Foxboro, Mass.
McAvity & Sons, T., St. John, N.B.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Precision Instrument Co., Detroit, Mich.

MIXING VALVES
Mueller Mfg. Co., H., Sarnia, Ont.

MILL AND MINING MACHINERY
Canadian Fairbanks-Morse Co., Montreal.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Goldie & McCulloch Co., Galt.
Hamilton Co., Wm., Peterboro, Ont.
Waterous Engine Works Co., Brantford.

METER TESTERS
Mueller Mfg. Co., H., Sarnia, Ont.

MOTORS
Canadian Fairbanks-Morse Co., Montreal.
Can. General Electric Co., Toronto, Ont.
Green's Economiser, Ltd., Toronto.
Milton & Prentiss, Toronto.

MOTORS, DIRECT CURRENT
Lancashire Dynamo & Motor Co., Toronto, Ont.

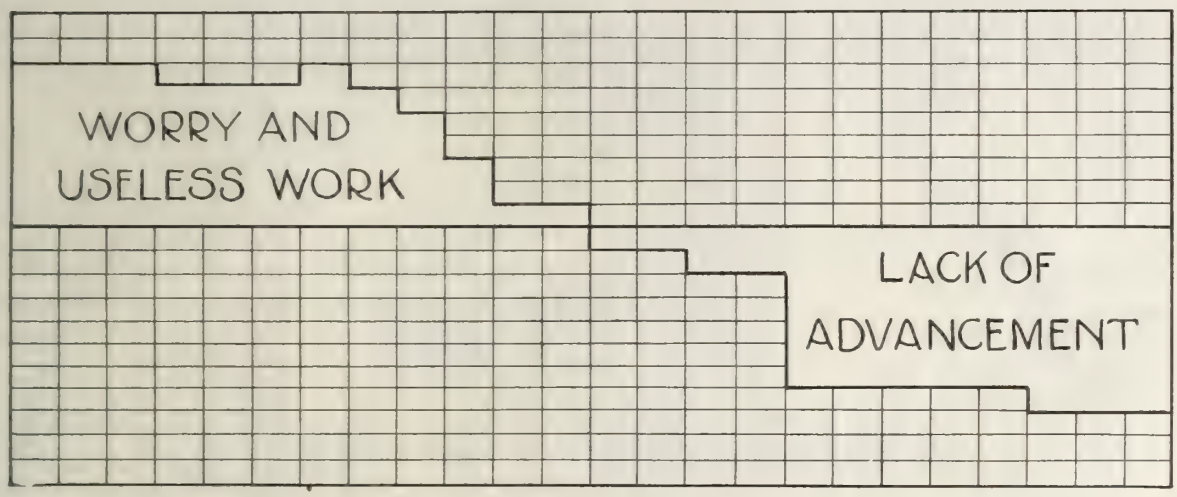
MOTORS, INDUCTION
Lancashire Dynamo & Motor Co., Toronto, Ont.

MOTORS, SYNCHRONOUS
Lancashire Dynamo & Motor Co., Toronto, Ont.

OAKUM
Wm. C. Wilson & Co., Toronto.

OFFICE RAILINGS
Jas. Morrison Brass Mfg. Co., Toronto.

Let the C.A.S.E. Smooth Out Your Load Curve



Remove The Peaks of Worry And Unproductive Labor And Build Up The Valleys By Working For Your Advancement

A man who is thoroughly grounded in the practice of his profession, who is free from personal worry and trouble, overcomes the many difficulties besetting the path of the operating engineer with little labor and in a manner ensuring his advancement.

The successful man owes his success to a wise appreciation of the advantages and mutual help offered by association with those in the same field of endeavor. To join an association having for its objectives the welfare of the engineer in things mental and material, his advancement in knowledge and skill, his protection by provision for sickness and distress is to take advantage of an opportunity indispensable to all who hope to better themselves.

If you are interested in such an organization and live where less than fifteen engineers are located, send for a copy of our constitution and application blanks for admission to nearest branch lodge. If there are more than fifteen engineers in your community, get together and send for particulars regarding formation of a branch lodge.

J. H. HALE, General Secretary,

Canadian Association of Stationary Engineers

230 Caroline Street Hamilton, Ont.

If any advertisement interests you, tear it out now and place with letters to be answered.

OIL CUPS
Albany Lubricating Co., New York City.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

OILER, COMPOUND FEEDERS
Lunkenheimer Co., Cincinnati, O.

OILERS, GAUGE
Lunkenheimer Co., Cincinnati, O.

OILERS, MULTIPLE
Can. Detroit Lubricator Co., Walkerville, Ont.
Lunkenheimer Co., Cincinnati, O.

OIL FILTERS AND CIRCULATING SYSTEMS
Bowser & Co., Inc., S. F., Toronto, Ont.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
Jas. Morrison Brass Mfg. Co., Toronto.

OIL SEPARATORS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
Direct Separator Co., Syracuse, N.Y.
Elliott Co., Pittsburgh, Pa.
Leitch Co., Arthur S., Toronto, Ont.
Liberty Mfg. Co., Pittsburgh.
Jas. Morrison Brass Mfg. Co., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.

OILING SYSTEMS
Albany Lubricating Co., New York City.
Bowser & Co., Inc., S. F., Toronto, Ont.
Lunkenheimer Co., Cincinnati, O.

OILS, LUBRICATING
Albany Lubricating Co., New York City.
Can. Economic Lubricant Co., Montreal, Que.
Kellogg & Co., E. H., New York, N.Y.
Wm. C. Wilson & Co., Toronto.

PACKING, ASBESTOS
Johns-Pratt Co., The, Hartford, Conn.

PACKING ENGINE
Can. Asbestos Co., Montreal, Que.
Garlock Packing Co., Hamilton, Ont.
Johns-Pratt Co., The, Hartford, Conn.
Peerless Rubber Mfg. Co., New York, N.Y.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING FIBRE
Beveridge Paper Co., Ltd., Montreal, Que.
Can. B. K. Morton Co., Montreal, Que.
Johns-Pratt Co., The, Hartford, Conn.
Wm. C. Wilson & Co., Toronto.

PACKING, HYDRAULIC
Can. Asbestos Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Can. B. K. Morton Co., Toronto, Montreal.
Crane Packing Co., Chicago, Ill.
Durabla Manufacturing Co., New York.
Garlock Packing Co., Hamilton, Ont.
Goodyear Tire & Rubber Co., Toronto.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, METALLIC
Can. B. K. Morton Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Crane Packing Co., Chicago, Ill.
Greene, Tweed & Co., New York.
Holmes Metallic Packing Co., Wilkesbarre, Pa.
Milton & Prentiss, Toronto.
Steel Mill Packing Co., Windsor, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, ROD
Can. Asbestos Co., Montreal, Que.
Can. B. K. Morton Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Crane Packing Co., Chicago, Ill.
Garlock Packing Co., Hamilton, Ont.
Canuck Supply Co., Ltd., Montreal, Que.
Steel Mill Packing Co., Windsor, Ont.
Peerless Rubber Mfg. Co., New York, N.Y.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, SHEET
Can. Asbestos Co., Montreal, Que.
Can. B. K. Morton Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Canuck Supply Co., Ltd., Montreal, Que.
Durabla Manufacturing Co., New York.
Garlock Packing Co., Hamilton, Ont.
Jenkins Bros., Ltd., Montreal.
Johns-Pratt Co., The, Hartford, Conn.
Peerless Rubber Mfg. Co., New York, N.Y.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, AMMONIA, STEAM AND WATER
Can. Asbestos Co., Montreal, Que.
Can. B. K. Morton Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Canuck Supply Co., Ltd., Montreal, Que.
Crane Packing Co., Chicago, Ill.
Garlock Packing Co., Hamilton, Ont.
Greene, Tweed & Co., New York.
[illegible]
Johns-Pratt Co., The, Hartford, Conn.
Steel Mill Packing Co., Windsor, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, LEATHER
Can. B. K. Morton Co., Toronto, Montreal.
[illegible]
Garlock Packing Co., Hamilton, Ont.
Graton & Knight Mfg. Co., Montreal.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
[illegible]
Wm. C. Wilson & Co., Toronto.

PACKING PISTON
Crane Packing Co., Chicago, Ill.

PACKING, VALVE STEM
Crane Packing Co., Chicago, Ill.
Johns-Pratt Co., The, Hartford, Conn.

PAINTS
Wm. C. Wilson & Co., Toronto.

PAINT, DAMP RESISTING
Toch Bros., Toronto, Ont.

PAPER, INSULATING, ETC.
Beveridge Paper Co., Montreal, Que.

PATTERNS
Victoria Foundry Co., Ottawa, Ont.

PENSTOCKS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.

PILLOW BLOCKS
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Waterous Engine Works Co., Brantford.

PIPE COILS
Frick Co., Waynesboro, Pa.
York Mfg. Co., York, Pa.

PIPE COVERINGS, STEAM, BRINE, AMMONIA AND ICE WATER
Armstrong Cork & Insulation Co., Montreal, Que.

PIPE, CAST IRON
Wood & Co., R. D., Philadelphia, Pa.

PIPE STEEL
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

PIPE VISES AND CUTTERS
Armstrong Mfg. Co., Bridgeport, Conn.

PIPE, GAS
Can. Allis-Chalmers, Ltd., Toronto, Ont.

PIPES, WATER
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont

PIPING AND FITTINGS
Frick Co., Waynesboro, Franklin Co., Pa.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
York Mfg. Co., York, Pa.

PIPING, STEAM
Babcock & Wilcox, Ltd., Montreal.

PLATE WORK
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd. St. Catharines, Ont.
Hamilton Co., Wm., Peterboro, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

PLUG COCKS
Homestead Valve Mfg. Co., Pittsburgh, Pa.

PLUMBING SUPPLIES
Mueller Mfg. Co., H., Sarnia, Ont.
Wm. C. Wilson & Co., Toronto.

POWER PUMPS
American Steam Pump Co., Battle Creek, Mich
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
The John McDougall Caledonian Iron Works Co. Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
Waterous Engine Works Co., Brantford.
Garlock Packing Co., Hamilton, Ont.
Laurie & Lamb, Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.

POWER, TRANSMISSION MACHINERY
American Pulley Co., Philadelphia, Pa.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Goldie & McCulloch Co., Galt.
Hamilton Co., Wm., Peterboro, Ont.
Jeffrey Manufacturing Co., Montreal.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
MacGovern & Co., New York.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Morse Chain Co., Ithaca, N.Y.
Waterous Engine Works Co., Brantford.

PRESSES
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

PRESSURE, BLOWERS, CENTRIFUGAL
Can. Sirocco Co., Windsor, Ont.

PULLEYS
American Pulley Co., Philadelphia, Pa.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Wm. Hamilton Co., Ltd., Peterboro.
Jeffrey Manufacturing Co., Montreal.
Victoria Foundry Co., Ottawa, Ont.
Waterous Engine Works Co., Brantford.

PULP MILL MACHINERY
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Hamilton Co., Wm., Peterboro, Ont.
Jeffrey Manufacturing Co., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

PUMPING MACHINERY
American Steam Pump Co., Battle Creek, Mich.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Bawden Machine Co., Toronto.
Beveridge Paper Co., Montreal, Que.
Laurie & Lamb, Montreal.
McAvity & Sons, T., St. John, N.B.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.
Waterous Engine Works Co., Brantford.

PUMPING MACHINERY, ELECTRICAL
Bawden Machine Co., Toronto.
Beveridge Paper Co., Montreal, Que.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Jeffrey Manufacturing Co., Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.

PUMPS, AIR
American Steam Pump Co., Battle Creek, Mich
Bawden Machine Co., Ltd., Toronto.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Montreal.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co. Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
Storey Pump & Equipment Co., Ltd., Toronto

PUMPS, ACID
Bawden Pump Co, Toronto.
Beveridge Paper Co., Montreal, Que.

PUMPS, CONTRACTORS'
Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Beveridge Paper Co., Montreal, Que.
McAvity & Sons, T., St. John, N.B.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, ELECTRICAL
American Steam Pump Co., Battle Creek, Mich.
Beveridge Paper Co., Montreal, Que.

PUMPS, FEED WATER
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Beveridge Paper Co., Montreal, Que.

PUMP GOVERNORS AND REGULATORS
Bawden Machine Co., Ltd., Toronto.
Darling Bros., Montreal.
G. M. Davis Regulator Co., Chicago.
D'Este Co., Julian, Boston, Mass.
Elliott Co., Pittsburgh, Pa.
Mason Regulator Co., Boston, Mass.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.
Watson & McDaniel Co., Philadelphia.

PUMP STRAINERS
Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Darling Bros., Ltd., Montreal.
Liberty Mfg. Co., Pittsburgh, Pa.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, HAND AND POWER
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Darling Bros., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, BOILER FEED
Bawden Pump Co, Toronto.

PUMPS, CENTRIFUGAL
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Darling Bros., Montreal
Hamilton Co., Wm., Peterboro, Ont.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Pulsometer Engineering Co., Ltd., London, Eng.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Victoria Foundry Co., Ottawa, Ont.
Waterous Engine Works Co., Brantford.

PUMPS, DUPLEX
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Beveridge Paper Co., Montreal, Que.

PUMPS, GEARED, COMPOUND
American Steam Pump Co., Battle Creek, Mich
Bawden Machine Co., Ltd., Toronto.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Montreal.
Inglis Co., The John, Toronto, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, ELECTRICAL
Bawden Pump Co, Toronto.

PUMPS, HYDRAULIC, PRESSURE
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Darling Bros., Montreal.
Inglis Co., The John, Toronto, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.

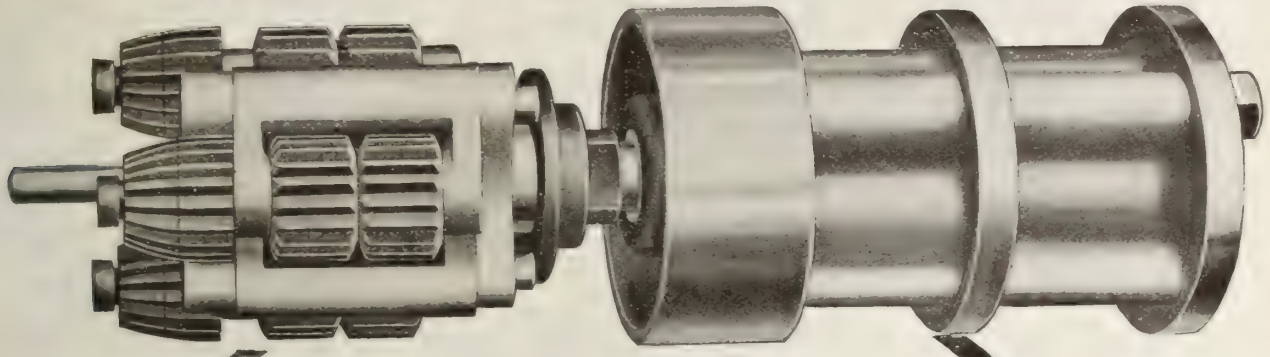
PUMP LEATHERS
Beveridge Paper Co., Ltd., Montreal, Que.
Can. B. K. Morton Co., Toronto, Montreal.
Graton & Knight Mfg. Co., Montreal.

PUMPS, OIL
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Ltd., Toronto.
Bowser & Co., Inc., S. F., Toronto, Ont.
Can. Detroit Lubricator Co., Walkerville, Ont.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, STEAM TURBO
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Darling Bros., Montreal.
Escher Wyss & Co., Montreal, Que.
Pulsometer Engineering Co., Ltd., London, Eng.
Smart-Turner Machine Co., Ltd., Hamilton.
Waterous Engine Works Co., Brantford.

CLEAN YOUR BOILER TUBES

IN LESS TIME, WITH LESS POWER



You can remove all of the scale and keep the tube surfaces clean and polished by frequent use of

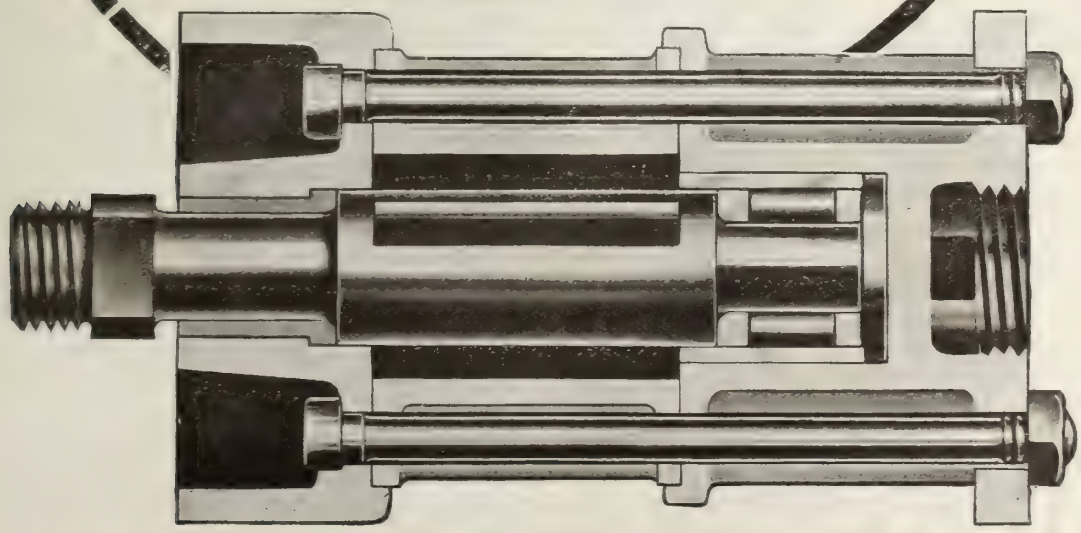
ROTO TUBE CLEANERS

Unrivaled in speed and durability. By far the cheapest cleaners because of their high efficiency. They combine the most powerful, reliable and durable motors with the most effective scale-removing tools.

Hardened Steel Armor Rings thoroughly protect the motor. The hard steel rings keep it straight, round, up to size and a correct fit for the boiler tube, even after long use. Roto motors cannot pass over scale or get wedged and stuck in the boiler tube. They positively eliminate the usual trouble of wearing oval, taper or undersize.

Roto Tube Cleaners include air, steam and water driven, cleaners for all kinds of straight and curved tubes of iron, steel, cast iron, copper, brass, etc., in boilers, fuel economizers, heaters, condensers, evaporators, etc.

Write for Catalogues now.



THE ROTO COMPANY, HARTFORD, CONN.

If any advertisement interests you, tear it out now and place with letters to be answered.

PUMP TANK, RECEIVER
American Steam Pump Co., Battle Creek, Mich.
Beveridge Paper Co., Montreal, Que.
Smart-Turner Machine Co., Hamilton, Ont.

PUMPS, STEAM
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Ltd., Toronto.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
Inglis Co., The John, Toronto, Ont.
Laurie & Lamb, Montreal.
Leitch Co., Arthur S., Toronto, Ont.
McAvity & Sons, T., St. John, N.B.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, TRIPLEX
Smart-Turner Machine Co., Hamilton, Ont.

PUMPS, VACUUM
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Ltd., Toronto.
Beveridge Paper Co., Montreal, Que.
Laurie & Lamb, Montreal.
Leitch Co., Arthur S., Toronto, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PYROMETERS
Foxboro Co., The, Foxboro, Mass.
Green's Economiser, Ltd., Toronto.
Jas. Morrison Brass Mfg. Co., Toronto.
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.

RADIATOR TRAPS
Beveridge Paper Co., Montreal, Que.
Sarco Co., Inc., New York, N.Y.

RADIATOR AIR VENTS
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

RAGS
Wm. C. Wilson & Co., Toronto.

REBOILERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

RECEIVERS, AIR
Can. Allis-Chalmers, Ltd., Toronto, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.

RECORDING INSTRUMENTS
Can. H. W. Johns-Manville Co., Toronto, Ont.
Foxboro Co., The, Foxboro, Mass.
Green's Economiser, Ltd., Toronto.
Precision Instrument Co., Detroit, Mich.
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.

REFRIGERATOR DOORS, WINDOWS, ETC.
Jamison Cold Storage Door Co., Hagerstown, Md.

REFRIGERATING MACHINERY
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Griscom-Russell Co., Ltd., Montreal.
Frick Co., Waynesboro, Franklin Co., Pa.
Linde Canadian Refrigeration Co., Montreal.
Vilter Mfg. Co., Milwaukee, Wis.
York Mfg. Co., York, Pa.

REFUSE DESTRUCTOR
Canadian Griscom-Russell Co., Ltd., Montreal.
Laurie & Lamb, Montreal.

REGULATORS, PRESSURE
Chaplin-Fulton Mfg. Co., Pittsburgh, Pa.
D'Este Co., Julian, Boston, Mass.
Jas. Morrison Brass Mfg. Co., Toronto.
Taylor Instrument Co., Rochester, N.Y.

REGULATORS, TEMPERATURE
Sarco Co., Inc., New York, N.Y.
Taylor Instrument Co., Rochester, N.Y.

RETORTS
MacKinnon, Holmes & Co., Sherbrooke, Que.

REVOVLING DOORS FOR HARDENING ROOMS
Jamison Cold Storage Door Co., Hagerstown, Md.

ROOFING
Wm. C. Wilson & Co., Toronto.

ROOFINGS—RUBBER, PLASTIC, LIQUID
Beveridge Paper Co., Montreal, Que.

ROPE
Wm. C. Wilson & Co., Toronto.

ROPE PRESERVATIVE
Cling Surface Co., Buffalo.

ROTARY CONVERTERS
Canadian Fairbanks-Morse Co., Montreal.

RUBBER HOSE
Can. H. W. Johns-Manville Co., Toronto, Ont.
Garlock Packing Co., Hamilton, Ont.
Garlock Mfg. Co., Pittsburg, Pa.
Thomson-Gordon, Ltd., Hamilton, Ont.

RUBBER MOLDS
Bawden Machine Co., Ltd., Toronto.

SAFES
Canadian Fairbanks-Morse Co., Montreal.
Goldie & McCulloch Co., Galt.

SCALE REMOVERS
Babcock & Wilcox, Ltd., Montreal.
Beveridge Paper Co., Ltd., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Roto Co., Hartford, Conn.
William B. Pierce Co., Buffalo, N.Y.
Snowdon, C. C., Calgary, Alta.

SEAM PROTECTORS, GIRTH
National Boiler Protector Co. of Canada, Montreal Que.

SHAFTING
Can. Bond Hanger & Coupling Co., Alexandria Ont.
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd. St. Catharines, Ont.
Hamilton Co., Wm., Peterboro, Ont.
Waterous Engine Works Co., Brantford.

SHAKING AND DUMPING GRATES
Babcock & Wilcox, Ltd., Montreal.
Galt Foundry Co., Galt, Ont.
Waterous Engine Works Co., Brantford.

SMELTER LININGS
Beveridge Paper Co., Montreal, Que.

SMOKE BOXES, STACKS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Green's Economiser, Ltd., Toronto.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

SMOOTH-ON
Wm. C. Wilson & Co., Toronto.

SPECIAL MACHINERY
Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Hamilton Co., Wm., Peterboro, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Waterous Engine Works Co., Brantford.

SPEED INDICATORS
Foxboro Co., The, Foxboro, Mass.
Schaeffer & Budenburg Mfg. Co., Brooklyn, N.Y.
L. S. Starrett Co., Athol, Mass.

SPLICE PROTECTORS
Jordan Bros., Inc., New York, N.Y.

SPROCKET CHAIN ATTACHMENTS
Waterous Engine Works Co., Brantford.

SPROCKET RIMS
Babbitt Steam Specialty Co., New Bedford, Mass.

SPUR WHEELS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Hamilton Co., Wm., Peterboro, Ont.
Waterous Engine Works Co., Brantford.

STACKS, STEEL
Babcock & Wilcox, Ltd., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.

STAND PIPES, STEEL
MacKinnon, Holmes & Co., Sherbrooke, Que.

STAYBOLTS, FLEXIBLE
Can. Allis-Chalmers, Ltd., Toronto, Ont.

STEAM SEPARATORS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Darling Bros., Montreal.
Direct Separator Co., Syracuse, N.Y.
D'Este Co., Julian, Boston, Mass.
Elliott Co., Pittsburgh, Pa.
Leitch Co., Arthur S., Toronto, Ont.
Penberthy Injector Co., Windsor, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Watson & McDaniel Co., Philadelphia.

STEAM SPECIALTIES
Alberger Heater Co., Buffalo, N.Y.
Canadian Fairbanks-Morse Co., Montreal.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
D'Este Co., Julian, Boston, Mass.
Liberty Mfg. Co., Pittsburg, Pa.
Lunkenheimer Co., Cincinnati, O.
Mason Regulator & Engineering Co., Montreal.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor.
Watson & McDaniel Co., Philadelphia.

STEAM TRAPS
American Steam Gauge & Valve Mfg. Co., Boston Mass.
Anderson Co., Y. D., Cleveland, O.
Canadian Fairbanks-Morse Co., Montreal.
Can. Sirocco Co., Windsor, Ont.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
Davis Regulator Co., G. M., Chicago.
D'Este Co., Julian, Boston, Mass.
Dunham Co., Ltd., C. A., Toronto, Ont.
Elliott Co., Pittsburgh, Pa.
J. T. Long, 84 Adam St., Montreal. Que.
Can. Morehead Mfg. Co., Woodstock.
Mason Regulator & Engineering Co., Montreal
Nashua Mach. Co., Boston, Mass.
Sarco Co., Inc., New York, N.Y.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Watson & McDaniel Co., Philadelphia.

STEEL BARRELS
Smart-Turner Machine Co., Hamilton, Ont.

STEEL DRUMS
Smart-Turner Machine Co., Hamilton, Ont.

STEEL TANKS
Babcock & Wilcox, Ltd., Montreal.
Hamilton Co., Wm., Peterboro, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works, Brantford, Ont.

STOKERS
Babcock & Wilcox, Ltd., Montreal.
Ed. Bennis & Co., Little Fulton, Bolton, Eng.
Detroit Stoker Co., Detroit, Mich.
Galt Foundry Co., Galt, Ont.
Green's Economiser, Ltd., Toronto.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Dertoit, Mich.

STRAINERS
Babcock & Wilcox, Ltd., Montreal.
Bawden Machine Co., Ltd., Toronto.
Beveridge Paper Co., Montreal, Que.
Elliott Co., Pittsburgh, Pa.
Self-Cleansing Strainer Co., Chicago.

STRUCTURAL STEEL WORK
Babcock & Wilcox, Ltd., Montreal.
Hamilton Co., Wm., Peterboro, Ont.
MacKinnon, Holmes & Co., Ltd., Sherbrooke. Que.

SUPERHEATERS, STEAM
Babcock & Wilcox, Ltd., Montreal.
Green's Economiser, Ltd., Toronto.

SWITCHBOARDS
Can. General Electric Co., Toronto, Ont.

SWITCHES AND SWITCH BOXES
Can. H. W. Johns-Manville Co., Toronto, Ont.

TACHOMETERS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Foxboro Co., The, Foxboro, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

TANKS, BLOW-OFF
Darling Bros., Montreal.
John McDougall Caledonian Iron Works, Montreal
Waterous Engine Works Co., Brantford.

TANKS, FREEZING, STORAGE AND WATER COOLING
Frick Co., Waynesboro, Franklin Co., Pa.

TANKS, OIL
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Bowser & Co., Inc., S. F., Toronto, Ont.
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Hamilton Co., Wm., Peterboro, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

TANKS, WATER
Inglis Co., The John, Toronto, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

TAPPING MACHINES
Mueller Mfg. Co., H., Sarnia, Ont.

TECHNICAL BOOKS
MacLean Publishing Co., Toronto.

THERMOMETERS
Foxboro Co., The, Foxboro, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Milton & Prentiss, Toronto.
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.

THERMOSTATS
Sarco Co., Inc., New York, N.Y.

TIN
Dominion Metal Co., Sherbrooke, Que.

TOOLS
Mueller Mfg. Co., H., Sarnia, Ont.

TRANSFORMERS
Can. General Electric Co., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.

TRANSMISSION MACHINERY
American Pulley Co., Philadelphia, Pa.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Can. Bond Hanger & Coupling Co., Alexandria. Ont.
Canadian Fairbanks-Morse Co., Montreal.
Goldie & McCulloch Co., Galt, Ont.
Hamilton Co., Wm., Peterboro, Ont.
Jeffrey Manufacturing Co., Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Waterous Engine Works Co., Brantford.

TRAPS, STEAM AND WATER-LINE
Beveridge Paper Co., Montreal, Que.
D'Este Co., Julian, Boston, Mass.

TRUCKS, FACTORY
Beveridge Paper Co., Ltd., Montreal, Que.
Canadian Fairbanks-Morse Co., Montreal.

TUBE CLEANERS
Babcock & Wilcox, Ltd., Montreal.

WATER SCAIFE AND WE-FU-GO
PURIFICATION SYSTEMS
SOFTENING & FILTRATION
FOR BOILER FEED AND ALL INDUSTRIAL USES
WM. B. SCAIFE & SONS CO. PITTSBURGH, PA.

Don't buy that New Electrical Apparatus Just Yet

WE can supply you with high-grade apparatus that has been slightly used and discarded through no fault of its own, at an **immense saving in cost.** For instance, in many cases we take over entire plants simply because of changed conditions such as increased capacity, change of system, etc.

EVERYTHING IS OVERHAULED AND REFINISHED BY US AND **GUARANTEED** AS GOOD AS NEW, BOTH ELECTRICALLY AND MECHANICALLY.

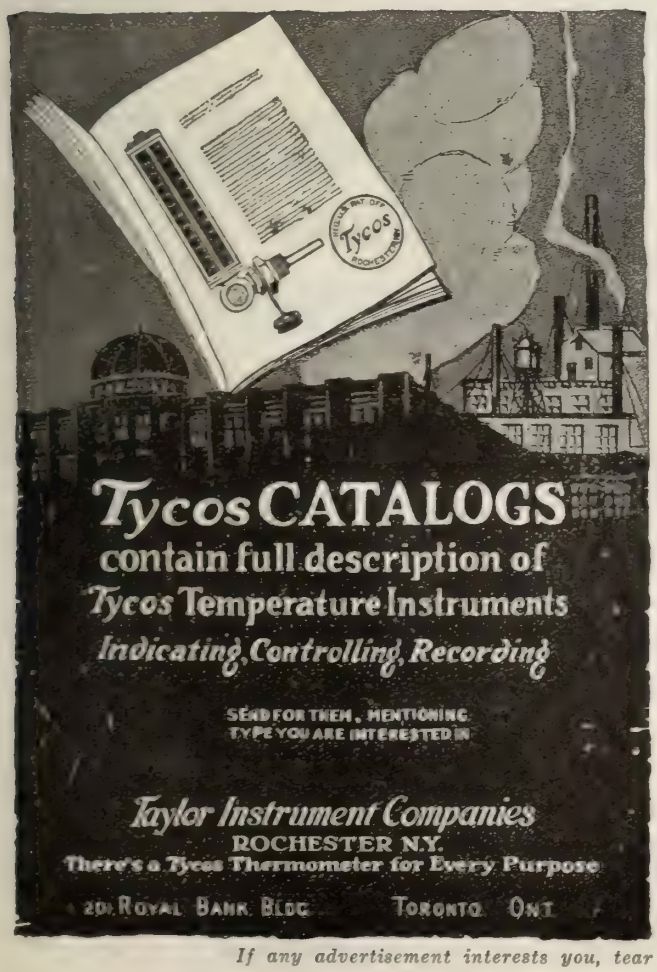
Our catalogs of offerings should be in the hands of every power plant superintendent each time they are gotten out, and it will be worth while for anyone interested in this class of power plant equipment to be on our mailing list to receive all offerings.

Nearly all of the principal power, lighting and street railway plants in the United States are our customers.

WRITE FOR OUR LATEST CATALOG of **Power House Equipment, Street Cars, Motors, Hoists, Compressors, etc.**

MACGOVERN & COMPANY, Inc.

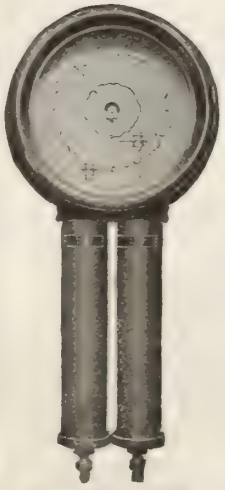
114 Liberty St., New York City


Tycos CATALOGS
contain full description of
Tycos Temperature Instruments
Indicating, Controlling, Recording
SEND FOR THEM, MENTIONING TYPE YOU ARE INTERESTED IN
Taylor Instrument Companies
ROCHESTER N.Y.
There's a Tycos Thermometer for Every Purpose
201 ROYAL BANK BLDG TORONTO ONT

UEHLING WASTE METER

COMBINED

CO_2 AND TEMPERATURE RECORDER



Record of CO_2 and stack temperature on one chart.

Does your fireman know how much fuel he is wasting? Do you know?

The **Uehling CO_2 Recorder** makes a complete 24 hr. record of your combustion efficiency and the **CO_2 indicator at the Boiler Front** holds the fireman responsible.

Get more **Steam** per pound of **Coal** and reduce your annual fuel consumption.

Let us know the number and size of your boilers and coal consumed per year, upon receipt of which information we will be glad to send you full particulars.

CO_2 Indicator for Boiler Front

Let us hear from you. We are pioneers in the manufacture of Indicators and Recorders for Power Plant purposes.

Send for our Bulletin No. 110.

Uehling Instrument Company

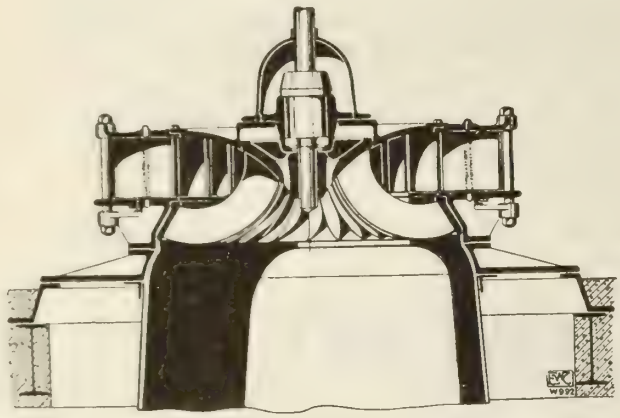
2008 Empire Building **New York City**

If any advertisement interests you, tear it out now and place with letters to be answered.

Escher Wyss & Co. S.A. Zurich (Switzerland)

Montreal Office: 112 Coristine Building

Water Turbines



Governors

Pipelines

Turbopumps

15/18

ADVERTISING INDEX

A

Albany Lubricating Co. 69
Alberger Heater Co. 54
American Steam Gauge & Valve Mfg. Co. 52
American Steam Pump Co. .. 59
Anderson Co., V. D. 81
Armstrong Cork & Insulation Co. 11

B

Babbitt Steam Specialty Co. .. 60
Babcock & Wilcox 78
Beveridge Paper Co. 77
Boiler Inspection Dept. 58
Boving Hydraulic & Eng. Co.. 76
Bowser, S. F., & Co., Inc. 72

C

Can. Allis-Chalmers Co. 75
Can. Assoc. Stationary Engrs.. 83
Can. Bond Hanger & Coupling Co ... 69
Can. Detroit Lubricator Co... 8
Can. Fairbanks-Morse 79
Can. General Electric Co. 75
Can. H. W. Johns-Manville Co. 61
Can. Morehead Mfg. Co. 64
Can. S K F Co. 77
Can. Steam Boiler Equipment Co. 4
Canuck Supply Co., Ltd. 57
Chaplin-Fulton Mfg. Co. 12
Cling-Surface Co. 69
Cole Ltd., Geo. W. 45
Coppus Engr. & Equip. Co.... 7
Coventry Chain Co. 62
Crane Packing Co. 78

D

[illegible] 8
[illegible] 9
Davis Regulator Co. .. 12
D'Este Co., Julian ... 64
Direct Separator Co. . 59
Dixon Crucible Co., Jos 45
Dominion Belting Co. 74
Dominion Coal Co. 76
Dunham & Co., C. A. 47
Durabla Mfg. Co. 52

E

Economy Fuse & Mfg. Co. of Canada 81
Elliott Co. 43
Engineering & Mach. Works of Canada, Ltd. 2
Escher Wyss & Co. 88

F

Federal Engineering Co. 81
Francis & Co., Walter J. 45
Frick Co. 11

G

Galt Foundry Co. .... —
Garlock Packing Co. 70
Garth Co. 76
Gates, John W. 45
Goldie & McCulloch Co. 16
Goodyear Tire & Rubber Co. .. 72
Graton & Knight Mfg. Co. ... 51
Greene, Tweed & Co. 53
Green's Economiser Co. ..... —

H

Holmes Metallic Packing Co.. 76
Homestead Valve Mfg. Co. ... 62
Hoyt Metal Co. 2

I

Inglis Co., John...Inside back cover

J

Jamieson Cold Storage Door Co. 77
Jefferson Union Co. 48
Jeffrey Mfg. Co. 63
Jenkins Bros. 66
Johns-Pratt Co., The 58
Jones Underfeed Stoker Co. . 4
Jordan Bros., Inc. 6

K

Kellogg & Co., E. H. 47
Kerr Engine Co. 68
Kipp-Kelly-Brown Co. 46

L

Ladd Co., The Geo. T. 77
Laurie & Lamb 13
Leitch Co., The Arthur S. 6
Liberty Mfg. Co. 43
Linde Canadian Refrigeration Works Co. 10
Long & Co., J. T. 47
Lunkenheimer Co. 64

M

MacGovern & Co. 87
MacKinnon, Holmes & Co. .. 45
MacLean's Magazine 56
Magnolia Metal Co. 74
Mason Regulator Co. 6
Mason Regulator & Engr. Co.. 7
McAvity & Sons, T. 68
McDougall Caledonian Iron Works Co. 14
McGhie, W. C. 76
McLaren Ltd., D. K. 67
Metlskin Co., Inc. 50
Morrison Brass Mfg. Co., Jas. Outside back cover
Morse Chain Co. 70
Mueller Mfg. Co. 65
Murphy Iron Works 3

N

National Boiler Seam Protector Co. 76

O

Ogilvie Flour Mills Co. 46

P

Penberthy Injector Co..Front cover
Pennsylvania Flexible Metallic Tubing Co. 52
Pilley Packing & Flue Brush Mfg. Co. 77
Power Plant Equipment Co. .. 59
Pratt & Cady Co., Inc. 50

R

Roto Co. 85

S

Sarco Co., Inc. 44
Scaife & Sons Co., Wm. B. .. 86
Schaffer & Budenberg Mfg. Co. 6
Shell-Bar, Boico Supply, Ltd.. 3
Smart-Turner Mach. Co. 77
Snowdon, C. C. 72
Starrett, L. S., Co. 78
Steel Mill Packing Co. 58

T

Taylor Instrument Co. 87
Thomson-Gordon, Ltd. 58
Trimont Manufacturing Co. ... 78

U

Uehling Instrument Co. 87
United States Rubber Co. ..... Inside front cover

V

Vilter Mfg. Co. 10

W

Wall, W. J. 46
Waterous Engine Works Co.. 1
Watson & McDaniel Co. 76
Wenting, J. H. 77
Williams & Co., J. H. 62
Wilson & Co., Wm. C. 47
Winnipeg Electric Railway 46
Wood & Co., R. D. 45

Y

Yarnall-Waring Co. 60
York Mfg. Co. 12

Boilers for all Services

INGLIS quality has not been attained in a day or a month or a year or two. It represents the fruit of over half a century in meeting the requirements of boiler users.

Inglis boilers are Canadian standard in materials, workmanship and efficiency. They ensure a lifetime service with a minimum of repairs.

We are also sole Canadian makers of Erie City Water Tube Boilers, Vertical and Horizontal.

Our representatives will be pleased to show installations of our different types of boilers to prospective customers.

Write for prices and specifications.

INGLIS Boilers

The John Inglis Company

Limited

ENGINEERS AND BOILER MAKERS

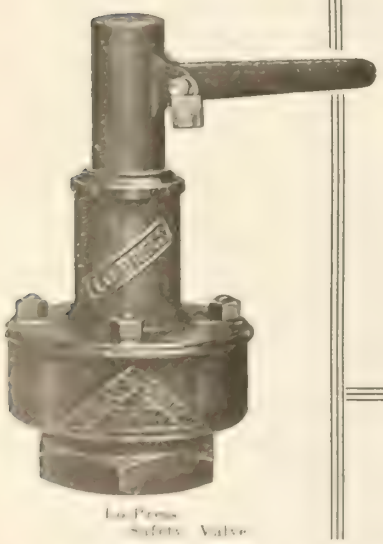
14 Strachan Avenue Toronto, Canada

MORRISON'S

Reliable Steam Goods and Specialties

Morrison Recording Gauge

Beaver Check Valve



Lo-Pressure Safety Valve

Everything for the Engine and Boiler Room

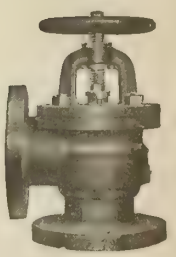
All J. M. T. Products are modern in design and represent *quality* in workmanship and material.

They are factory tested and can be relied upon to give long and satisfactory service. Approved by provincial boiler inspection departments.

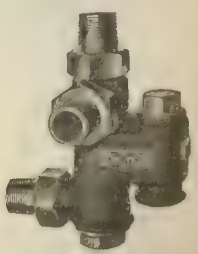
TRADE MARK J.M.T. A GUARANTEE OF QUALITY

J. M. T. Gate Valve

J. M. T. Reducing Valve



Beaver Valve Iron Body, Bronze Mounted



J. M. T. Injector

JAMES MORRISON BRASS MFG. COMPANY

93-97 ADELAIDE STREET WEST - - - TORONTO, ONTARIO

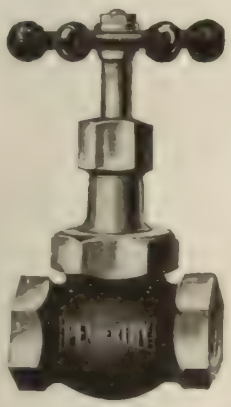
POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power; and to the operation of Refrigerating Machinery.

Published by The MacLean Publishing Company, Limited, 143-153 University Ave., Toronto

MONTREAL: Southam Bldg. LONDON, ENG.: 88 Fleet St., E.C. WINNIPEG: 1207 Union Trust Bldg

Vol XI—No. 8 Publication Office, Toronto—August, 1918 Published Monthly $1.00 per Year.



GLOBE

ANGLE

GATE

THIS IS THE NAME

TRADE PENBERTHY MARK.

That Guarantees You Quality Valves

We Manufacture Both Types, viz.

"REGRINDING"

With the Metal Disc for 200 lbs. Pressure

"COMPODISK"

With the Composition Disc for 175 lbs. Pressure

SWING CHECK

In Design, Construction, Workmanship, Finish and Quality, the Penberthy Line Stands in a Class by Itself.

WRITE FOR FREE CATALOG

Manufactured by

Penberthy Injector Co., Limited

WINDSOR - - ONTARIO

HORIZONTAL CHECK

No Upkeep Cost--No Replacement Cost--No Loss From Leaks

Couple up your pipe lines with Dart Unions and be forever free from leaking connections.

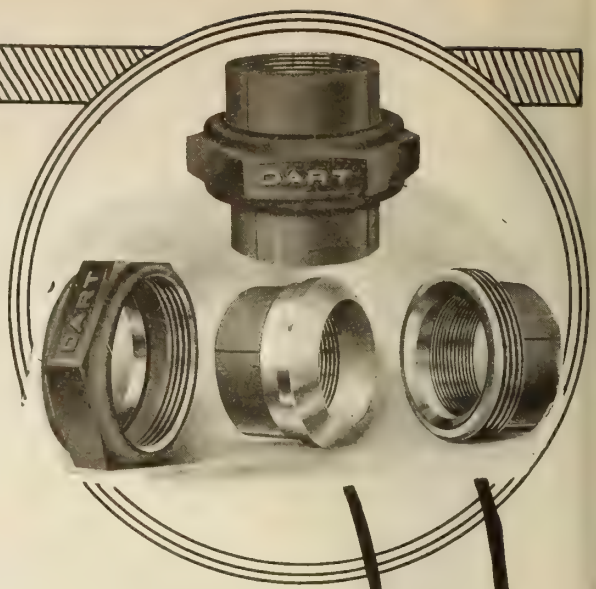
Dart Union Pipe couplings stay tight because the Bronze faces will not rust or corrode and the heavy iron parts will not stretch or pull apart.

Dart Unions are easy to use because of the Ball Shaped joint which enables you to connect pipes quickly whether pipes are in or out of alignment.

No upkeep cost. No replacement cost. No loss from leaks.

Order from your jobber.

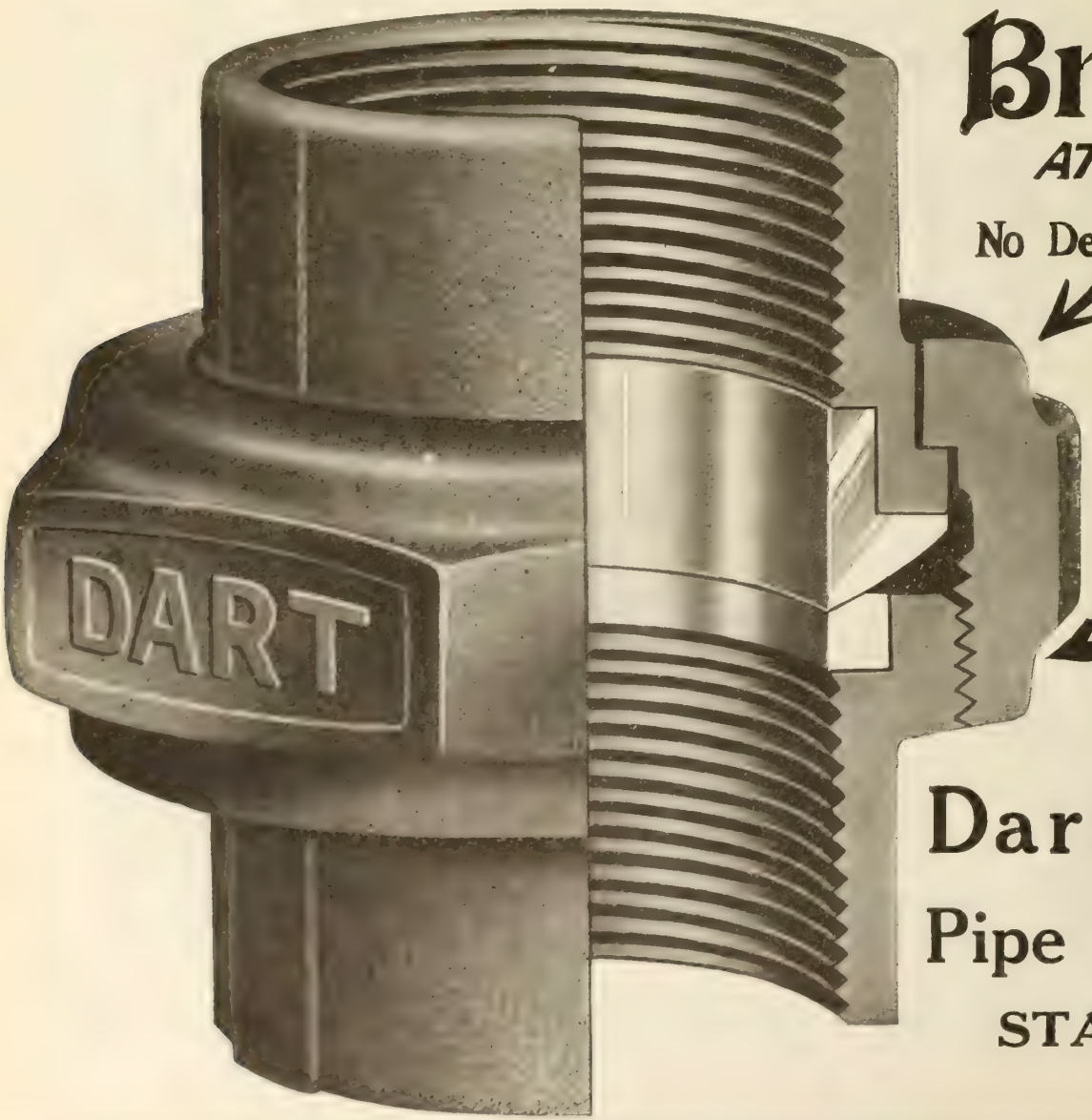
Manufactured by Dart Union Co., Ltd., Toronto, Ont.



Bronze to Bronze

AT THE JOINT

No Deterioration

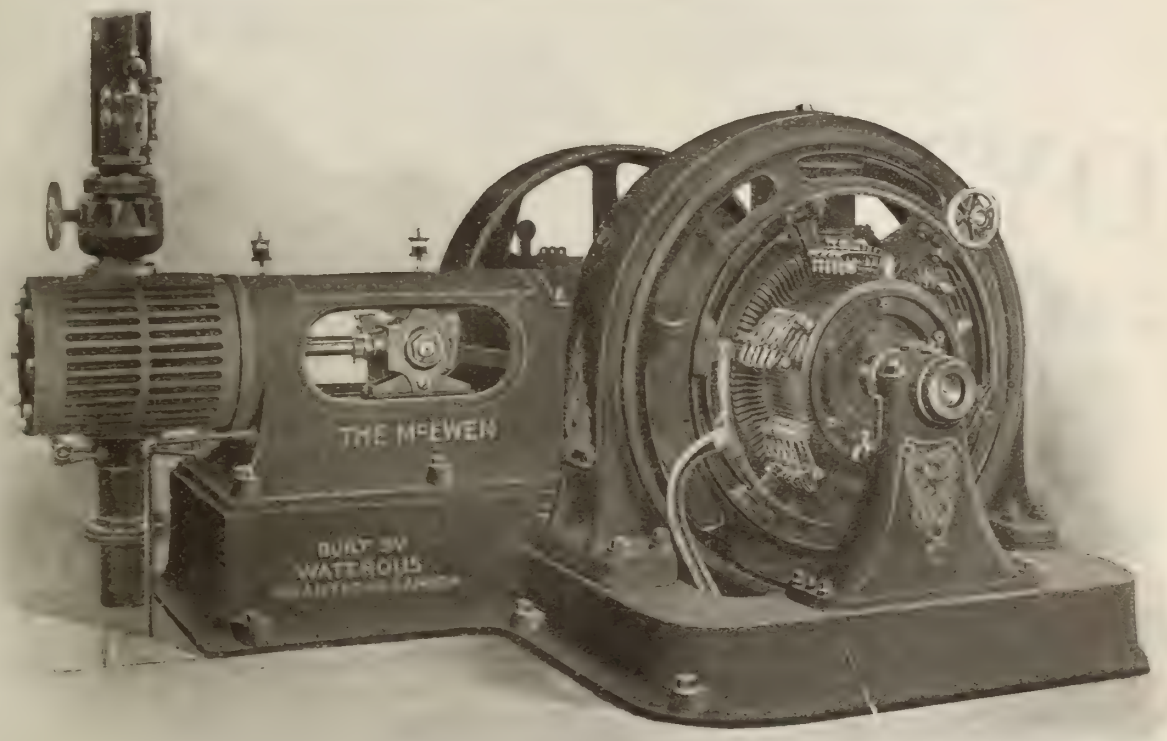


Dart Union

Pipe Couplings

STAY TIGHT

"The McEWEN"



THIS illustration represents our Horizontal Automatic High-Speed Engine, which we build in simple and compound units from 10 to 700 horse-power. Heavy, rigid bed designed for accessibility and for endurance. Cross-head guides, main bearings, and face for cylinder attachment, are machined in one operation to ensure perfect alignment. Cross-head guides are cast as part of the frame. They cannot be misadjusted. Valve of the piston type, perfectly balanced in every position, and is practically frictionless. Valve is double-ported. Balancing pressure plate is slotted to correspond with valve seat. Produces additional passage to cylinder by providing double admission and exhaust edges. Relief valves are made absolutely unnecessary. Guaranteed control by our famous Begthrup Inertia Governor. The McEwen Engine is adapted to all kinds of work. Its particular field is driving electric generators, for lighting, power, street railway and mine haulage. Every engine built on the duplicate part system, and thoroughly tested before leaving our works.

Send us your conditions and ask for bulletin.

MORE THAN 75 IN OPERATION

Waterous

BRANTFORD, ONTARIO, CANADA

If any advertisement interests you, tear it out now and place with letters to be answered.

For High Speed and Heavy Duty

For stationary engines of every class; for rolling mills, planing mills, saw mills and pulp machinery, the Babbitt without an equal is

HOYT'S
Frost King

It is the perfect Babbitt for all-round use. Men as familiar as yourself with the varying conditions and hard work to which a general purpose Babbitt must stand up, compound Frost King with expert care. Make your work easier, your babbitting expense much less, by using Frost King—the Babbitt that is perfect.

HOYT METAL CO., TORONTO

New York, N.Y. London, Eng. St. Louis, Mo.

HOYT'S
Nickel Genuine

Used in gas engines, gasoline engines and all classes of marine engines, this specific purpose Babbitt will give service unsurpassed by any other babbitt made or possible to make. It completely satisfies thousands of users. It satisfies our own experts. If your dealer is sold out, have us ship you a trial supply direct.

View Showing Interior of Boiler Department.

Stationary Boilers

Horizontal Tubular
Vertical Tubular
Locomotive Types

To conform with various Provincial codes.

Catalogs gladly furnished to members of the C.A.S.E.

Kindly address nearest office

Engineering & Machine Works of Canada, Limited

Formerly
St. Catharines Works of
The Jenckes Machine Co., Ltd.

Head Office and Works
St. Catharines, Ont.

Sales Offices
710 C.P.R. Building, Toronto
344 St. James Street, Montreal
Hall Machinery Co., Sherbrooke, Que.

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

Murphy AUTOMATIC Furnace

Murphy Stokers

A few longtime constant users, and there are others!

Lockport Paper Co.,	Lockport, N.Y.	33 years constant use
Hartje Paper Co.,	Steubenville, Ohio	24 years constant use
Sherwin-Williams Co. 12 contracts 20 Stokers	Montreal, P.Q. Cleveland, Ohio Kensington, Ill.	16 years constant use
Laurentide Co., Ltd.,	Grand Mere, P.Q.	13 years constant use
Ford Motor Co.,	Detroit, Mich.	
" " "	Des Moines, Iowa	18 years constant use
" " "	New York, N.Y.	
Ohio Traction Co., 16 Repeat Orders	Cincinnati, Ohio	28 years constant use 74 Murphy Stokers

For printed matter address

MURPHY IRON WORKS

DETROIT, MICH. BUFFALO, N.Y.

Every Barrel of **BOICO** The Quick Remover and Positive Preventive of Boiler Scale

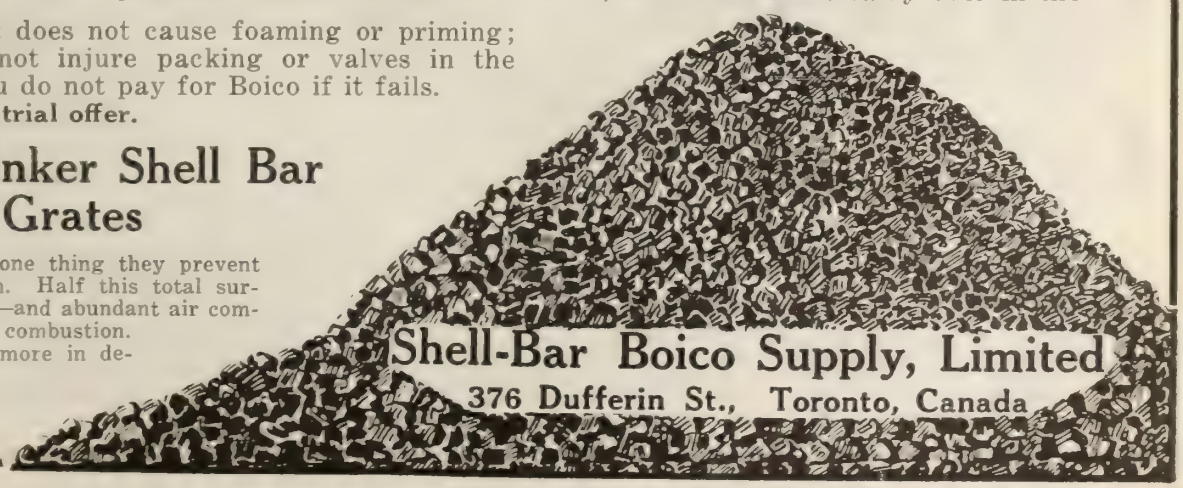
SAVES A PILE OF COAL

It's such a heartless job trying to keep a boiler clean with ordinary compounds that comparatively few are always wholly clean. Consequently a good deal more fuel than need be is burned up on the grates. We claim for Boico that it removes absolutely all scale; that it positively prevents further formation of scale; that it does not carry over in the steam; that it does not cause foaming or priming; that it does not injure packing or valves in the slightest. You do not pay for Boico if it fails.

Write for our trial offer.

Anti-Clinker Shell Bar Grates

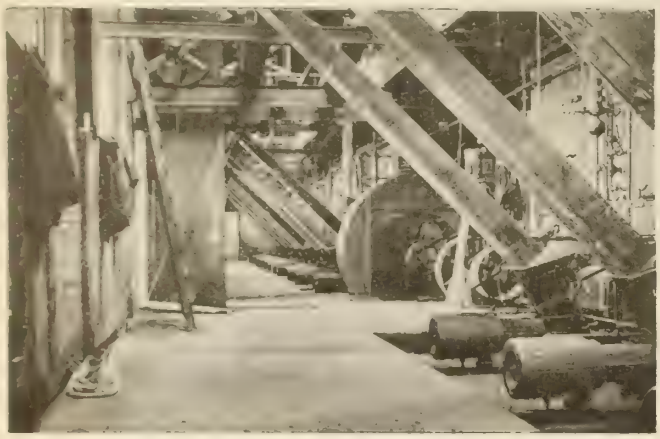
save coal. For one thing they prevent clinker formation. Half this total surface is air space—and abundant air commands perfect combustion.
Let us tell you more in detail.



Shell-Bar Boico Supply, Limited
376 Dufferin St., Toronto, Canada

Steady Steam Pressure Always With 15 to 25% Less Coal

Yes—15 to 25% of your present fuel bill saved! Surely that alone is reason enough for you to discontinue the old, uncertain and ever costly method of stoking. How much better it would be to have a smokeless stack—the fuel gases that go into smoke used to make steam; or, instead of the good intentions of a fireman, to have the scientific exactness of the



JONES UNDERFEED STOKER

It is perfectly automatic—the simplest stoker built. It maintains the steam pressure, **"saves and serves."**

Write us for Catalog.

Jones Underfeed Stoker Company, Limited

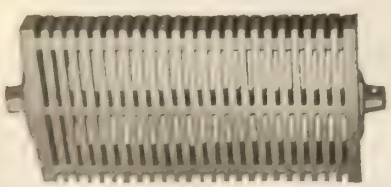
37-41 Britain Street - - TORONTO

Cyclone Grates

To Get All the Energy Out of Low-Grade Coal

To get all the energy out of screenings or the best hard coal you can buy, use Cyclone Shaking and Dumping Grates, because their 60% air space and 90% underdraught insure perfect combustion. No atom of heat energy can escape. No clinker can form. And no good fuel can get into the ash pit. Their new jarring, shaking movement lets the worthless ashes through—but nothing else.

Engineers in the city for Exhibition will be most cordially welcomed at our plant at 20 McGee street, where we would be glad to demonstrate the Improvements in the Cyclone Shaking and Dumping Grate Bar.



The Canadian Steam Boiler Equipment Co., Ltd.

Sole Makers for Canada

20 McGee Street **Phone G. 3660** **Toronto, Ontario**

AGENTS:
ST. JOHN, N.B., F. W. Blizard, 329 Charlotte St.
MONTREAL, Mason Regulator Co., Ltd., St. James St.
HAMILTON, Robt. Fitzsimmons, 8 Grove St.
WINNIPEG, Vulcan Iron Works.

Protects You. Write! Our 30 Days' Trial Offer

THE GALT FOUNDRY CO., LTD.

OFFICE AND WORKS:

GALT, ONTARIO

PRODUCT

THE GALT SPRINKLER STOKER

For smokeless and economical combustion and utilizing low-grade fuels.

The Galt Sprinkler Stoker is a real Coal saver, and can be installed on Power and Heating Boilers, Annealing Furnaces, and in all classes of Installations.

Will burn any kind of fuel from anthracite dust up to 3" lump.

ADVANTAGES

They give complete and smokeless combustion.

They feed the fuel to the furnace with the doors shut.

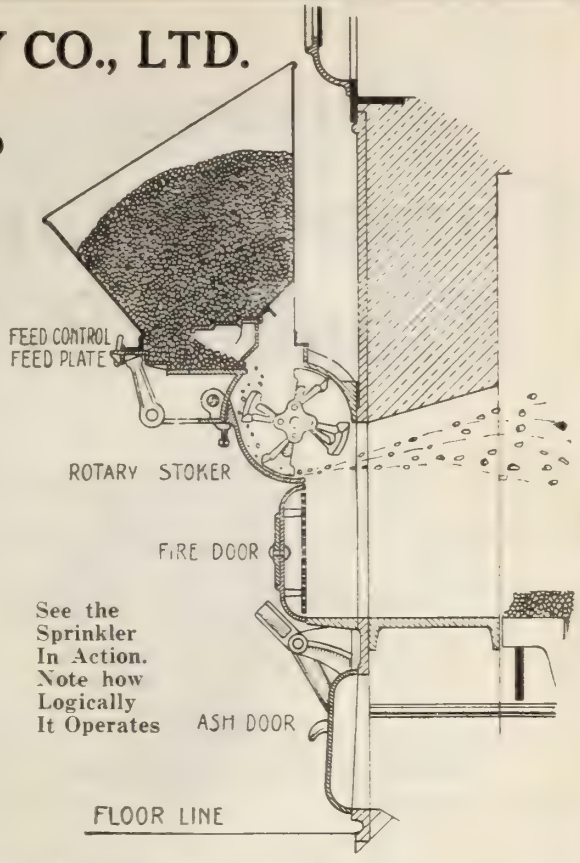
They do not require skilled firemen.

They maitain a brilliantly hot fire.

They are simple, strong, and beautifully made.

The Galt Sprinkler Stoker automatically feeds and uniformly spreads the fuel to the furnace in a light, continuous stream, and gives a perfectly level fire 3 to 4 inches thick.

Send for one of our Combustion Engineers to look over your plant—no obligation.



See the Sprinkler In Action. Note how Logically It Operates

GALT STOKERS BURN CHEAP FUEL AND LESS OF IT

Write for Catalogues and detailed information.

If any advertisement interests you, tear it out now and place with letters to be answered.

Having Commutator Troubles?

The Jordan Commutator Truing Device will true your commutators without a shut-down.

Jordan Bros., Inc.

82 Beekman St. New York City, N.Y.

Canadian Representative :

CANADA SALES CO., 183 Church Street, Toronto, Canada

MASON

Reducing Valves

Pump Regulator
Balanced Valves
Damper Regulators

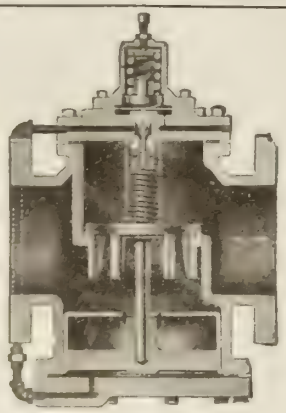
If you order a Mason you will get absolute satisfaction. This we guarantee you. You simply cannot make a mistake.
Dependable regulation under every possible condition.

Our complete catalog tells you WHY. Let us mail you a copy.

Mason Regulator Company

BOSTON, MASS.

TORONTO REPRESENTATIVES:
The Arthur S. Leitch Co.,
506 Kent Bldg., Toronto.



Kieley & Mueller Specialties

Regulating Valves
Back Pressure Valves
Pump Governors
Separators
Traps

FOR EVERY SERVICE

SALES ENGINEERS

THE ARTHUR S. LEITCH CO.

TORONTO

When Buying Thermometers

There's Just Three Things to Remember—

First, you must have accuracy and sensitiveness—

Second, durability is absolutely essential—

Third, the thermometer must be suitably constructed for the intended application.

Accuracy, sensitiveness and durability are absolutely guaranteed in

"Crescent" Thermometers

And with nearly seventy years of experience to our credit, we are qualified to properly interpret your needs.

Our Catalog P.H. 200 illustrates and describes "Crescent" Thermometers for every application. Also test thermometers, glass thermometers, etc.

Get a copy of Catalog P.H.-200 to-day.

The Schaeffer & Budenberg Mfg. Co.

Brooklyn, New York

Chicago
Pittsburg
St. Louis
Philadelphia
Los Angeles

Canadian Agents:

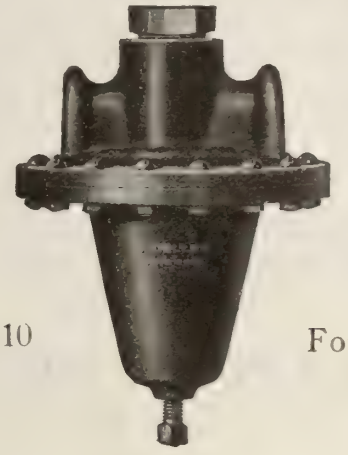
Milton and Prentiss, Toronto.

Power Plant thermometers for all temperatures not exceeding 1000° F

Also—"Columbia" Recording Gauges and Thermometers, Gauges, Gauge Testers, Tachometers, Steam Calorimeters, Counters, etc.

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

MUELLER



E5010 For Water

Reducing and Regulating Valves

Before you install your valve, be absolutely sure on these three points.

1. **The right kind** of valve is the one that is adapted to your particular service. No one type will answer all purposes. Different service and at times different conditions in the same kind of service necessitates different types of valves.

2. **The right size** of valve is the size that will make the proper reduction and regulation and has a wide enough seat opening to prevent obstruction and cutting out of the seat. *A general fault is using a valve that is too large.* Ordinarily they should be smaller than the pipe to which they are attached.

3. **Proper assembling** means that valves should have working parts suitable to service, and diaphragms and springs suitable to pressure range.

Don't guess. Consult us. When valves are installed under MUELLER supervision, we fully warrant them to perform the service for which we recommend them.

We make valves for water, steam, gas, air, oil and ammonia. There is a stock valve in our catalog that will meet your needs. If you have a specially intricate problem to solve, our experts are at your command.

H. MUELLER MFG. CO., LIMITED

SARNIA, CANADA

MUELLER

ALTHOUGH THE PRESENT ATMOSPHERIC CONDITIONS MAY BE TROPICAL, the time is not far distant when the keen east winds will be penetrating the cracks and crevices of your building. When the icicles will be hanging from your windows and you will be at your wit's end for a remedy.

Be prepared for that time by installing NOW the WEBSTER VACUUM SYSTEM OF HEATING.

You will not only secure efficient heating conditions, but in addition you will get MAXIMUM HEAT AT A MINIMUM FUEL COST.

Ask our engineering department to tell you about it. An enquiry places you under no obligation.

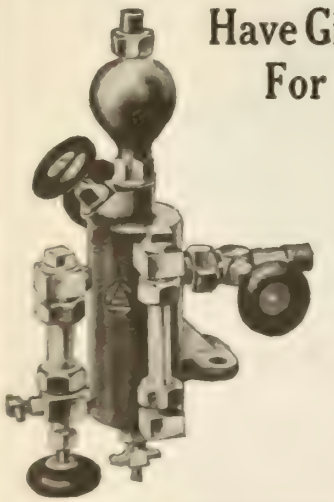
DARLING BROTHERS, LIMITED

120 PRINCE STREET, MONTREAL

VANCOUVER CALGARY WINNIPEG TORONTO HALIFAX

Detroit Lubricators

Have Given Satisfaction For Forty Years.



Built in a sufficient variety of styles to lubricate properly every type of steam engine, pump, gas engine, air compressor, etc.

Send to-day for catalog L 1. The information on lubricating devices contained in it will be valuable to you.

THEIR efficiency holds over half the world's trade.

Makers of Stewart Carburetors.

CANADIAN DETROIT LUBRICATOR COMPANY, LTD.

WALKERVILLE, ONT

There is no doubt **that PROPER lubrication is as necessary as the machine itself.**

If YOU are satisfied that this is a fact, then WE can supply the PROPER lubricator, viz.:

The Rochester Lubricator

Manufactured by

Greene, Tweed & Co., New York

Sole Agents for Canada:

Darling Brothers, Limited

120 Prince Street, Montreal

Conserve Canada's Coal Supply

There is an urgent need of Coal Conservation in Canada. The war has created a demand far in excess of the sources of supply, and next winter may see Canada facing a critical fuel situation. Under these circumstances it becomes the patriotic duty of all users of fuel to conserve Canada's coal piles to the fullest extent of their ability.
There is no surer and more practical method of conserving coal in the power houses of Canada than through the use of—

COPPUS TURBO BLOWERS

They will add from 25 to 100% to the rated capacity of your boilers—and as much as 200% if operated in connection with mechanical stokers. Then, too, you can burn the cheapest fuel you can buy and get maximum results.

If you are not getting an evaporation of from 4 to 6 pounds of water per hour, per square foot of heating surface of your boilers, it means that you are not operating at maximum efficiency and it is both good business and patriotic, under the present demand for coal conservation to remedy the matter at once. And all you need is sufficient draft and a means to control it according to requirements. Right here is where COPPUS TURBO BLOWERS solve the problem. The draft is absolutely under control at all times and in any amount that you may need. Boilers can easily be forced up to 200 per cent. of normal rating. Their steam consumption is very small, only half as much as a number of other makes—and the boiler efficiency is greatly increased. This means fuel conservation and less trouble all round.

There never was a time to practice fuel economy in the power house like the present, and there's no surer and more practical method to this end than through the adoption of Coppus Turbo Blowers.

Write for full details.

Coppus Engineering and Equipment Co.

351 Park Ave., Worcester, Mass.

COPPUS TURBO BLOWERS

If any advertisement interests you, tear it out now and place with letters to be answered.

A National Demand

Urgent appeals for the conservation of food products has greatly increased the demands for

Refrigeration Plants

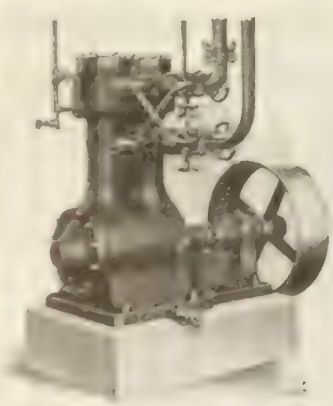
Linde machines show indisputable constructional advantages combining the accepted features of design which are common with certain individual features adding to strength, excess load carrying capacity, operating economy and availability for this particular work.

The Linde Canadian Refrigeration Co., Ltd.

37 St. Peter Street, Montreal

TORONTO WINNIPEG VANCOUVER

Refrigerating and Ice Making Machinery Exclusively



Ice-making and Refrigerating Machinery

Built in any capacity that you desire. HORIZONTAL OR VERTICAL

Our SMALL MACHINES have the same "regularity of Operation," "Reliability" and "Efficiency" as our large ones.

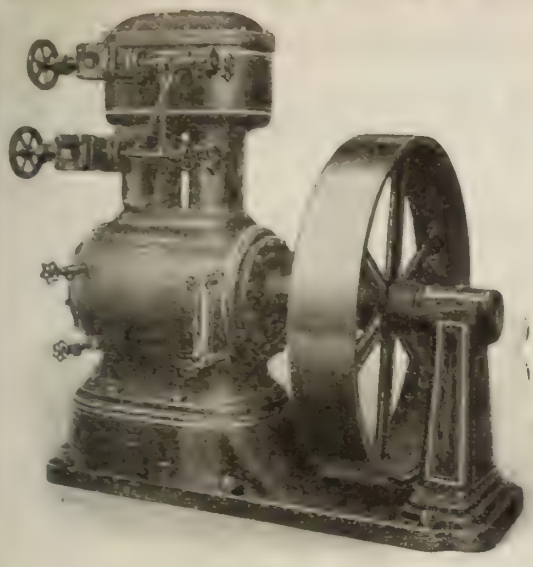
AMMONIA FITTINGS, CONDENSERS, BRINE COOLERS, ETC.

Our Machines are in daily operation in Canada

CORLISS and POPPET VALVE ENGINES

The Vilter Manufacturing Company

242 Beecher St. - - - Milwaukee, Wisconsin



The Details of FRICK Refrigerating Machines

of the above type are illustrated and completely described in "Ice and Frost" No. 3. Specifications of the various sizes are also given for both belt and steam-driven machines. Frick machines are very efficient, of A1 workmanship and material and exceedingly durable.

All Frick Machinery is guaranteed—Quality and Service are embodied in all equipment.

Ask for a copy of our list of users covering 48 pages of satisfied customers—also your copy of "Ice and Frost."

Frick Company
WAYNESBORO, PA. U.S.A.
ICE MACHINERY SUPERIOR SINCE 1882

Canadian Representatives:
FRICK ICE & REFRIGERATING COMPANY
Montreal, Canada

There is a FRICK Machine for every refrigerating purpose—all types—Vertical — Horizontal — Absorption.

Conserve Meat—Eat More Fish

And now the fish industry has come into its own. But without artificial refrigeration, only a few persons could comply with this request.

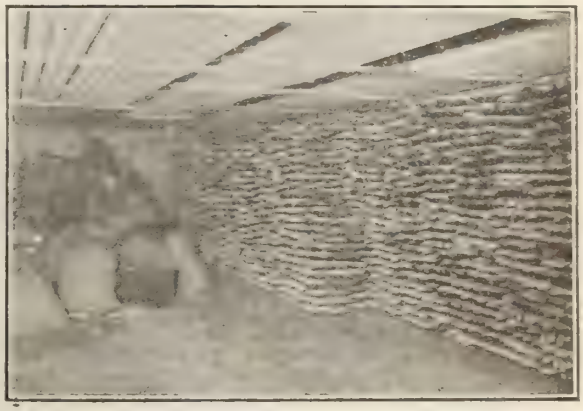
The proper preservation of fish requires constant low temperatures, but to maintain them economically, heat leakage through the walls, floors and ceilings must be reduced to a minimum. Here, therefore, as in all other cold storage rooms, proper insulation is of vital importance. Hence the most up-to-date fish freezing and storage plants, as well as a score of other industries, are using

Nonpareil Corkboard Insulation

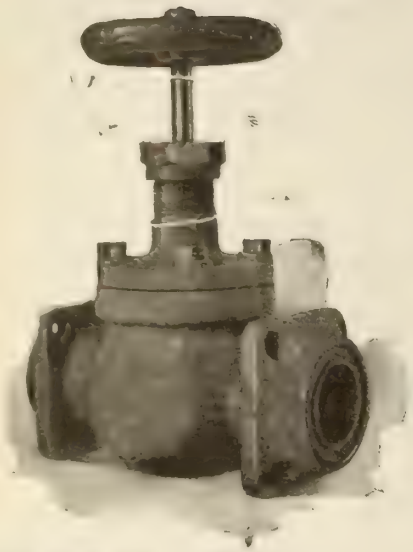
For Cold Storage Rooms and Freezers

Armstrong Cork & Insulation Company, Ltd., 504 McGill Bldg.
Toronto, Ontario, Canada

Also Manufacturers of Nonpareil Cork Covering for Brine, Ammonia and Ice Water lines



Fish storage room thoroughly insulated with Nonpareil Corkboard. Cape Cod Cold Storage Co., Provincetown, Mass.



York Ammonia Valves and Fittings

assist materially in the conservation of ammonia.

Dependable Ammonia Valves and Fittings are of vital importance in every Refrigerating and Ice-Making Plant to-day.

YORK Ammonia Valves and Fittings are correctly designed, made under ideal conditions, subjected to an air test under water, and guaranteed tight under all usual working pressures.

A trial order will convince you of the superiority of YORK Valves and Fittings.

Stocks are carried by our Canadian Representatives at all times. For prices and any other information pertaining to YORK Quality Products, write

CANADIAN ICE MACHINE COMPANY

TORONTO, 82 Chestnut St. MONTREAL, 626 Coristine Bldg.
WINNIPEG, 85 Lombard St.

YORK MANUFACTURING CO., YORK, P.A., U.S.A.
Ice-Making and Refrigerating Machinery Exclusively

DAVIS

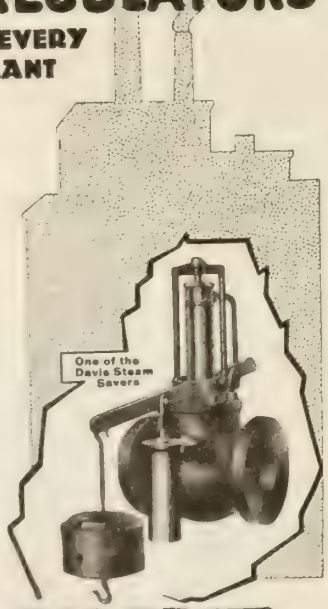
PRESSURE REGULATORS

CAN SAVE STEAM IN EVERY PLANT—IN YOUR PLANT

In big power plants and in little plants, correct steam pressure for the various uses is essential to economical operation. The Davis Pressure Regulator saves steam by reducing the generated high pressure to the lower pressures as needed.

The desired pressure is obtained by adjusting the number of weights on the lever arm. The pressure is *weighed*, because the Davis Pressure Regulator is built like a pair of balance scales—just as simple and just as accurate. As simple and unfailing as the law of gravity, because it is controlled by gravity. There are no springs; no diaphgram to give trouble.

The new valve booklet contains some mighty useful information about valves and piping and will be sent free on request to the G. M. Davis Regulator Co., 144 Milwaukee Avenue, Chicago



DAVIS VALVE
STEAM SAVERS SINCE 1875
SPECIALTIES

D

VIGILANT

Feed Water Regulator

It gives you 100% protection from high and low water accidents year after year.

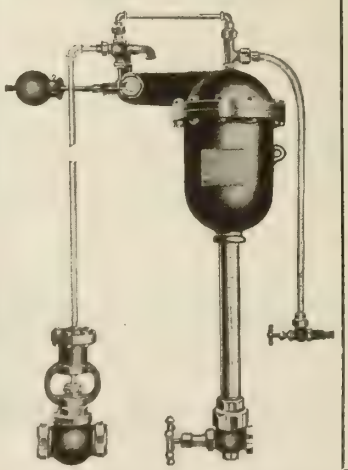
It saves you 3 to 17% on fuel at the same time.

It keeps the water within ¼" of middle gauge. Firing or load variations make no difference to it.

It is used in the plants of nearly every iron and steel producer in the United States. Nothing better can be found—or need be.

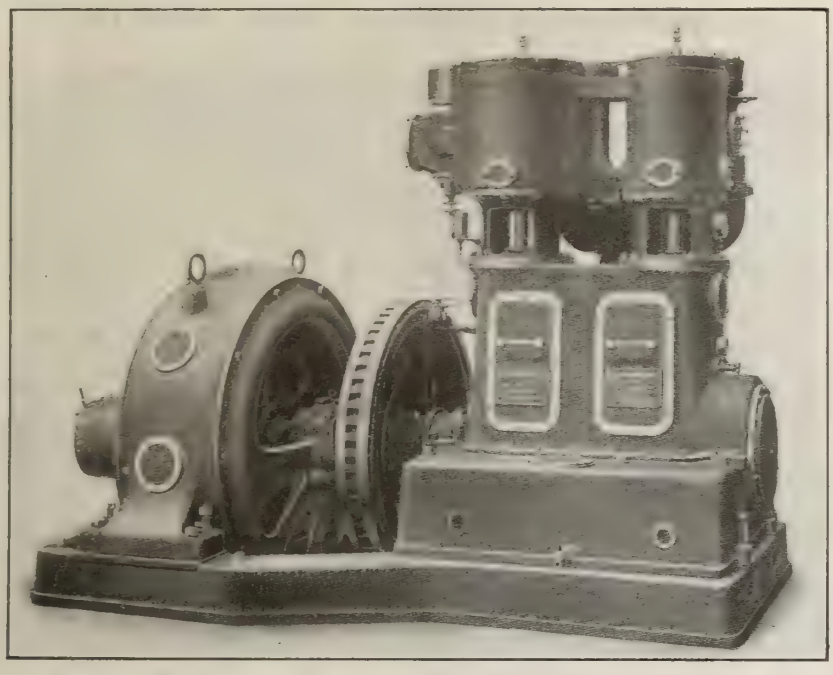
No floats or anything else to get out of order.

Catalog for the asking.



The Chaplin-Fulton Manufacturing Company
128 Penn Avenue : : Pittsburgh, Pa.

BELLISS & MORCOM, LTD.
Engines and Air Compressors



Belliss & Morcom Motor-Driven Air Compressor.

Belliss Steam Engines, Steam Turbines, Diesel Engines,
Air Compressors, Condensing Plants

Heenan Refuse Destructors, Air Coolers, Water Coolers,
Oil Coolers, Dynamometers

Paterson Water Softening Plants and Filters

Centrifugal Pumps

We can make good delivery for War Service.

LAURIE & LAMB

Engineers

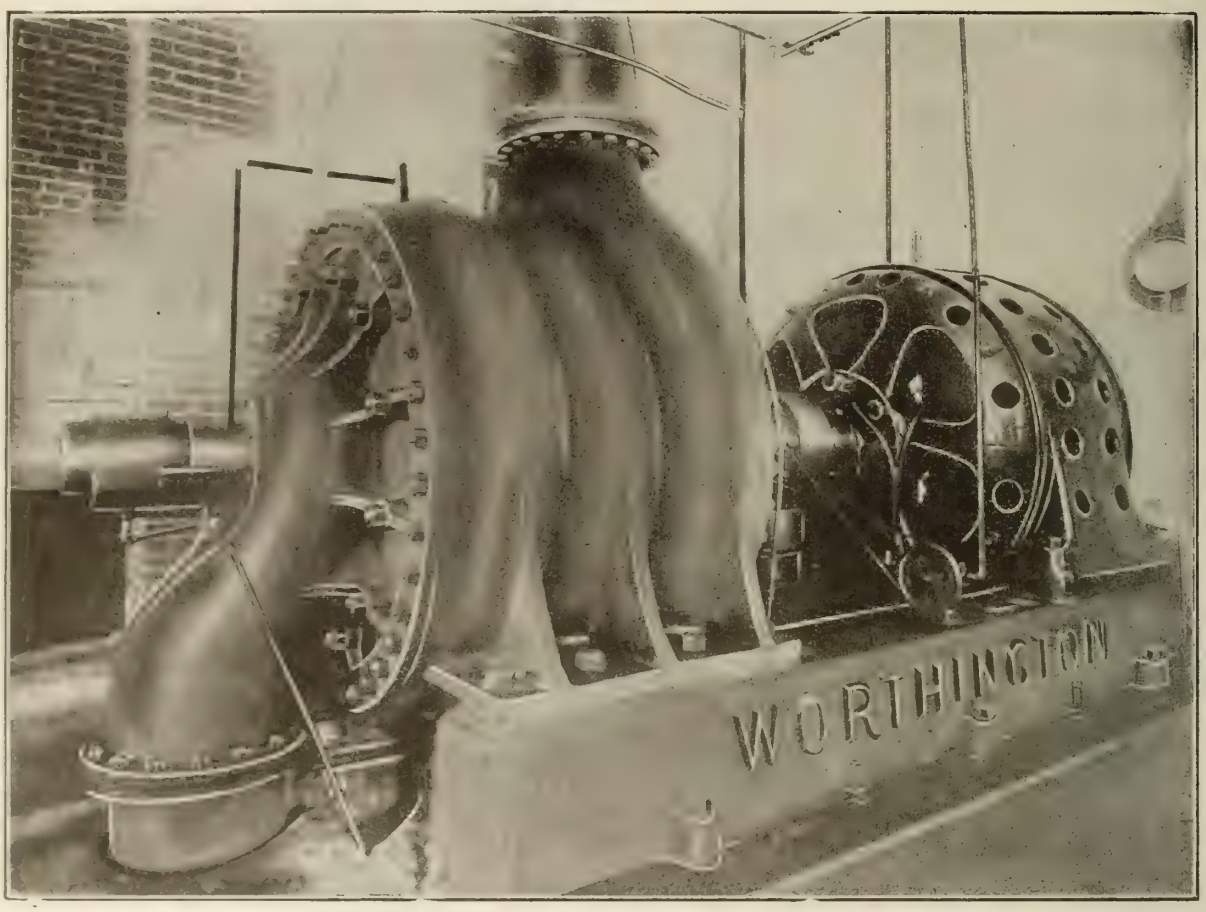
211 Board of Trade Bldg. - - MONTREAL

If any advertisement interests you, tear it out now and place with letters to be answered.

THE JOHN McDOUGALL CALEDONIAN IRON WORKS CO., Limited

Manufacturers of Boilers, Castings, Condensers, Elevators, Engines, Filters, Forgings, Hydraulic Machinery, Pumps — centrifugal and reciprocating, Steam Turbines, Tanks, Water Wheels, Water Works Plants

Works : Seigneurs and William Streets, MONTREAL



5,000,000 gallons daily—Montreal Water Works—Driven by 400 H.P. Induction Motor.

Our Engineers have spent many years developing Centrifugal Pumps and we are now able to offer you perfected designs in any size pump from inch and a half and up for any service you may desire, and to be driven either with motor, engine or belt.

Write us for Engineering information, or prices, any time.

Sole Canadian Agents for H. R. Worthington Co.

Keeping in Stock at Montreal a large assortment of their Boiler, Feed and General Service Pumps

The Publisher's Page

TORONTO AUGUST, 1918

Selling the Buyer

BEFORE you make a sale it is only reasonable to assume that the buyer must be made familiar with the article or appliance you wish to sell. More than that, he will likely demand to know who you are, where you are, and all about you, or sufficient about you to enable him to determine what you have in the way of reputation to back the goods you have for sale.

THE process of making an actual buyer out of a prospect consists primarily in educating him. Education in all branches of endeavor is best accomplished by means of the *printed word*. It is not only the most effective medium, but it is the most *economic*. It not only accomplishes what it is intended to do, but it does it with the least possible expense.

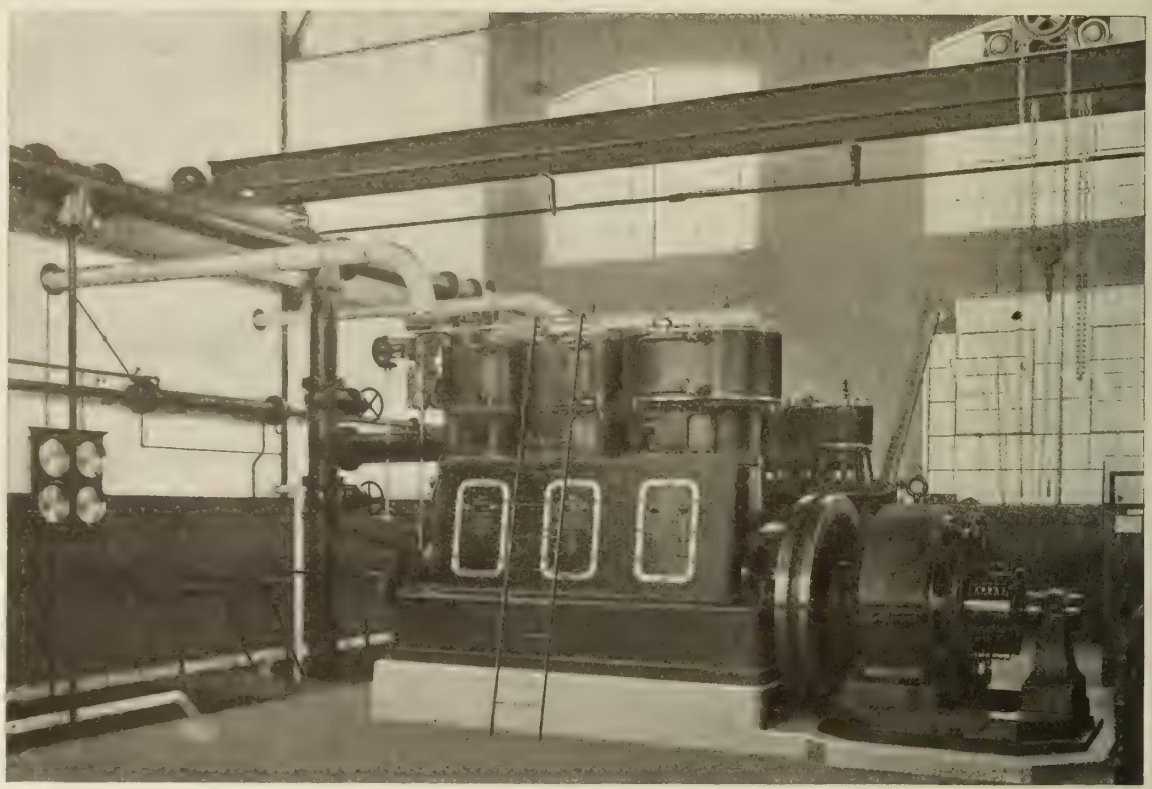
IN every branch of commercial and industrial life we have to-day the *technical* or trade journals. Only the unthinking underestimate the power of those educative mediums. Their rapid growth and increasing circulation alone are convincing evidence of their usefulness. They are specialists in their respective fields of endeavor.

They are the great disseminators of practical information and trade news. Their clientele is made up of sober, thinking, ambitious, responsible mechanics and business men. The idly curious and irresponsible do not read them.

IT is because the technical journal is educational in character that so many manufacturers recognize in it the ideal medium for *educating* their army of probable buyers and customers to understand and appreciate the merits of their respective lines. It is because of this recognition and as a result of it that the advertisements of to-day are so vastly superior to the advertising of a few years ago, when, perhaps, the pulling power and value of the printed word was not so generally appreciated.

POWER EQUIPMENT

Built to Meet Your Own Requirements



A corner in the Engine Room of our New Power Plant recently erected at our Main South Works. Equipped with G. & McC. Co. Three-Cylinder Compound and Two-Cylinder Compound Vertical Forced Lubrication Steam Engines.

G. & McC. CO. ENGINES and BOILERS

will provide your plant with

A Continuous and Economical Service

WE BUILD

Horizontal and Vertical Steam Engines; Steam Turbines; Return Tubular and Water Tube Boilers; Heaters; Tanks; Pumps and Condensers; Transmission Machinery; Safes, Vaults and Vault Doors.

The advice of our Engineering Experts, our Catalogues, Specifications, Photographs, etc., will be cheerfully supplied to interested parties.

The GOLDIE & McCULLOCH CO., Limited

Head Office and Works: GALT, Ontario, Canada

TORONTO OFFICE:	WESTERN BRANCH:	QUEBEC AGENTS:	BRITISH COLUMBIA AGENTS:
Suite 1101-2,	248 McDermott Ave.,	Ross & Greig, 412 St. James St.	Robt. Hamilton & Co.,
Traders Bank Bldg.	Winnipeg, Man.	Montreal, Que.	Vancouver, B.C

POWER HOUSE

European Practice in the Design of Induced Draft Plants

Mechanical Draft Has Several Advantages Over Natural Draft —Induction Method Gives Excellent Results in Practice and Has Been Found to Give Considerable Saving in First Cost and Maintenance Expense

By FRANK C. PERKINS

THE general construction and details of mechanical draft for furnaces may be noted in the accompanying illustrations and drawings as designed by Engineer Louis Prat, of Paris, who points out that the problem is to put in contact with a given weight of fuel a definite quantity of air, so that combustion will be as perfect as possible.

The ideal draft is that which permits of a constant relation between the weight of fuel and air at all rates of combustion. The brick chimney fails completely in this duty and in addition presents the serious inconveniences of great irregularity of the draft, which varies with the temperature of the gases, condition of the atmosphere and extremely low efficiency. Calculations show that this does not reach one per cent even when compared with an average power plant and allowing for the loss of heat inevitable in a boiler plant.

It is maintained that the useful power is very low with brick chimneys in consequence of the shape of the draft necessary for the requirements of stability, instead of the conical bell-mouth shape evase chimney, called for by the laws governing the escape of gases.

There is also an enormous bulk and weight for the small draft created. This means high price for the chimney alone, and it is frequently doubled when the cost of foundations are included. It is held that the capital cost in works operating on chimney draft is always much greater than in the case of mechanical draft and it must not be overlooked that the more economically a boiler plant works the more pronounced are the inconveniences of the chimney, since the better the utilization of the heat the lower the chimney temperature and consequently the draft.

In a well managed boiler house it is possible to have an economiser outlet temperature of about 300 degrees Fah., say an average chimney temperature of 260 degrees Fah. To produce a draft of 1.2 in water gauge under these conditions would call for a chimney 300 feet high, assuming the air temperature at 60 degrees Fah. But as a well designed plant should work equally well in summer and winter, if the low temperature is assumed, it would be necessary to have a chimney over 400 feet high. These heights are for the theoretical or calculated draft, the actual draft might be reduced by anything up to 20 per cent. In a word, the chimney is the result of custom, force of habit, and is primitive.

Natural draft by fires has been long abandoned in many mines, although in their case the pit shafts form suitable chimneys, because it has been shown that the chimney method takes from 50 to 60 times more power than a properly designed fan installation.

The fallacy of steam jets is pointed out as the efficiency of steam jets is, like the chimney, also low. Without going into the complex theory of injectors it is an easy matter to verify their high steam consumption. It is proved by tests that an excellent steam jet installation never takes less than 4 per cent of the total steam evaporated by the boiler, but in actual practice that figure is generally at least doubled, and examples up to 15 per cent. are not unknown.

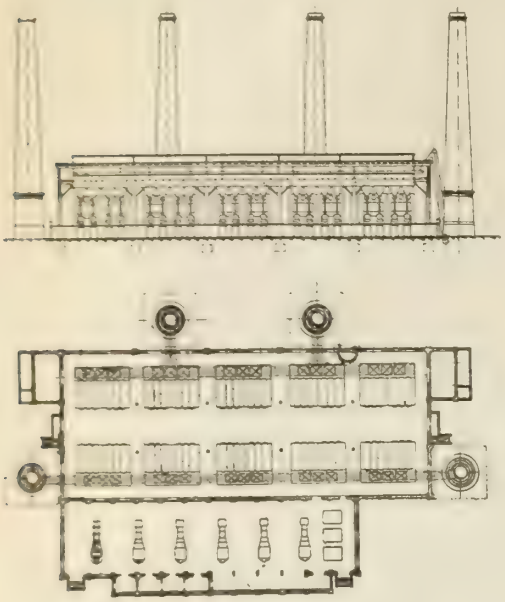
In comparing the energy in the steam used, to the useful work of supplying air, represented by the product of the pressure at the ash-pit and the volume of air supplied, the efficiency is found to be always less than 1 per cent. This low efficiency, due to the incorrect use of the expansion of the steam is aggravated by general misuse in practice. One can easily see that it is uneconomical to pass the large amount of air necessary for combustion through a bottle necked restriction where it attains enormous speeds and an instant afterwards, allow it to expand in an ashpit of large cross section. The best illustration of this is the necessity for open ashpits when the jets are stopped, i.e. when an attempt is made to work on chimney draft. The thin or blow pipe flames, the fire burning in holes, the depositing of coal dust on the boiler tubes and the increasing the difficulties of cleaning are all practical inconveniences well known to users of steam jets for draft productions.

A comparison of various systems of mechanical draft will be of interest, sho...

4,000 H.P. INDUCED DRAFT PLANT OF THE SECTEUR ELECTRIQUE DE CHAMPS ELYSEES A PARIS.

ing the only logical solution of the draft problem is the fan. A fan can be used in several different ways. Forced draft and suction draft or by aspiration and also mixed draft or by variable blowing as well as the system of induction are all used.

It is a mistake to confuse suction draft with induced draft. This system works by induction and the fan plays only a minor part in the aspiration of the flue gases. To compare clearly the respective qualities and limitations of various draft systems take a boiler with one air passage. The pressure in this passage varies at different points. At the point where it is equal to the pressure of the atmosphere it is the custom to call it [illegible].



TRIESTE MUNICIPAL POWER STATION IN AUSTRIA, DESIGNED FOR NATURAL DRAFT.

Mechanical draft, giving practically unlimited suction at the chimney, is alone able to satisfy, without limitation, any rate of combustion and evaporation, the demand whatever it might be. But here a practical and fundamental distinction must be made between the ordinary mechanical suction draft and induced draft. It is that of the motive power absorbed and the size of the apparatus. In the direct suction draft the damper must always be closed, if not the fan works in short circuit, without useful effect. It is necessary then to pass the whole volume of flue gas through the fan, resulting in a fan of enormous size. If, in order to reduce the capital cost, a smaller fan is installed, as is sometimes done in practice, the resistance to the flow of gas is increased considerably. Not only is the benefit of the natural draft lost, but the total resistance of the circuit is increased in such a way that finally the work on the fan is augmented considerably, both on account of the supplementary resistance due to its presence and to the fact that it works on too large an orifice.

In the induced draft system the difference is fundamental. The damper, which might well be omitted, is always open, the chimney is freely divergent, and the resistance of the circuit having been practically unchanged, the benefit of the natural draft is retained. In addition a very small fraction only of the total gas passes through the fan, which transfers to it a pressure sufficient for the draft requirements, a double reason for not using cumbersome fans. The pressure generated is utilised after the manner of a propelling jet in an injector, to create the complement of draft necessary for the flow of gas, hence the name pressure transformer given to this type of chimney.

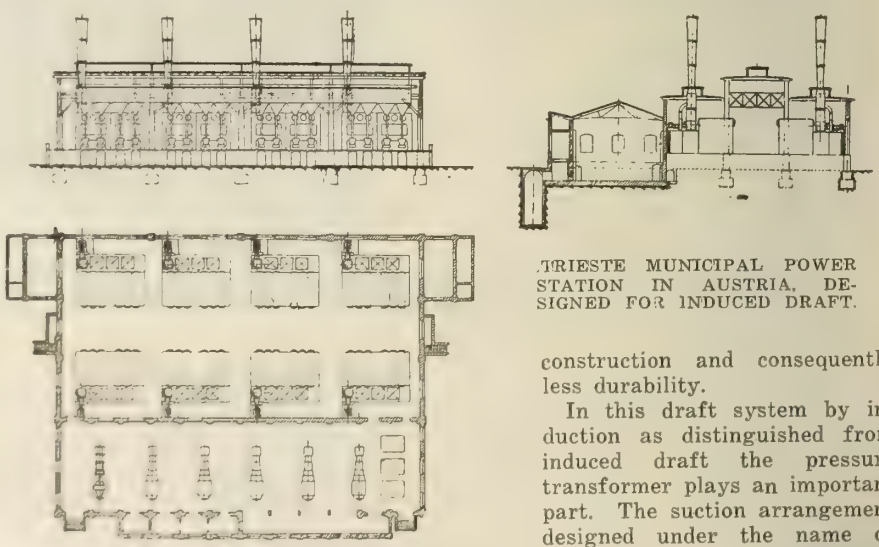
The power necessary consists of nothing more than that necessary to accelerate the natural draft, autovariable between certain limits and the fan, working on a reduced orifice, can be designed to give the maximum efficiency. Then, extremely small power, small size and simplicity of installation, these are the practical characteristics of this system of draft by induction.

It may be of interest to consider the limitations of forced draft systems. The systems called compensated, balanced and proportional are in fact, forced draft systems offering in consequence the criticisms well known to which must be added the necessity of an automatic regulator controlling the damper. These systems all aim at the same object, i.e., to maintain automatically in the furnace a pressure equal to that of the atmosphere.

It is said that in this way air infiltration is reduced but only within small limits, because from the furnace, which is usually slightly below zero pressure, the suction or draft increases up to the damper. The more volatile the coal, the less is it possible to obtain zero pressure in the furnace owing to the back-draft and the liability of explosions. This simple and doubtful advantage of reducing infiltration of which one should not overestimate the importance, with boiler settings and flues as normally maintained, is sometimes obtained at the price of complications to be avoided in practice, on one side an automatic regulator controlling the speed of the fan, on the other an automatic damper regulator, parts undesirable for ordinary boiler-house use.

Induced draft avoids the very serious inconveniences inherent in the forced or balanced systems where air is supplied under pressure, below the grates. The installation is simple, the excavation and flues are avoided, the loss of pressure due to bends is less, the burning of fire-bars and the blow-pipe flames are suppressed, but as pointed out, the method is conducive to abnormally large fans. For example in order to burn 3,500 lbs of coal per hour, it is calculated that a fan having an impeller over 6 ft. diameter would be required; large enough to ventilate an important mine.

In order to overcome this difficulty one is tempted to use a fan too small for the orifice on which it has to work. In order to reduce the dimensions and consequently the selling price, it is not unusual to install fans running at excessive speeds and low manometric efficiency. These are points to be considered seriously and further economy on weight means lighter construction and consequently less durability.



TRIESTE MUNICIPAL POWER STATION IN AUSTRIA, DESIGNED FOR INDUCED DRAFT.

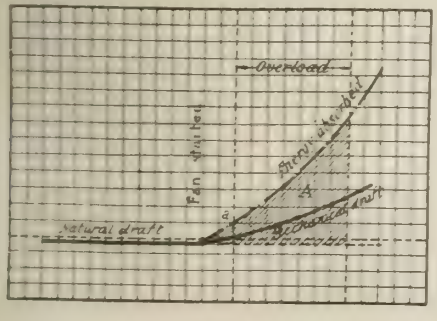
In this draft system by induction as distinguished from induced draft the pressure transformer plays an important part. The suction arrangement designed under the name of pressure transformer comprises essentially a steel chimney comparable to an injector. The suction inducing the flow of gas is created by leading into the contraction chamber the propelling jet of gas discharged from the fan through the nozzle. In the event of stoppage of the fan, the effect is produced by a

3,000 K.W. INDUCED DRAFT INSTALLATION OF THE CENTRALE DE ROME, ITALY.

steam ejector which acts as a standby. The whole forms a substantial apparatus wholly constructed of heavy boiler work, without a moving part. The propelling jet can be either atmospheric air or hot gases from the flue.

In the one arrangement, called out of circuit, the fan is completely out of contact with the gas, and consequently is in the best position for preservation. However, the addition of cold air lowers the temperature of the gas and the useful effect of the natural draft is reduced in the proportion of cooling. Another arrangement called in circuit: the fan deals with hot gas as in the case of ordinary suction draft, but the injection of cold air is obviated, and consequently the power necessary becomes extremely small.

It is pointed out that there is sometimes found a general prejudice against the steel chimney, which is said to have a very limited life. It is well to remember that this criticism is only correct in



CHARACTERISTICS OF MECHAICAL DRAFT SYSTEMS.

cases where thin steel plates are used. It is necessary before everything to ensure constant operation and plates of ample thickness should always be employed.

There are many installations which have been at work for fifteen years without stoppage or repairs and when properly constructed there is no reason why steel chimneys should not have very long lives. There are cases in England and America where such have been in constant use for forty years or more.

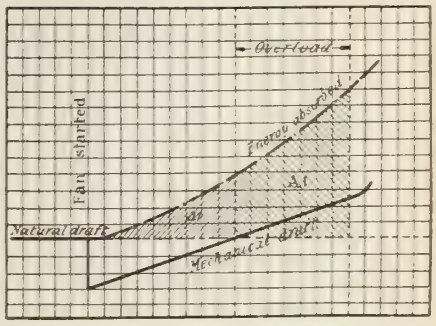
The construction of the fan with one opening is largely used and it is said the mechanical efficiency never falls below 60 per cent and the manometric efficiency is almost always equal to unity. This explains their ability to run at much lower speeds than usually met with in current practice. In the fans dealing with the flue gases directly the external blades produce scouring air currents which thoroughly cool the pedestal and bearing. This is a distinct advantage over the usual method of water cooled bearings, as it is simple, absolutely automatic, and requires neither attention nor upkeep. The bearings, which are easily dismantled, are of the flexible type fitted with oil ring lubrication and have a length equal to four times the diameter of the shaft.

In the past, mechanical draft has been frequently criticised on the ground of less security from stoppage than that given by a chimney. It has been the experience of some users that for one reason or another, probably carelessness or accident, the fan had stopped, causing great inconvenience owing to the fall in draft. With the ordinary suction draft arrangement the only remedy is a second fan as a reserve. This means considerable increase in first cost and additional space. In this system the reserve fan is superseded by a steam jet. Unlike the injectors used for forcing air under the grate bars, it is possible to so design the diffusers that the steam is properly utilized and the reserve draft is thus obtained without excessive steam consumption. Moreover this steam injector might in case of necessity, work simultaneously with the fan. In this way it would be possible to double the draft, which might prove a great convenience, say at a time when there was an abnormal demand for steam, or in the case of a temporary shut-down of one boiler in a battery.

The characteristic features of this draft plan are of interest. A most important feature of this induced system of Louis Prat is its ability to use the greatest possible part of the natural draft due to the hot gases in the chimney. This is owing to the fact that the pressure transformer adds little or nothing to the resistance of the circuit, whilst a fan, dealing with all the flue gas, causes extra resistance almost always greater in amount than the natural draft previously available.

In the induced draft the damper is kept fully open and the only resistence, infinitesimal, is that represented by the reduced section of the aspiring chamber. The result is that the natural draft is utilized almost entirely and the energy wasted, is considerably less than with ordinary suction draft.

The advantages of mechanical draft are less disputed as the number of installations increase. Years ago, one



CHARACTERISTICS OF INDUCED DRAFT SYSTEMS.

found only systematic opposition and skepticism, whereas to-day one looks for mechanical draft in most new installations and applies it more and more to existing plants. The graphic representation of the growth of these installations is particularly suggestive and it has been brilliantly crowned by the most important mechanical draft installation in the world, that of the C.P.D.E. (the Paris Electricity Distribution Co.) which has installed the induced draft for boilers equal to 180,000 h.p. capacity.

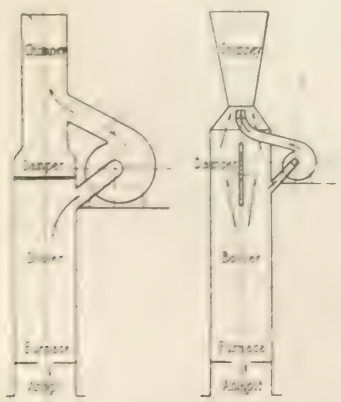
It is urged that the principal advantages include flexibility, thus making it easy to keep up with the demand for steam. Economy is made easy by the great facility with which the air supply is controlled to suit the rate of combustion and nature of fuel, steady draft independent of atmospheric and other changes usually met with in boiler house practice, thus making for efficient operation.

Regarding the steam raising units and the great reduction of capital costs, either when applied to a new installation or to the extension of an existing plant, it is held that this point is of more than passing interest. In consequence of the great elasticity, the ease with which it can be

15,000 H.P. INDUCED DRAFT SYSTEM WITH 5 TUBES AT PLANT OF THE SOCIETE ELECTRIQUE "LE TRIPHASE" AT ASNIERS, FRANCE, ON THE SEINE RIVER.

started up and the ability to force the fires to the utmost limit, it becomes easy to satisfy the variable demands for steam with the minimum number of boilers in operation. This is a matter of great importance, seeing that it reduces the standby plant and the number of banked fires, the effect of the latter, from the point of view of fuel consumption alone, is well known to those familiar with central station practice.

An advantage which must appeal to those responsible for public service supply lighting, traction, or motive power is the increased security in the employment of separate chimneys instead of a single large chimney. In case of accident to a chimney the whole of the boiler plant may have to be shut down and in increasing the number of units this possibility is so much diminished. This idea was first developed in large electric power stations. It is adopted for example at the large three phase power station at Asnieres, near Paris, at the Grand Quevilly Power Station, supplying Rouen, and at those of Trieste, Victoria Falls Power Co., Sampierdarwna, all of which are equipped on the induced steam here considered.



MECHANICAL DRAFT SYSTEMS.

The reduced capital costs are important. This point is clearly explained by the suppression of flues and chimneys, costly in themselves and by the foundations and earthwork which they require. The saving on land and buildings, the space required being less, and the reduction in standby boilers are of equal importance. These different factors play a most important part in new schemes, inasmuch as they make for a great reduction in capital expenditure.

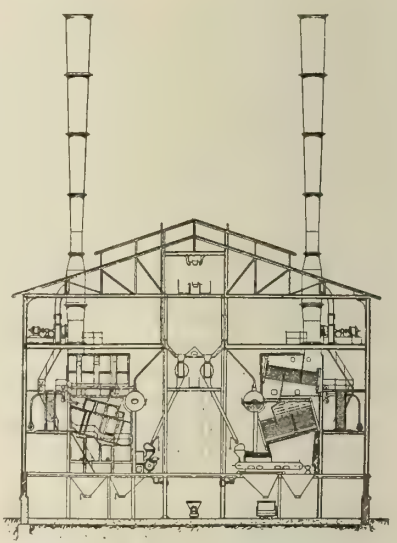
Two schemes were proposed for the Municipal Electricity Station at Trieste, Austria. The first with natural draft, was abandoned in favour of the induced system, which permitted a great reduction in land and buildings as well as in boiler plant and figures were given in support of the above statement. They were prepared for another large station and show a saving of $65,000 on the initial cost and $6,000 on the annual operating expenses. On the strength of this the administration of the Centrale du Grand Quevilly, near Rouen, decided in favour of the induced system.

Regarding the induced system applied to brick chimneys it is pointed out that in many cases when considered for existing installations, it is simply desired to accelerate the natural draft and the pressure transformer is specially suited for such application, as its small size enables it to be placed inside an existing brick chimney. In this arrangement the benefit of the natural draft, due to the height of the chimney, is retained.

The insertion of the turere and blower increases but very slightly the resistance of the circuit, so that the power necessary to produce the acceleration is extremely small. There has been an application of this kind made on a plant of 55,000 h.p. at the Central Power Station at St. Denis, near Paris. Each chimney is 182 feet high, enclosing a presure transformer dealing with the flue gases from six boilers, each having 4,550 sq. ft. heating surface. Before mechanical draft was adopted, the natural draft varied from .6 in. to .88 in. w. g., varying with the seasons, the hourly evaporation of each boiler varied between 16,500 and 17,600 lbs. After the installation of mechanical draft the evaporation could be increased to 31,000 lbs. per hour with a draft of 1.42 in. w. g. at the chimney base. The results obtained at the tests with six boilers at work are of interest.

Rate of combustion per sq. ft. of grate per hour	H.P. absorbed	Power absorbed in per cent. of steam produced
16.1	Natural draft	Nil
20.6	22.2	0.25
22.1	47.9	0.42
24.0	85.5	0.76

It is unnecessary to dwell upon the low motor power required. As to fuel economy it is claimed that the possibility of economic steam raising is another advantage of the induced system. This economy is due not only to the facility with which the draft may be controlled,



INDUCED DRAFT INSTALLATION AT GRAND-QUEVILLY POWER STATION NEAR ROUEN.

thus permitting a proper relation between the weight of fuel and air in order to maintain high CO_2 values in the flue gas at all loads, but to the fact that it makes possible the use of extremely low grade fuel. It is common knowledge that the poorer classes of fuel, slack, dross, screenings, coke waste, etc., have a market value much below that commonly used for steam raising purposes although their actual caloric value may be at least equal to the latter.

It is possible to buy more B. T. U. for a given sum, but this could not be taken advantage of unless the necessary draft could be guaranteed at all times. Small coal, which always calls for strong draft, is dealt with very satisfactorily on this system. Not being limited by insufficient draft, it is possible to reduce the air spaces between the firebars and thus reduce the loss due to unconsumed fuel falling into the ashpit, an important

point when dealing with small fuel.

Again the great increases in furnace temperature, owing to the higher rate of combustion, is in itself favourable to improved combustion and ensures more efficient smoke consumption. The induced system has low power consumption and with the ordinary suction draft arrangement where the fan deals with the whole of the flue gases, the power required is at least 2 per cent of the total steam generated by the boilers and frequently this figure is increased to 3 per cent. With the induced draft and the fan out of circuit, the figure is 0.5 per cent. to 1 per cent and with the fan in circuit 0.3 per cent.

On account of the low power consumption a large electric power station near Paris adapted this induced draft system. The problem to be solved was the following: Given a battery of 10 boilers each of 22,000 lbs. normal evaporation per hr. and working on the same chimney, how to increase the evaporation 50 per cent i. e. to a total 330,000 lbs. per hour.

The simplicity of installation is important as well as the reduced size. Besides the technical and economic qualities, draft by pressure transformation possesses practical advantages which are important in themselves. The great simplicity of fixing, owing to the small size, permits of a solution to the most difficult case where space is valuable or limited.

With forced draft, automatic or not the costs and difficulties of installing are greatest on account of the necessity for flues or ducts from the fan to the ashpit. With the ordinary suction draft these ducts are unnecessary, but the fans, always large for reasons explained, are often difficult to instal and it is necessary to have cumbersome connections from the fan to the flue and chimney.

The great facility with which the induced system lends itself to a good layout is clear apart from the fan, which is certain in action and calls for no attention other than lubrication. the installations have no moving parts, there is no weak link or part likely to get out of order through dirt and dust or inattention of the staff. To those familiar with the rough handling to which boiler-house plant is frequently subjected, the qualities of strength and reliability in operation without undue attention or maintenance are, without doubt amongst the most prized of all the advantages of this system.

The consideration of mechanical draft for kilns is important and there has only been considered the combustion in boiler furnaces but it goes without saying, it applies equally well to furnaces in general. By the employment of a rational method of draft it is possible in most cases to improve considerably the output or useful effect of the plant.

For cement kilns there is considerable increase in production and reduced fuel consumption by using the mechanical draft and in pottery kilns, working on continuous kilns burning ceramic, there is great improvement in temperature regulation and the operation of the kilns is made easier. For melting furnaces there is increased temperature, reduced melting period and considerable increase in production by using the induced draft system as well as for reheating furnaces, such as are used in a large number of iron and steel works.

COTTON CLOTH FOR AIRCRAFT

By M. M.

The cotton trade presents many war features. One of the most interesting —and one that is often overlooked—is the provision of cloth for use in the building of aircraft, more particularly of aeroplanes. In this direction the trade has afforded most valuable help to the Allies. In pre-war days the making of aeroplanes fabrics had secured a solid footing in Lancashire, and the government exercised a wise discretion, soon after hostilities began, in acquiring control of the whole output and preventing leakage to the enemy. But pre-war production was far from sufficient to meet war needs, and in the last two years there has been a considerable development in the making of fabrics that aeroplane building has asked for. More spindles and more looms have been set to work. Some of the best known and the biggest of the fine spinning concerns are wholly devoted to turning out the yarns, which are spun from high-grade Egyptian and from Sea Island cotton. To make this supply of cotton certain was one of the subjects which the government had in view in deciding to take over the whole of the next crop of Egyptian cotton, a step which had received unanimous approval of the trade.

In application of fine and strong textile to the covering of aeroplane wings cotton has been running a sort of race with linen. There is no doubt that the use of linen, in the past at any rate, has presented some advantages over the use of cotton cloth. Linen is stronger, and has a smoother surface. On the other hand it is heavier, usually weighing 4 oz. per yard as against 3¼ oz. in the case of cotton, an important consideration. One objection to cotton has been that the surface being less smooth than that of linen, there is some interference with the proper application of dope. As to the comparative strength of the two fabrics, one would suppose that cotton cloth, which will stand a strain of 1½ tons per square yard, would meet all demands that are ever likely to be made upon it. However there is no finality in sight in the design and manufacture of cotton fabrics. No one feels more strongly than manufacturers that we have not yet sounded the possibilities of cloth. The more the staple is examined and tested scientifically, the more wonderful does it appear, and the more clearly is it recognized, that the end is not yet. So far, the twin sciences of spinning and weaving in practice have kept fairly level with the demands of the public, but further progress will be made, and it is not too much to hope that cotton cloth will be produced which for aircraft purposes will be of unapproachable excellence and suitability.

At the present time experiments are being carried out with the object of eliminating faults and defects, such as they are, and of providing, a fabric which shall fully satisfy the needs of the aircraft industry. Designers of aeroplanes have laid down certain requirements and the cotton trade is endeavouring to meet them. It must be remarked in this connection that, as the aircraft industry has grown, its needs in the way of essential materials have grown with it and have become more exacting. The chief objects now aimed at are still greater strength and durability, and still greater powers of resistance to wind pressure, with an absolutely smooth and even surface that will not be too absorbent of dope. All this has to be accomplished without any sacrifice of lightness, and without any considerable reduction in the element of elasticity. We have every confidence that the response of the cotton trade will be of the most satisfactory character, and that the aeroplane cotton fabrics of the future will be worthy of a great industry which in the past has scored many triumphs.

FLINT AND TINDER AGAIN

The manufacture of tinder-box flints is booming just now owing to the match shortage.

This is probably the oldest handicraft in Britain—older, in fact, it could hardly be, for it forms an industrial link—the only one—with the prehistoric Stone Age.

The centre of the industry is the little village of Brandon, on the borders of Norfolk and Suffolk. The men who pursue it are known locally as flint-knappers, and the work is done in little sheds, often situated at the back of the cottages in which the workers live.

In pre-war days the demand for the flints they produced came chiefly from Spain and Italy, in the rural areas of which countries the old-fashioned flint-and-steel tinder-box has never been wholly supplanted by the modern match. But nowadays practically the entire supply is eagerly snapped up by the makers of those ingenious little mechanical devices for lighting pipes and cigarettes with which the war has rendered us familiar.

It has been found possible mechanically to work tungsten containing a considerable amount of tungsten carbide when the carbide was made separately, powdered, and added to the tungsten powder before pressing. Tungsten ingots containing tungsten carbide made up in this manner may be mechanically worked when the carbon content is far in excess of that necessary to make the tungsten brittle ordinarily. When added in this way the tungsten carbide does not surround the tungsten grains.

Engineer's Life Not a Bed of Roses When Things Go Wrong

Poorly Designed Plant Adds Greatly to the Labors of the Engineer, and is a Source of Constant Worry and Danger in Operation

By S. BALMFIRTH

IT does not often fall to the lot of the man in overalls to have occasion to amend or remodel the work of the consulting engineer but in the writer's case it was necessary to change over much of the plant over which he took charge in October, 1913.

This plant, furnishing the power requirements of a large hospital, had three 200 h.p. B. & W. boilers with chain grate stokers, Blake and Knowles feed pumps, vacuum pumps and bilge pumps in the boiler and pump rooms. Three Goldie-McCulloch vertical high speed engines were directly connected to Swedish General Electric generators of 120, 100 and 25 k.w. capacity, all capable of being operated at 25 per cent. overload. There was also installed a twelve-ton C O 2 refrigerating and ice making plant with refrigerators scattered all over the buildings.

Boiler Room

It will be difficult to describe the plant so as to enable the reader to visualize the conditions that were imposed upon the operating staff. To begin with, the boiler room was only 28 ft. wide, and three B. & W. boilers were placed in that space. This left a passage between the single boiler and the double battery 3 3 ins. wide and a passage 26 ins. wide between the second boiler of the battery and the wall of the building. Of this second passage, half was taken up with steam and other service pipes, so that in passing from the front to the rear of the boilers, one had to turn side-wise and even then, one rubbed his shoulders on the pipes and his nose on the brickwork of the boiler. Those who have had to do with B. & W. chain grate stokers will understand the difficulties attending the care of these stokers. It was not possible to open the side door half way, so that the work of replacing ashplates whilst the boiler was in service was a task to be dreaded.

The heat radiated from the boiler setting was so great, that the cork insulation on the circulation and suction piping of the refrigeration plant (which ran through this passage) actually caught fire on several occasions, and about six or eight feet were burned off. The beams carrying the boiler room ceiling were only eighteen inches above the tops of the boiler drums, so that there was less than three feet of room for men to work in on the boiler tops and the engineers were constantly receiving burns of a more or less serious nature. The constant temperature over the boiler tops varied from 145° to 155° F. If one tried to open a valve on the boiler tops barehanded, he left the skin of his hand on the valve wheel, the writer speaks feelingly on this subject.

To operate the stokers, a 4x5 vertical engine was installed, but when the writer took charge one boiler was under steam and had been for some time and the engine was pounding like a steam hammer and as this engine was the only means of driving the stokers provided, the only way of taking up lost motion on the brasses, or to do anything else was to get up steam, and fill the boiler with water, when the engine might be stopped, and any necessary work done before the steam ran down again (perhaps).

The boiler fronts were about 14 ft. 6 ins. in from the south wall of the boiler room and as the boiler tubes are eighteen feet long it will be seen tha' replacing boiler tubes was an interesting job to say the least. There were windows in the wall, but they were not the full width of the boilers, neiher were they in line with the boilers. Holes have had to be cut in the wall in order to replace tubes.

Pump Room

As shown in the plans, the pump room was directly in front of the boilers under the engine room floor. The ceiling was about eight feet high. As before mentioned this room contained two feed pumps, one vacuum pump, sump tank and pump, and also a Cochrane heater. The feed pumps were placed on the same level as the heater, with the water cylinder heads not more than two feet away from the wall, and when it was necessary to pack the pumps, which was very frequent at first on account of the amount of sand in the water, the man doing the job had to sit on the suction pipe, which ran along the floor between the pumps and the wall, with his neck against the high pressure drip pipe which discharged into the Cochrane heater. As may be imagined there were all kinds of pump troubles, especially at peak load, when the pumps frequently lost water, due to the high temperature of the water and the lack of suction head.

The sump was covered with a cast iron plate which carried a submerged centrifugal pump motor driven. The motor burned out about every two weeks until it finally gave up the ghost entirely. The pump was handling hot water in quantities, the motor was of th enclosed type, with practically no ventilation, standing on a hot plate, in a temperature of 145°.

The vacuum pump discharged into the feed heater and all the exhaust steam went through the heater, so that all the air drawn from the heating system, was mixed with the steam and carried round the building again. This in the writer's opinion was one of most prolific causes of the troubles which cropped up from time to time.

An oil separator was placed in the low pressure main, between the heater and the heating system (to keep the oil out of the heating system, the boilers did not matter).

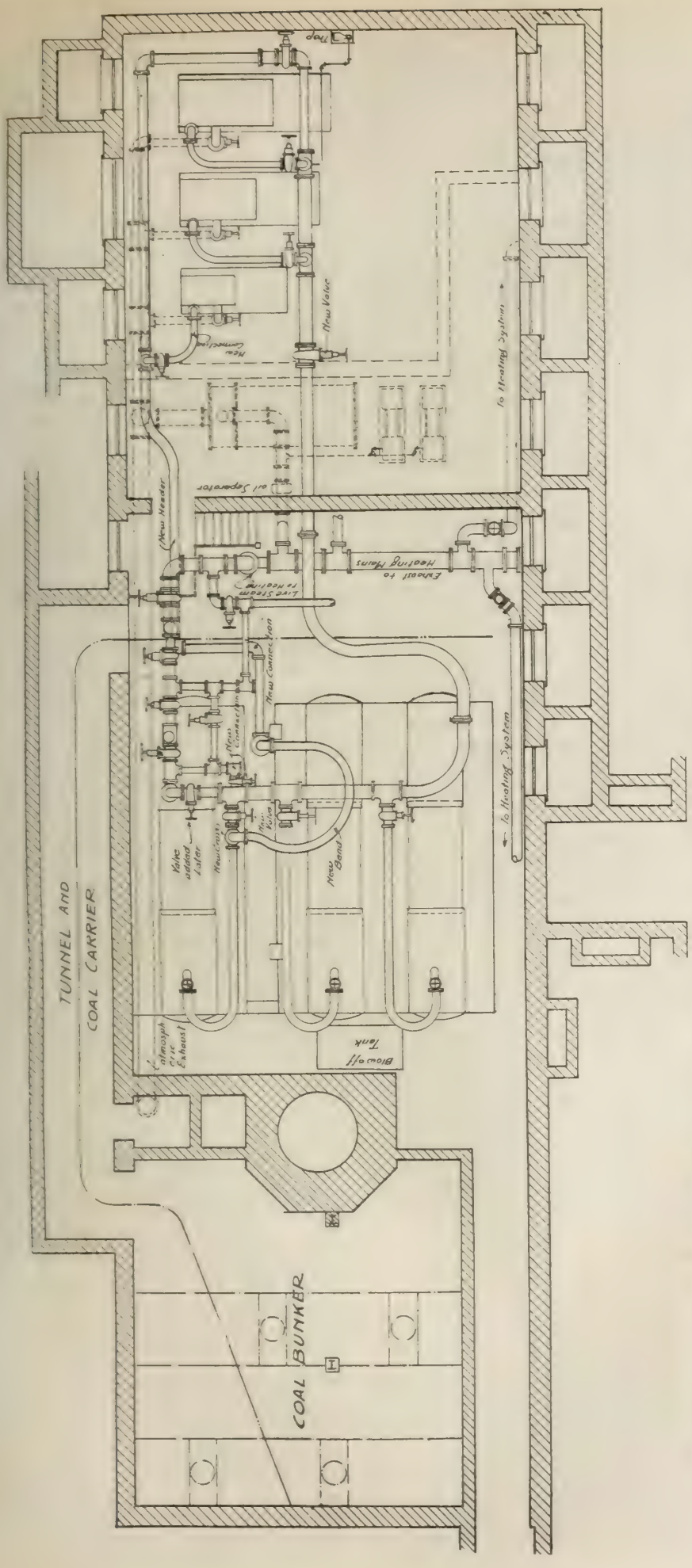
There was an atmospheric vent to the heater, but as the high pressure returns created steam pressure in the heater the vent was useless, as it only allowed steam to blow away as well as air. There was no means of closing off the steam from the heater, except its own interior valves, and as the plans did not include a stop valve in the discharge pipe between the vacuum pump and heater, it was impossible to work on either without a complete shut down, although later a valve was installed on the vacuum pump discharge. The outboard exhaust pipe ran along the top of No. 1 boiler setting and passed over the flue at the rear of the boilers, and was provided with a Swar exhaust head.

The back pressure valve had been installed wrongly and did not seat, but it was impossible to alter it, because there was no means of shutting the steam off from it. It was eventually set right by running the small engine, and opening the heating systems on the three buildings, then breaking a joint and dropping in a blank flange of sheet steel, but the job nearly put three men out of business before it was done with the heat and escaping steam.

Bunker Arrangement

The coal was brought to the boilers in a bucket carried on an I beam, with a one-ton Yale and Towne trolley hoist, from a bunker in the rear of the boiler room. The floor of the bunker was about three feet lower than the passage which connected boiler room and bunker and about four feet below the level of the stoker hoppers. So that the firemen had to jump down about three feet, or if the bunker were full, dig down that distance, and then raise the full bucket which weighed about 1300 lbs. from four to five feet, to be able to push it, and then climb out of the bunker.

The ash handling system as installed was unique. The ashes had to be pulled forward from the back of the ashpit, shovelled out on to the floor, (the pits being about two feet deep), and shovelled into cans. The cans were hoisted up about seven feet on the coal hoist,



LAYOUT OF PLANT SHOWING COAL BUNKERS, BOILER ROOM AND ENGINE ROOM. FEED WATER HEATER AND PUMPS SHOWN DOTTED UNDER ENGINE ROOM.

run on the trolley to the hydraulic lift, rolled on to and then off the lift, at the ground level, and then dumped. In all, the ashes were handled some six or seven times by the firemen, who sometimes would have from twelve to fifteen cans to take out on each shift. Imagine this in zero weather.

The firing floor was ventilated by means of a motor driven supply fan on the roof of the power house. The air was washed by a Carriere air washer. This was one of the best features of the whole installation. There were three ducts supplying the firing floor, each about 24 ins. diameter so that the firing floor itself was fairly cool. There was also an exhaust fan to remove the hot air. The supply ducts in front of the boilers in addition to the other piping took up so much room that although there was a gallery across the boiler-room, between the drums and tube doors, it was impossible to walk upright in it, one had to go on hands and knees.

There was only one steam main, and only a single feed pipe for the three boilers, and not a single valve on the feed line between the boiled feed stop-valve and the discharge valve on the pumps, so that if it were necessary at any time to pack a feed stop-valve, the pump had to be stopped.

High Pressure Piping

Similarly, if any main stop-valve on the boilers were to be packed, all the boilers had to be shut down. There was only one valve on each boiler, and that a gate valve and no non-return valve. It was not thought necessary either to provide any escape pipe for the safety valves, so that every time they blew, the boiler room was filled with steam incidentally making the place hotter.

The steam main to the engines was 8 in. to supply in all 275 H.P. The engines had stop-valves, respectively 3½ in., 3½ in. x 2½ in. so that the pipe was about two sizes too large. It was drained by a 2 in. Bundy trap, discharging to the feed water heater. Every time it discharged, it blew all the water out of the heater up the outboard exhaust, and kept the firemen guessing where the water had gone to. Incidentally it upset the plates which retained the filtering medium, coke, in place, and for a week the writer did nothing but take that pair of pumps apart and put them together again, getting out the coke. The separator drips on the engines, we piped to another two-inch Bundy trap which discharged to the sewer, just why is not known. The oil separator on the exhaust line was dripped to a ¾ in. Bundy lifting trap, needless to say this trap would never work.

There were other things about the plant that were not just according to Hoyle, one of them being that the C O2 compressor was belt-driven from a 20 H.P. motor, set so close to the floor as as to pick up any dirt or anything else, if the belt got the least slack. The reader can see from what has been de-

scribed what the writer had to contend with, and this in a plant in which continuous service is imperative, in which a shut-down without notice might mean the death of a patient.

Anyone can see from this description that serious trouble was inevitable. In In fact trouble did begin in about 18 months. The steam piping began giving trouble by leaking at the threads, both high and low pressure systems being affected. In the writer's opinion this was caused mostly by the air being carried over with the steam, (through the low pressure system especially) and never being got rid of,which corroded the piping, as it is well known that moisture in presence of air, will rust iron more quickly than if entirely submerged.

Alterations.

Things ran on for about two years when the writer obtained permission to install an auxiliary steam main and a duplicate feed line, and drew up plans for the same.

These were submitted to the boiler inspection department and after examination of the same, it was decided by the chief boiler inspector, to inspect the plant, as the department had no records of it. This was done, and the inspector's report was far from complimentary or comforting. The installation of the new lines was sanctioned, including non return valves, if the writer could find room to get them in. However, before the whole of the alteration could be carried out, more trouble developed and the management decided to remodel the whole boiler plant, in accordance with the suggestions of the writer, who was instructed to draw up the necessary plans.

The work to be done was—to build a new fire room to the east of the existing boiler-room to cut the boilers down, turn them at right angles to existing position, lower the whole three boilers five feet, rebuild them, and reconstruct all service mains. These included steam for engines, steam for laundry, cooking, sterilizing; also steam for dairy and operating room use, heating mains, refrigerating pipe lines; also hot and cold water service pipes, and some electric lighting cables.

Whilst this was being done it was necessary to operate the plant to give service twenty-four hours daily. This has been done, although to be exact the last sentence has not been carried out to the letter. In all the interruptions to service have amounted to about 48 hours during the alteration, these suspensions of service having been arranged for so as to cause the least amount of inconvenience.

REGULATIONS FOR DEALERS IN COAL

Regulations regarding the importation, sale and delivery of coal have been issued by the Fuel Controller. Among other things they require that every coal dealer shall post in a prominent place in his office a conspicuous typewritten or printed notice containing a list of prevailing retail prices of all classes and sizes of coal handled by him, including discounts, if any. In calculating overhead charges to determine the price of coal, dealers are required to exercise moderation in the amount they include as their own salaries. In this connection the regulations state, "Salaries and expenses to officers or partners are not to be increased over those prevailing during the year 1914 at a greater rate than salaries in other lines have increased. A dealer may charge his business with his own salary but a reasonable rate only."

Dealers conducting a retail as well as a wholesale business are required to apportion their overhead expenses and fixed charges to each branch, and this apportionment must bear reasonable comparison with the average overhead expenses and fixed charges of dealers who are engaged entirely in retail or entirely in a wholesale business.

A VAST NEW OIL SOURCE

The oil shortage brings into prominence a hitherto neglected source of oil in the form of "oil shale," an organic-matter bearing clay formation, which, when crushed and treated with superheated steam, yields crude oil and sulphate of ammonia. The prospective development of the huge deposits of oil shale is one of the reasons for the oil land leasing bill now before Congress.

Shale occurs in widespread, thin beds which were formerly sea bottom. These beds are deposits of the clayey matter carried by rivers—clayey matter which, being finely broken up, does not sink readily to the bottom, but after being emptied into the ocean is carried by the current and spread over wide areas. One of the characteristic traits of shale formation is that it very readily breaks into thin layers.

Shale is oil yielding, but not oil bearing. Upon treatment with super-heated steam a chemical reaction takes place which yields crude oil. It must be mined like coal, and at about the same price, so that even with an extensive production of oil from shale there will be no great reduction in the price of oil.

Prof. Russell D. George, State geologist of Colorado, recently said that in two counties of Colorado there was enough shale to make "ten times as much oil as has been produced in the United States since the discovery of oil in 1859."

OILS AND THEIR USES

By M. M.

EVERYONE knows scomething about the usefulness of oils in the workshop, but there are a great many who employ them indiscriminately, thereby making more or less serious mistakes. A little general understanding and commonsense is necessary, and also a little discernment as to the nature of the oils which are useful in everyday use. A very common mistake is to oil a sewing machine, bicycle, pram or clock with any kind of oil which happens to be handy. Frequently these are oiled too often and yet again they are oiled too seldom, being left till they squeak. Then they are given too much oil, often of the wrong sort, and then there is more trouble. The right oil to use for a clock, no matter what sort it is, is clock oil, which is a clean, thin lubricating oil that does not dry or get sticky. It is also suitable for any light machinery. The least possible touch of oil on the working parts only of clocks will suffice, and as the movements are slow, they do not need it often. Now if this oil were used for sewing machines and the like, they would require it too often, so a machine oil with more body is best used very lightly, but as frequently as may be needed to keep all the parts slightly greased. Fast-running machinery requires oiling the oftenest. Whereas once a year might do for a clock, once a day would be necessary for a machine in constant use. And the heavier the machinery the heavier the oil should be; engine oil is really heavy machine oil.

Linseed oil, in appearance, might seem to be a good lubricant; but it is altogether unsuitable. It dries like a hard varnish, and, of course, would clog any machinery almost as badly as varnish would, except that it hardens slowly. If a piece of rag that has been used in apers oil, and another wet with linseed oil, be left exposed to dry air for a considerable time, the former will be still the same, but the latter will have become stiff and heavy. For this reason it is quite unfit for using on hones and whetstones when sharpening tools, for it makes them hard and useless, but it is always around woodworking shops, and thus many workmen have spoilt their stones before finding the reason out. If used for oiling the bright blades of saws or other tools, it makes them brown and varnishy. But linseed oil is the very best for rubbing into the wood parts of tools to keep them clean, and it imparts a hard, finished surface. For woodworking and polishing it is invaluable; also, in the manufacture of varnishes, oilcloths and imitation leathers. Boiled linseed oil is the only kind for mixing paint; or it would never dry. It is also essential for making putty; the best is made from raw linseed oil and whiting. Very often cotton-seed oil is used as a substitute for linseed oil but is a very poor substitute. Linseed oil is useful for domestic purposes in reviving varnished furniture and leather goods. It is sometimes employed for machine belting, but castor oil is considered best for the purpose, also for the leather of bellows and such like articles, where suppleness and durability are required. As it is expensive, however, palm oil makes a good substitute.

Petroleum or paraffin, besides being the recognized burning oil for lighting and heating purposes, is excellent and cheap for cleaning the working parts of machinery before lubricating. It is good for thinning down machine oil before lubricating and makes a capital lubricant for locks and light machinery, if a little sperm oil is added.

Power Plant Management and the Selection of Coal

The Proper Selection of Coal Suitable For the Conditions Under Which it is Burned is Essential in the Economical Operation of the Power Plant—The Present Article, the Second of a Series, Deals With This Phase of Power Plant Operation

By ROBERT JUNE

POWER will win the war. Coal is the source of power. Every cartridge, every rifle, shell, field-gun, motor truck, aeroplane, merchant vessel, destroyer, and dreadnought, requires a given quantity of coal for its production. Our available supplies of coal are definitely limited by mining and transportation conditions. If we waste coal at any point where it can be saved, our effective power on the battlefield is inevitably lessened. Probably no single factor in the operation of an existing power plant, or the design of a proposed plant, offers such opportunities to effect economies as does the proper selection of coal—the adoption of the right fuel to the right equipment.

Classification of Coals

Ninety-five per cent. of the coal used in steam production falls in one of the four following classifications:—

Anthacite Coal consists almost entirely of carbon and inorganic matter; it contains little, if any, hydrocarbon. Some varieties approach graphite in their characteristics and are burned with difficulty, unless mixed with other coals.

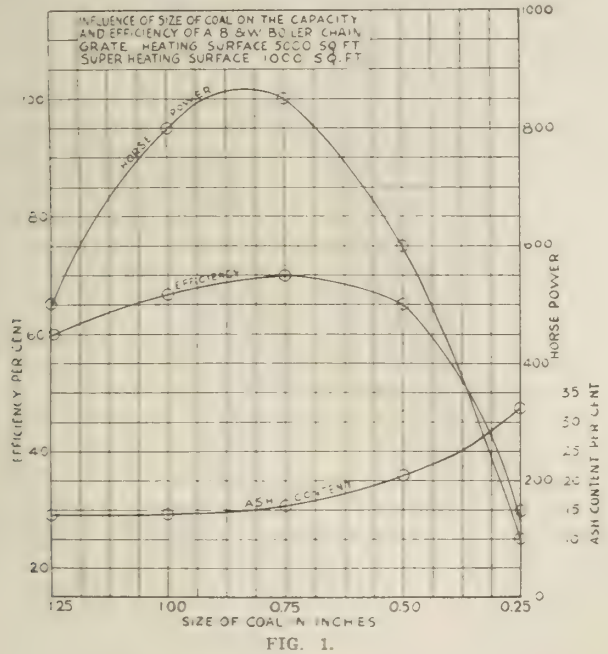

INFLUENCE OF SIZE OF COAL ON THE CAPACITY AND EFFICIENCY OF A B & W BOILER CHAIN GRATE HEATING SURFACE 5000 SQ FT SUPER HEATING SURFACE 1000 SQ FT
HORSE POWER
EFFICIENCY
ASH CONTENT
EFFICIENCY PER CENT
HORSE POWER
ASH CONTENT PER CENT
SIZE OF COAL IN INCHES
1.25
1.00
0.75
0.50
0.25

FIG. 1.

Good anthracite is hard, compact and lustrous, and gives a vitreous fracture when broken. It burns with very little flame, unless moist, and gives a very intense fire, free from smoke. As it is only available for steaming purposes in certain limited sections of the country, specific problems relating to its combustion will not be discussed, attention only being called to a principal objection to its use, that is, no matter how carefully handled, it is liable to break up under the influence of the high temperature of the furnace when freely fired, with consequent large losses of fine pieces through the grates to the ash pit. It must also be remembered that it requires at least 40 per cent. greater combustion space than does bituminous coal. On this account it should never be purchased for use in furnaces not designed for it.

Dry Bituminous Coals are the best of the bituminous variety for steaming purposes. They are hard and dense, black in color, but somewhat brittle and splintery. They ignite readily, burn freely with a clean bluish flame and without caking.

Bituminous Caking Coals swell up, become pasty and fuse together in burning. They contain less fixed carbon and more volatile matter than the free-burning grades. Caking coals are rich in hydrocarbon and are particularly adapted to gas making. The flame is of a yellowish color.

Long Flaming Bituminous Coals have a strong tendency to produce smoke. Some varieties cake, others do not, while burning. This coal is preferable for use under pans, dryers, in cement kilns, etc., rather than for general steam making purposes.

As a general proposition, the free-burning, dry bituminous coals of the West Virginia, Pittsburgh and Illinois districts are to be selected for the production of steam.

The Question of Size

The selection of coal of a certain classification is not enough. The size of the coal influences the capacity of the boiler owing to its effect on draft. With poor draft, fine coal cannot be burned in sufficient quantities to maintain the rated capacity. If thin fires are resorted to, the efficiency of the boiler is usually lowered by holes in the fire. Dust and very fine coal check the air flow or else pass up the stack unburned. Experience alone will show the size of coal best suited to individual operating conditions. After you have determined the proper size of coal, you should insist that all deliveries conform to this uniform size, particularly since coal of uniform size does not pack so badly as coal of mixed sizes.

Bituminous coals in the Eastern States are graded and sized as follows:—

A.—Run of mine coal; the unscreened coal taken from the mine after the impurities, which can be practically separated, have been removed.

B.—Lump coal; that which passes over a bar-screen with openings 1¼-inch wide.

C.—Nut coal; that which passes through a bar-screen with 1¼-inch openings and over one with ¾-inch openings.

D.—Slack coal; that which passes through a bar-screen with ¾-inch openings.

Bituminous coals in the Western States are graded and sized as follows:—

E.—Run of coal; the unscreened coal taken from the mine.

F.—Lump coal; divided into 6-inch, 3-inch and 1¼-inch lump, according to the diameter of the circular openings over which the respective grades pass; also 6 by 3 lump, and 3 by 1¼ lump, according as the coal passes through a circular opening having the diameter of the largest figure and over one of the smaller diameter.

G.—Nut coal; divided in 3-inch steam nut, which passes through an opening 3 inches in diameter and over 1¼-inch; 1¼-inch nut which passes through a 1¼-inch diameter opening and over a ¾-inch diameter opening; and ¾-inch nut, which passes through a ¾-inch diameter opening and over a ⅝-inch diameter opening.

H.—Screenings; that which passes through 1¼-inch diameter opening.

For maximum efficiency, coal should be uniform in size. As a rule, the percentage of ash increases as the size of coal decreases. This is due to the fact that all of the fine foreign matter separated from larger coal, or which comes from the roof or the floor of the

mine, naturally finds its way into the smaller coal. The influence of the size of screenings on the capacity and efficiency of a boiler in a specific case is illustrated in Fig. 1. The curves are plotted from a series of tests conducted with Illinois screenings on a 500 H.P. B. & W. boiler, equipped with chain grates, at the power house of the Commonwealth Edison Company.

Relation of Composition of Coal to the Size of Combustion Space

Coal must be adapted to the combustion space in your furnaces, or your furnaces must be adapted to the coal, if you are to avoid waste. As the chemical composition of the coal enters into this problem, I include Table 1.

Coals of different composition require different sizes of combustion space. The chemical characteristics that are most likely to affect the size of the combustion space required for a given set of conditions are the quantity and quality of the volatile matter. The quantity of the volatile matter is shown by its percentage as determined by the proximate analysis. The quality of the volatile matter is indicated approximately by the ratio of volatile carbon to available hydrogen, and also by the oxygen content of the coal on a moisture and ash free basis.

The principle chemical characteristics of Pochahontas (Bituminous Caking), Pittsburgh and Illinois coal are given in Table II.

Table III. gives the size of the required combustion space for the three coals and several sets of conditions, indicated by columns 1, 2, and 3.

Roughly speaking, under the same conditions, Pittsburgh coal requires about 20 per cent. larger combustion space than Pocahontas coal, whereas Illinois coal requires about 40 per cent. larger combustion space than Pittsburgh coal.

That the size of the combustion space does not increase in direct proportion to the percentage of volatile matter in the coal is shown graphically in Fig. 2.

Both Figs. 2 and 3 are plotted from data given in Table III. The curve of the upper group of Fig. 3 gives the relation between the size of combustion space and the product of quantity times the quality of volatile matter for one degree of completeness of combustion indicated by the figure near each curve. For complete combustion, it may be said that the size of the combustion space varies directly as the product of the quantity and quality of the volatile matter, as given in Table III.

If you want to know whether or not you are burning coal of the right composition, measure up the combustion space in your furnaces, then have a detailed chemical analysis made of a fair sample of your coal, and check them against the data given herein. If you contemplate a new power plant be sure that combustion space is designed for the coal which you can buy to best advantage.

Influence of Moisture

Moisture in coal reduces the steaming efficiency. One per cent. of moisture means a loss of thirteen BTU per pound of coal in superheated vapor in the smoke gases. It also decreases the capacity of the furnace, due to lowering the rate of combustion.

Although moisture is a great and uncertain variable, and the producer can exercise no control over this factor, still the purchaser should protect himself against excessive moisture by stipulating an amount consistent with the average inherent moisture in the coal, and proper penalty should be fixed for delivery in excess of the amount allowed, a corresponding bonus being paid for delivery of less than contract amount.

TABLE I.

Class of Coal	Fixed Carbon	Volatile Matter	Heating value per lb. of Combustible
Anthracite	92.5 to 97	3 to 7.5	14,000 to 14,800
Semi-Anthracite	87.5 to 92.5	7 to 12.5	14,700 to 15,000
Semi-Bituminous	75 to 87.5	12.5 to 25	15,500 to 16,000
Bituminous Pocahontas	60 to 75	25 to 40	14,800 to 15,200
Bituminous Illinois	50 to 60	35 to 50	13,500 to 14,800

TABLE II.

Item	Pocahontas	Pittsburgh	Illinois
Volatile matter in moisture and ash free coal, per cent.	18.05	34.77	46.52
Fixed carbon in moisture and ash free coal, per cent.	81.95	65.23	53.48
Volatile carbon in moisture and ash free coal, per cent.	8.55	20.47	26.22
Available hydrogen in moisture and ash free coal, per cent.	3.96	4.70	3.96
Ratio of available carbon to available hydrogen, per cent.	2.16	4.35	6.6
Oxygen in moisture and ash free coal, per cent.	3.32	5.59	10.93

TABLE III.

Temperature of gases in per cent of theoretical heat	Rate of combustion pounds per sq. ft. of grate per hour.	Excess of air (per cent.)	Cubic feet of combustion per sq. ft. of grate area		
			Pocahontas	Pittsburgh	Illinois
1	2	3	4	5	6
3	20	50	2.7	2.9	4.3
3	30	50	3.2	3.7	5.3
3	40	50	3.6	4.4	6.3
3	50	50	4.0	5.6	8.9
3	50	50	4.8	6.8	11.9
4	50	50	2.0	2.2	3.5
3	25	50	2.3	2.7	4.35
3	25	50	2.7	3.1	5.1
2	25	50	3.4	4.0	6.2
1	25	50	4.0	5.0	7.1
6	25				

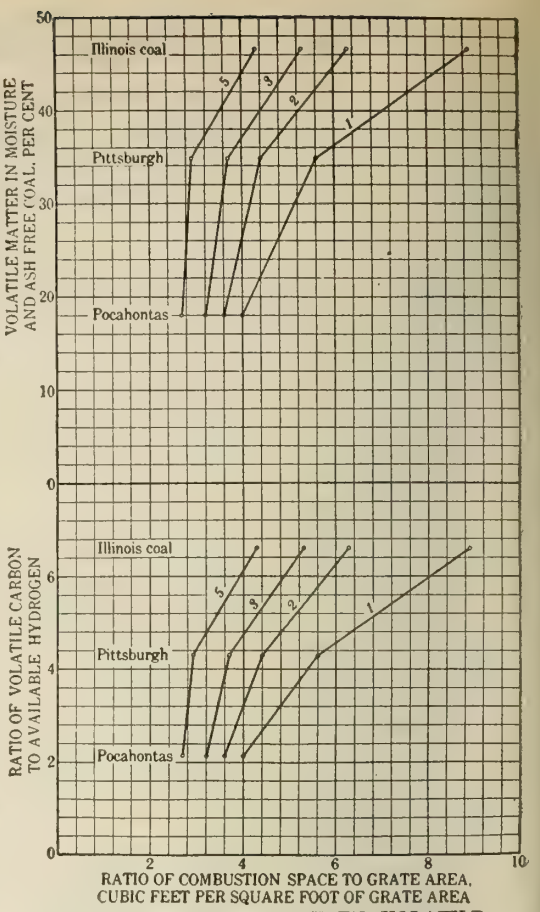

Illinois coal
Pittsburgh
Pocahontas
VOLATILE MATTER IN MOISTURE AND ASH FREE COAL, PER CENT
RATIO OF VOLATILE CARBON TO AVAILABLE HYDROGEN
RATIO OF COMBUSTION SPACE TO GRATE AREA, CUBIC FEET PER SQUARE FOOT OF GRATE AREA

FIG. 2 — RELATION BETWEEN VOLATILE MATTER OF COAL AND SIZE OF COMBUSTION SPACE REQUIRED. SMALL FIGURES NEAR EACH CURVE INDICATE PERCENTAGE OF HEAT NOT DEVELOPED OWING TO INCOMPLETE COMBUSTION. RATE OF COMBUSTION 50 POUNDS, EXCESS OF AIR 50 PER CENT.

The Ash Problem

The amount of earthy matter or ash is of considerable importance in fixing the heating value of the coal since the heating value of the combustible is practically constant. The effect of ash on the heating value of Illinois screenings as fixed under a B. & W. boiler with chain grate is shown in Fig. 4. This value varies with the different types of boilers, grates and furnaces, but is substantially as illustrated. The amount of refuse in the ash pit is always in excess of the earthy matter as reported by analysis, except where the amount carried beyond the bridge wall is very large.

The maximum allowable amount of sulphur is sometimes specified, since some grades of coal high in sulphur cause considerable clinkering. But sulphur is not always an indication of clinker-producing ash, and a more rational procedure would be to classify a coal as clinkering or non-clinkering, according to its behavior in the particular furnace in question, irrespective of the amount of sulphur content. Ash fuses between 2,300 and 1,500 deg. Fahr. and of the formation of objectionable clinker is to be avoided, the furnace must be operated at temperatures below the fusing temperature. Several large concerns insert an "ash fusibility" clause in their coal specifications.

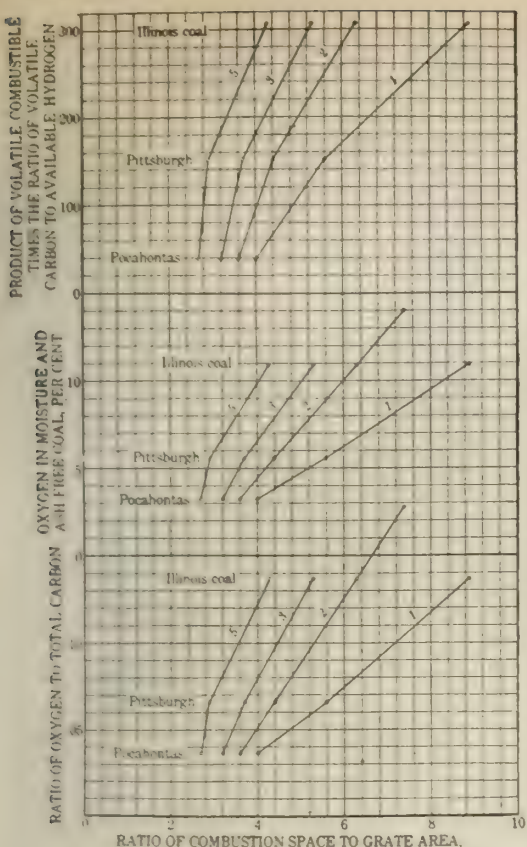

PRODUCT OF VOLATILE COMBUSTIBLE TIMES THE RATIO OF VOLATILE CARBON TO AVAILABLE HYDROGEN
OXYGEN IN MOISTURE AND ASH FREE COAL, PER CENT
RATIO OF OXYGEN TO TOTAL CARBON
Illinois coal
Pittsburgh
Pocahontas
RATIO OF COMBUSTION SPACE TO GRATE AREA. CUBIC FEET PER SQUARE FOOT OF GRATE AREA

FIG. 3—RELATION BETWEEN SIZE OF COMBUSTION REQUIRED AND CHEMICAL PROPERTIES OF THREE COALS. SMALL FIGURES, ETC. (SAME AS FIG. 2).

At present the ash problem is accentuated by the delivery of "dirty" coal. We find from reliable sources that the coal received in many of the largest power plants has increased by 5 to 10 per cent. in ash and has decreased in heating value by 8 to 12 per cent. Many good authorities state that the amount of coal consumed in their plants has increased 10 per cent. due entirely to the inferior quality of coal received to-day as compared with that received two years ago.

There is no excuse for this "dirty" coal. The railroads during the past year, have been burdened hauling 30,000,000 tons of worthless dirt that anyone can dig up from the back-door yard or have from rock-pile for the asking. These 30,000,000 tons of dirt have not only cost the power plant operator $120,000.000, but they have deprived him of 30.000,000 tons of real coal. The remedy for this condition is to be found in determined individual and co-operative insistence upon clean coal, and in the establishment of government coal-sampling stations to check the product of each mine as to quality and effectiveness of preparation.

Heating Value of Coal

I have purposely left discussion of the heating value of the coal till last, as this is the most obvious of all the factors entering into its selection.

The heating value of coal as determined by a sample burned in an atmosphere of oxygen does not give its absolute commercial evaporative power, since this depends largely upon the composition of the fuel, character of grade, and conditions of operation, as already outlined. In large plants where a number of grades of fuel are available, it is customary to conduct a series of tests with the different grades and sizes, and the one which evaporates the most water for a given sum of money, other conditions permitting, is the one usually contracted for. In designing a new plant particular attention should be paid to the performance of similar plants in operation, and the fuel and stoker should be selected which are found to give the best returns for the money.

However, there is no reason why the power plant operator should not know the number of B.T.U. in the coal which he puts into his furnace and every reason why he should know. The evaporation of so many pounds of water per pound of dry coal does not in and of itself indicate efficiency. The equivalent evaporation of 8 pounds of water per pound of dry coal would represent 70½ per cent. efficiency, if the coal contained 11,000 B.T.U. per pound, but the same evaporation with a coal of 14,400 B.T.U. heating value would represent only 53¼ per cent. efficiency. Therefore analysis of the heat units in the coal is essential to a knowledge of its value.

Purchase of Coal Under Specifications

Engineers differ as to the specifications to be used in purchasing coal. Some favor a system of bonus and penalty on ash basis only; others favor a similar system on B.T.U. basis only. Much can be said on both sides, but undoubtedly the safest system is a combination of the two. With such a system a proposal is made by the contractor, stating price, B.T.U. and ash content. Samples are taken each day of the coal furnished and a bonus is paid for B.T.U. content exceeding contract stipulation, the bonus being the same percentage of contract price that the excess B.T.U. is of the specification value. A corresponding deduction is made for coal falling below the specifications and in some cases a lower limit is set below which the coal may be refused at the purchaser's option, with the further stipulation that continued failure to supply coal within the specification limits will forfeit contract.

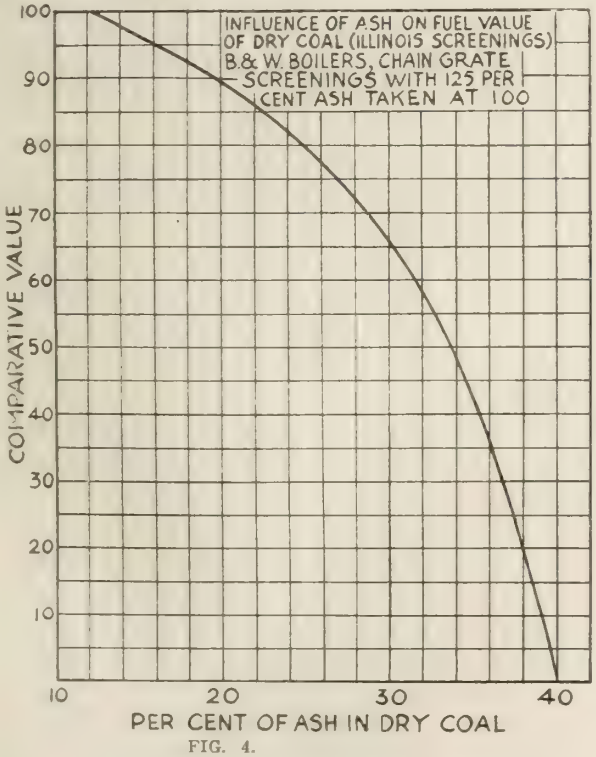

INFLUENCE OF ASH ON FUEL VALUE OF DRY COAL (ILLINOIS SCREENINGS) B.& W. BOILERS, CHAIN GRATE SCREENINGS WITH 12.5 PER CENT ASH TAKEN AT 100
COMPARATIVE VALUE
PER CENT OF ASH IN DRY COAL

FIG. 4.

For each per cent. which ash falls below analysis a bonus is allowed. Generally an increase of 2 per cent. increase in ash content is allowed without penalty, above 2 per cent. a penalty is deducted according to a sliding scale.

You can only be sure you are buying your coal right by making an analysis of it as delivered. Two carloads of coal may look the same, but may vary 10 per cent. or more in B.T.U. and a difference of 10 per cent. makes a difference of from 8 to 10 per cent. in the value of the coal.

If you are not in a position to make an analysis of the coal yourself, all you have to do is to put an empty barrel in your boiler room and have your fireman throw a part of a shovel of coal in it four or five times a day. At the end of a week or a month you can take this coal out, mix it thoroughly, quarter it, mix it again and quarter it until you reduce it to a size suitable to forward to the nearest testing laboratory. By mixing it, you will have a representative sample which will indicate pretty accurately the grade of coal you have been burning and from which you can determine the efficiency of your boilers.

In entering upon a contract, remember that the important items to be considered in the specifications are:-

A.—A statement of the amount and character of the coal desired.

B.—Conditions for delivery.

C.—Disposition to be made of the coal in case it is outside the limits specified.

D.—Correction in price for variation in heating value and in moisture and ash content.

E.—Method of sampling.

F.—By whom analyses are to be made.

In conclusion, it is not easy to select the proper coal for any given plant but there is no factor in power plant operation which will so well repay proper attention.

Ingersoll, Ont.—A $60,000 extension to the present plant of the Ingersoll Machine Co. is contemplated.

Switch Gear Standardization: Necessity and Advantages II.

The Problem of the Standardization of Equipment is Receiving World-wide Attention and it is a Well-recognized Fact That if a Country Wishes to Maintain its Position in the Engineering Markets of the Future Standardization of Equipment Will Become Necessary

By C. C. GARRARD

Air-Break Circuit Breakers

IN circuit breakers, brush contacts are usually used at considerably higher contact surface-density than with the jaws of knife switches. A separate standard of specific pressure drop of brush contacts is therefore required. The values given in Fig. 9 are put forward as a basis of discussion. They represent results which can be obtained by reasonably good work and which do not result in temperature rises above those suggested on page 12. A standard of breaking capacity also should be fixed analogous to that discussed under cut-outs and oil switches.

Cut-Outs

While the standardization of cut-outs has been carried out to a considerable extent in other countries, with us practically nothing has been done. This is not to say that the subject has not been worked at. Numerous researches and papers have been published. The engineering standards committee announce, however, in their 1917 report, the forthcoming issue of a specification for fuses for use on ships. It is to be hoped that this will be followed at no distant date by the others which are urgently needed in the interests of the industry.

One of the evils which the manufacturers of this class of article suffer under is that cut-outs have been considered as peculiarly fit subjects for special designs on the part of their users. In this, electric supply engineers have often followed the example of waterworks and gasworks engineers in similar circumstances.

The author was informed recently by a manufacturer in the Midlands that his firm alone made over 300 different patterns of ¾-in. main gas-cocks.

Many electric supply authorities issue their own specifications for house service cut-outs, necessitating special drawings, patterns, and tools. The same remarks apply to house-service cable boxes, main switches, and the like. It is perhaps too much to hope that all this can be swept away, within a reasonable time, simply by the issue of specifications by the engineering standards committee. An energetic propaganda among the responsible parties will be necessary to secure the desired results. These could best be obtained probably if supply engineers could be induced to take the matter up themselves with the object of securing uniformity as regards house-service fittings.

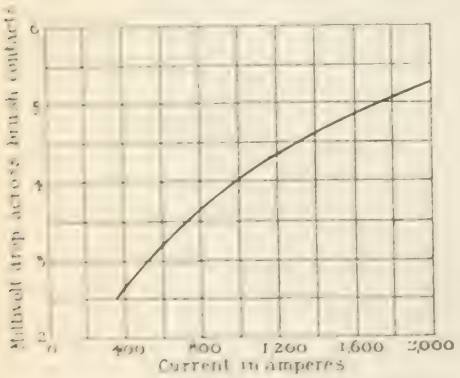


FIG. 8—MILLIVOLT DROP ACROSS BRUSH CONTACTS.

National Electric Code Cut-Outs

In any review of the subject of cut-out standardization, one of the first things to be considered is the enclosed cut-out standardized by the American National Electric Code. This is completely standardized as regards dimensions, and its use is practically obligatory in America as the code is the standard insisted upon by the fire insurance authorities there. The manufacture of N. E. C. enclosed cut-outs has consequently become a very important industry engaging the attention of a number of specialist firms. The general use of open and protected type cut-outs, as in this country, has been impossible in America. It is true the code contemplates open cut-outs and gives dimensions of the same. Nevertheless these appear practically never to be used. As, in spite of this, the fire hazard in this connection is not any greater with us than in the States, it cannot be said that the universal use of the relatively expensive enclosed type is justified. Nevertheless, there is a considerable field for enclosed cut-outs to meet severe conditions, and a British standard for such should be set up as well as for the protected type. As regards open-type cut-outs, the only thing about them which need be standardized is their name, as their use should be prohibited.

The short-circuit test called for in the N. E. C. enclosed cut-out is one of 10,000 amperes, independently of the size of the fuse. While this is a comparatively light test for a large cut-out (say, 400 amperes working current) it is a severe one for small currents (10 or 30 amperes) and one which many protected-type cut-outs will not pass. For very many purposes, however, such a severe test is quite unnecessary.

Short-Circuit Tests on Cut-Outs

It has been generally agreed that the severity of a short-circuit test to which a cut-out is subjected may be measured by the value of the short-circuit current which would flow if the fuse were replaced by a heavy copper connection having no appreciable resistance, the electromotive force of the supply remaining constant.

In endeavoring, therefore, to arrive at a figure for the short-circuit test to insert in a standard specification, one has to consider what short-circuit current, as

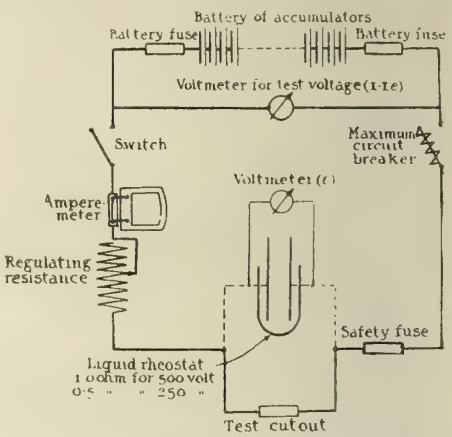


FIG. 9—STANDARD CUT-OUT TEST OF THE SWISS ELECTRO TECHNICAL SOCIETY. ELECTRIC ELEVATOR DISPATCHER.

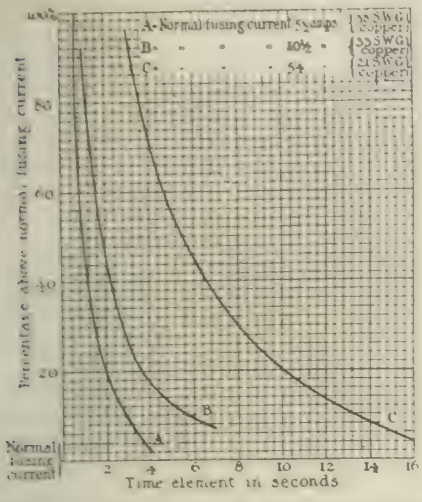
defined above, does actually flow in different situations in a supply network.

Schwartz and James in their paper laid it down that a short-circuit for main fuses and distribution boards not greater than 33 times the normal fusing current corresponds to the usual conditions met with in house-service installations. This means that for a 10-ampere working-current cut-out, having a normal fusing current of 30 amperes, the short-circuit current does not exceed approximately 1,000 amperes. This conclusion is a sound one and is borne out by practice in very many cases.

Nevertheless, with the increased size of modern distributing networks, conditions do arise which are very much more severe than those formulated above. It is easy to foresee this by calculating the short-circuit currents for small cut-outs situated at the immediate ends of short feeders having large cross-sections.

This view is also confirmed in a very interesting paper issued by the American Bureau of Standards in 1916. In order to get an idea as to the currents that might be expected under actual service conditions in case a short-circuit should occur near the customer's cut-out a number of tests were made, the results

of one series of which are given in Table 4. These tests were made in the heart of the Edison three-wire distribution system, at points varying from one to six city blocks from the nearest power house. The tests were made by connecting a resistance grid across the cut-out terminals. With the switch closed, a current


A-Normal fusing current
B- - - - 10½ -
C- - - - 54 -
Percentage above normal fusing current
Normal fusing current
Time element in seconds

PIPE TO CARRY OFF OIL EXPELLED FROM OIL SWITCH.

of about 300 amperes was taken, and at the instant of closing, the drop in volts at the cut-out was noted, and from this the current that would occur on dead short-circuit at the cut-out could be readily calculated.

TABLE 4.

Regulation Test on Continuous-current Customer's Service: Edison Three-wire System, Commonwealth Edison Company, Chicago.

Test No.	Distance to nearest Substation	Calculated Short Circuit Current
1	150	26,200
2	400	107,000
[illegible]	1,500	20,000
[illegible]	600	17,100
[illegible]	1,100	9,800
[illegible]	1,300	13,200
[illegible]	1,100	25,500
8	900	87,300
[illegible]	2,300	13,900
10	3,000	13,400
11	2,350	9,800
12	3,400	8,100
[illegible]	2,600	6,100

These tests may be taken as representative of a very large part of the Edison three-wire system in the larger cities of the States.

In view of the results given in Table 4 it might be thought at first that, to be on the safe side, all cut-outs should be specified to be capable of standing up to the very severe short-circuit conditions therein shown. This, however, would entail the use of much more expensive fittings than experience has shown in many cases to be necessary. In fact in probably the large majority of situations in this country nothing like the short-circuit conditions would exist as discovered in Chicago. The conclusion must, however, be drawn that with the increasing size of distribution networks the short-circuit conditions should be determined in the maner outlined above and cut-outs specified accordingly. It is also quite clear that a single rating as regards short-circuit would not be sufficient to cover the whole field; at least two types of cut-outs are necessary—one for heavy duty and one for lighter or ordinary duty.

Standard Method of Testing Cut-Outs

The various methods adopted by the standardizing authorities of the different countries for determining the rating (as regards short-circuit capacity) all go on the same lines, that is to say, the cut-out is short-circuited across a sufficiently large source of power with the short-circuit current limited to certain values.

Fig. 10 illustrates the test specified by the Association Suisse des Electriciens for enclosed cut-outs up to 60 amperes working current. The battery must have a voltage measured on open circuit at least 10 per cent. larger than the voltage of the cut-out being tested. The liquid rheostat of the value stated in the figure is first connected across the terminals of the cut-out (the latter not being in circuit) and the adjustable resistance arranged so that for a 250-volt cut-out a current of 500 amperes flows. It will be seen that this allows for a 10 per cent. drop at 500 amperes across the adjustable resistance which corresponds to a short-circuit current of 5,000 amperes. The test fuse is then connected instead of the liquid rheostat and must rupture the circuit without an explosion or sustaining the arc.

The principle of the German rules as regards the short-circuit test is the same as the Swiss rules except that the values are different, and in Table 5 the various figures for the different countries are tabulated.

TABLE 5.

Values of Short-circuit Current Specified by Various National Rules for the Testing of Cut-outs.

Working Amps. Current of Cut-out	Amps. Swiss	Amps. German	Amps. American	Schwartz Amps. and James
10	5,000	4,000	10,000	990
30	5,000	6,000	10,000	1,980
60	5,000	12,000	10,000	3,960
100	....	20,000	10,000	6,600

Plant Necessary When Making Short-Circuit Rating Tests on Cut-Outs

Considerable discussion has taken place as to the influence upon the severity of the test of the amount of plant connected at the time the test is made. The whole of this discussion can be clarified if we take as criterion of the severity of test the value of the short-circuit current as above defined. Naturally with a small amount of plant the short-circuit current is very limited. Again if we in any case limit the possible short-circuit current by series resistance then, provided a certain minimum of plant is exceeded, the addition of more plant makes very little, if any, difference. It is therefore only necessary to specify the minimum of plant that shall be used. It is suggested that 100 kilowatts would be sufficient for ordinary duty cut-outs and 500 kilowatts for heavy duty ones. It should be noted that these are the minimum values; more may be necessary in order to reach the short-circuit capacity when testing the larger sizes of cut-outs.

Time Element of Cut-Outs

In several of the foreign standards cut-out specifications periods of time are fixed within which the various cut-outs must operate. It is worth while to consider whether it would be advisable to include similar requirements in any British standards which may be issued.

The time taken to blow a fuse depends upon its size and the degree of overload. This is illustrated by the curves in Fig. 10. It will be seen that the times taken to melt the three fuses at the normal fusing currents were about 4 seconds, 10 seconds and 18 seconds respectively. It will also be observed that the current which gives a more or less instantaneous operation is very indeterminate, as the curves tend to rise practically vertically.

Schwartz and James suggested the following definition of "normal fusing current":—

"The minimum current required to fuse the wire in such a time interval as shall be necessary for the wire to have attained its maximum steady temperature."

This is practically the same definition as has been adopted by the National Electric Code.

The normal fusing current can best be ascertained by plotting a curve as in

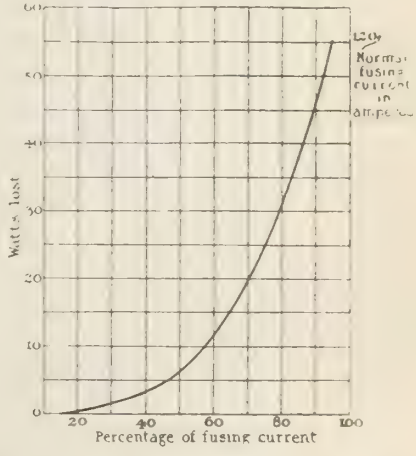


FIG. 11—CURVE FOR DETERMINING NORMAL FUSING CURRENTS OF A CUT OUT.

Fig. 11. It will be seen that the curve approaches a vertical asymptote, the value of which is the normal fusing current. If the normal fusing current be suddenly applied to the cold fuse a longer or shorter time will be required to melt the fuse depending on its size (see Fig. 10).

It follows from the above that if a definite and fixed time element be specified it would in the first place be necessary to specify value of time element for each diameter of fuse wire; secondly, it would be necessary to have different

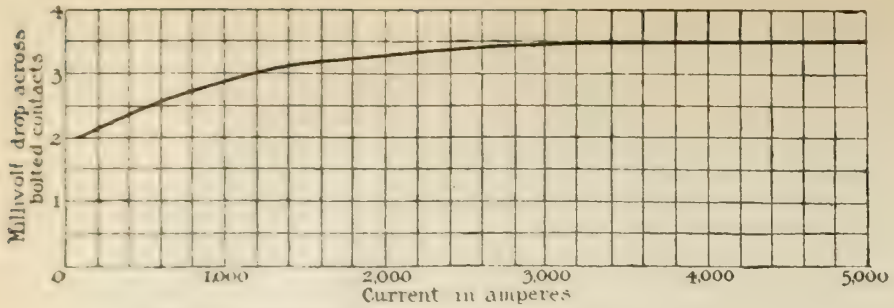


FIG. 12—MILLIVOLT DROP ACROSS BOLTED CONTACTS.

values of time element for open, protected, and enclosed cut-outs, and likewise different time elements for each fuse metal.

Temperature Rise

It is to be presumed that in fixing definite time elements for cut-outs those concerned have regarded them as essential in order to guard against overheating in the apparatus protected by the cut-out.

Considering the thinnest wires, these, according to the Institution wiring rules, would have a working current density not exceeding 5 amperes per square millimetre, and the normal fusing current of the fuse would be three times the working current. This gives a temperature rise per second in the conductors with the normal fusing current flowing of 1.1 degrees C.

A current just below the normal fusing current could flow indefinitely, and whether the conductor will reach a dangerous temperature will depend upon its heat dissipating capacity. It is obvious that to specify a time element for the fuse would not add to the margin of safety. The point is that the factor of safety as regards heating of the conductor is conditioned wholly by the value of the normal fusing current, as a current just below this value can flow continuously.

Turning to larger conductors the current density would be approximately 2 amperes per square millimetre and the normal fusing current double the working current. These figures correspond to a temperature rise of 0.08 degree Centigrade per second. The actual temperature rise of a conductor having a current flowing through it indefinitely in value just below the normal fusing current could only be determined satisfactorily by experiment. The institution wiring rule No. 98 *b* requires that fuses "must be so proportioned to the current to be carried that no conductor protected by them can be raised in temperature above that specified in Rule 44."

It would be very desirable if directions could be issued to guide the user in applying this rule. As it stands, the requirement simply begs the question. It is to be hoped that some information on this subject may be forthcoming before long. At any rate to specify the time element of a cut-out does not serve any useful purpose and it is suggested it should not be done.

Motor Starting-Gear

The most urgent matter in connection with starters requiring standardization is that of rating. Closely connected of course with the standardization of rating is the question of the performance of the device under standard test conditions. The requirement of the American National Electric Code is noteworthy in this connection. This reads as follows (N.E. Code 78 h):—

> "Starting duty resistances for direct-current motors shall be so constructed that when not more than 10 per cent. in excess of the voltage marked on the name-plate is applied to the main-line terminals, and the starting arm is operated at such a rate that the current through the resistance does not fall below the rated full-load current, and this test is continued for not more than three minutes, there shall be no resultant flaming or molten droppings; or if the resistance conductor is fused, the arc or any attendant flame or molten droppings shall be confined within the rheostat."

It would appear that a requirement which allows for the eventual appearance of flames or molten droppings under test conditions is altogether inadequate. A specification of temperature rise and freedom from permanent injury to the device rather should be laid down.

Diversity exists at present among the different manufacturers as regards their horse-power minute ratings of this class of apparatus. This would be obviated in future if a standard rating could be fixed. This is only a matter of definition, and could be settled. immediately if attention were given to the matter by the competent authority.

Copper Strip Connections of Switchboards

It would be a great advantage if the cross-sections of strips to be used for making the connections on switchboards were standardized. Hard-drawn copper is sometimes specified for these. Hard-drawn copper has a specific resistance 2 per cent. higher than annealed high-conductivity copper. Its use, moreover, is wasteful as it has to be purchased in straight, comparatively short lengths. Thus it has to be cut to waste much more than copper purchased in long rolls. Moreover, built-up hard-drawn busbars must contain many more joints which are expensive to make and also the cause of ohmic loss. In view of these facts it would be desirable to standardize on the basis of annealed copper. All strips, except the smallest, should, as far as possible, be of a uniform thickness (say ⅛ inch) but of varying widths. The use of such thin strips permits of large bars being built up with maximum ventilation; moreover, they are very much easier to handle than thicker strips. The sections illustrated in Fig. 12 are suggested as suitable for the proposed standards.

Temperature Rise of Connections

Present-day specifications are very vague on this point. Some engineers specify no appreciable temperature rise, and other requirements such as no excessive rise are common. The measurement of the temperature should be by thermometer. Connections in the immediate neighborhood of instrument shunts should be allowed to run hotter than the normal, as such shunts dissipate their heat to a great extent through the connections. Temperature measurements should therefore not be required to be made within 1 ft. or 1½ ft. of the shunts measured lineally along the conductor. The American Rule No. 722 allows a 30 degree C. rise on cut-outs and current-carrying parts of switches. Large current connections, however, would have to have a higher temperature limit fixed for them than small ones. Reasonable values would be up to 500 amperes not to exceed 20 degrees C. rise; 500 up to 1,500 amperes, 30 degrees C. and 1,500 amperes and above 40 degrees C. A standard of millivolt drop for bolted and riveted connections would be very desirable, and as a contribution to fixing this the curve in Fig. 12 is given showing results obtainable by reasonably good workmanship.

Switchboards

The only British standards (apart from some minor requirements in the Institu-

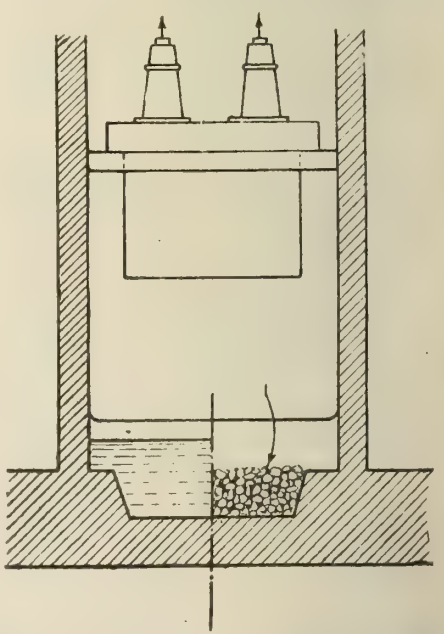


FIG. 13—OIL WELL AT BOTTOM OF OIL SWITCH CUBICLE PARTLY FILLED WITH SAND OR GRAVEL. THE WELL MAY BE COVERED WITH A PERFORATED METAL COVER.

tion wiring rules) as regards switchboard construction which have been as yet established are contained in the official regulations issued by the Home Office and Board of Trade. These latter are, however, concerned primarily with the safety of the workmen and of the public, and while their constructional requirements are excellent in themselves they are not appropriate means for setting up such standards. These should form the subject of special specifications to be issued by the standards committee. Among the requirements to be covered by such specifications may be enumerated the following:—

Clearances, general arrangement of apparatus and connections, prohibition of the use of inflammable material, passage ways, gates, shields, etc.

From the manufacturing point of view it would also be an excellent thing if the dimensions of slabs used in switchboard construction could be standardized. This has already been done by individual manufacturers and, if all could be brought into line, considerable economy would be effected.

As regards high-tension boards, a code of principles should be set up which would guide central station engineers and manufacturers in selecting the type of board most suitable for the particular service required. The matter is of particular importance in view of proposals for linking-up and bulk supplies, which are likely to be considerably extended in the future. Such linking-up is difficult and costly of realization when the stations to be connected are equipped with differing forms of switchgear.

Cellular or Cubicle Type of Switchboards

One of the most beneficial principles of high-tension switchgear construction is the cellular principle originally enunciated by Dr. Ferranti. As of late the desirability of this method of construction has been questioned, the opportunity is now taken of raising a discussion on the subject.

In the author's opinion all high-tensioned boards should be based upon this fundamental idea. Of course the present-day cells or cubicles are very different from the open-fronted pigeon holes originally used. For one thing modern experience has shown that the cells containing the oil switches should be practically gas-tight, or at least only have ventilation or drainage holes from which the emission of conducting fumes or vapors would be harmless. Again, too, the effect of arcs which have been set up as the result of accidents has demonstrated the necessity of very substantial construction of the dividing walls and partitions. There is, undoubtedly, a very considerable amount of practical experience with the use of high-tension switchboards available in the records of the supply authorities in this country. One very beneficial effect of the preparation of the standard specifications suggested would be to render this experience available to the industry generally, with consequent greatly accelerated progress all round.

Reference may be made here to the Commission on High Tension Apparatus set up by the Swiss Elektrotechnischer Verein, and Figs. 13 and 14 are taken from the second report of this commission.

The commission reported that it has been found necessary to leave openings in the oil-switch tanks to prevent their bursting when "internal explosions take place."

Figs. 13 and 14 represent arrangements of cubicles suggested by the Swiss commission to prevent the oil on issuing from such openings from spreading. These are self-explanatory. In Fig. 14 will also be seen a flap-opening to give relief to internal pressures set up within the cubicle. The report also recommends the provision of chimneys for the switch cells

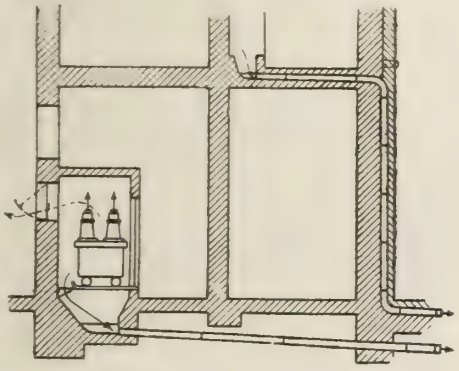


FIG. 14—CUBICLE ARRANGED WITH DRAIN OIL SEPARATOR

to carry off smoke, and that cables should leave each air-tight compartment through porcelain stuffing boxes.

It is very much to be doubted whether the cubicle vent proposal shown in Fig. 13 is advisable, but that on the contrary the cell should be as air-tight as possible. It would almost seem that the authors of these proposals contemplate the bursting or blowing-off of the oil-switch tanks as a normal incident of operation. It is very much better to make the switch tank sufficiently strong to withstand, in conjunction with a sufficient air cushion above the oil, any pressure which may be set up due to operating conditions. Such a construction does not offer any insurmountable difficulty. If a vent to relieve pressure inside the oil switch is provided, then this should communicate through a pipe with the open air or to a place where the expelled fumes are harmless. The provision, however, of a drain pipe as shown in Fig. 14 would seem to be a desirable precaution against accidents. One must not, of course, shut out entirely the possibility of accidents, and from this point of view the enclosure of the oil switch within an outer cell which will strictly localize the ill-effects of any such accident is a great advantage.

Lightning Protective Gear

The horn gap forming as it does a necessary constituent of very many forms of lightning arrester should be standardized as regards its shape and jump-over voltage. This latter depends partly upon the diameter of the rod used in the construction of the horns, and this must therefore be specified. As regards material, both galvanized iron and copper yield good results.

Great diversity exists in present-day practice as regards the size of choking coils used for the protection of machinery against the entrance of dangerous currents. It should be possible, however, to lay down standards (expressed in milli-henries) of inductance which afford reasonable protection in the various cases. If this be done, however, it would be necessary to fix upon a formula which could be generally accepted as sufficiently accurate for the calculation of the inductance of the coils. A mathematically rigid calculation of such coils is a matter of some complexity. Such, however, is not necessary, an accuracy of, say, 5 per cent. plus or minus being ample. A general formula with the necessary curves for use under these conditions should not be very difficult to obtain, and their general use would prevent disputes arising.

Reference may be made to the general formula put forward by Coursey for coils of small radial winding depth and that proposed by Doggett.

The precise shape and arrangement of the coil should for the present be left to the different manufacturers. The minimum clear air space between the turns of the coil should, however, be fixed.

There can be little doubt that the future development of overhead electric transmission is bound up in no small degree with the question of efficient protection against lightning. Of late, two methods for the protection of large systems have come to the front, namely, the static condenser system and the electrolytic. The former has been developed on the Continent and the latter, while it was invented in England, has been brought to its present high efficiency in America. It is probable that most new transmission lines of any considerable magnitude in the near future will be protected by the aluminum electrolytic arrester.

A very considerable amount of development work in connection with the aluminum arrester has been carried out in the private research laboratories of manufacturing firms. While a good deal of the results of this work has been, with commendable broad-mindedness, published in the technical press, naturally much is withheld and regarded as a trade secret. In view of the importance of the matter from the point of view of the future of the British electric supply industry and of the export trade, this is unsatisfactory, as the constants of such a vital piece of apparatus should be common property, just as are, for example, the insulating properties of the commonly used as di-electrics.

PRINCIPLES AND OPERATION OF MODERN ELECTRICAL EQUIPMENT—VI.

By A. M. PERE

LAST month's section took up the action of conductors moving in a magnetic field and explained the manner in which the generator and motor operated by means of elementary armatures consisting of one or two coils. Generators and motors are, however, very seldom built with this small number of coils, the only exceptions being magnetos and small toys.

Armatures for direct current machines were at first built up by winding

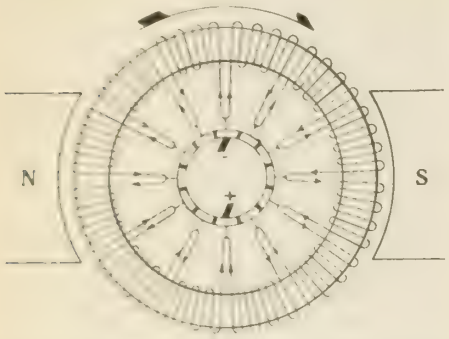


FIG. 1—DIAGRAM OF SINGLE DRUM ARMATURE BETWEEN POLES OF A BIPOLAR FIEL DMAGNET. THE DIRECTION OF CURRENT FLOW FOR THE ROTATION SHOWN IS REPRESENTED BY THE ARROWS AND ONLY THOSE CONDUCTORS ON THE OUTSIDE OF THE RING ARE EFFECTIVE IN CARRYING CURRENT.

coils of wire around a ring of iron or iron wire passing the conductor through the center of the ring for each turn. This construction is open to several very serious objections and is now never used except for a few special purposes. As may be imagined the time taken to wind an armature of this type was no small item and over one-half the wire used was of no value in generating electro motive force.

This will be clearly understood by reference to Fig. 1, which shows the elements of this form of construction. The magnetic flux from the field magnets

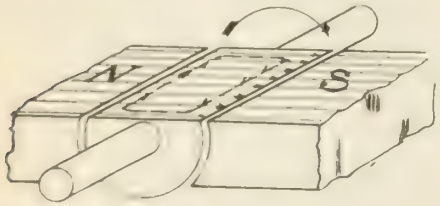


FIG. 2—SHOWING EDDY CURRENTS IN A SOLID IRON CORE, PRODUCED BY THE ACTION OF FIELD MAGNETS.

passes through the air-gaps into the ring of iron and through the ring into the other pole of the field, and the only active parts of the conductors are those on the outside of the ring shaped armature core. The conductors on the inside of the ring do not generate in e.m.f., which is useful but due to the everpresent magnetic leakage across the ring from pole to pole generate an e.m.f.,

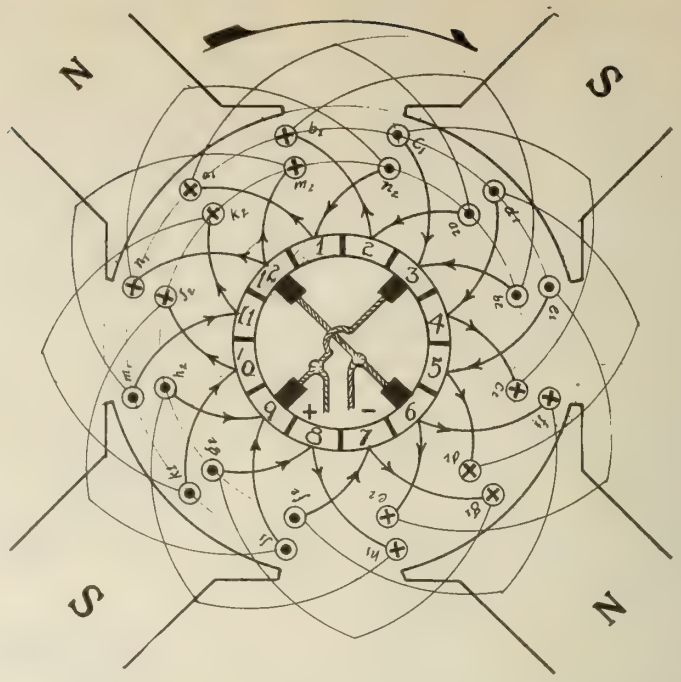


FIG. 3—DIAGRAM OF LAP WINDING FOR A FOUR-POLE FIELD. THE EASIEST WAY TO REMEMBER THE SIMPLE LAP WINDING IS TO REMEMBER THAT THE END OF ONE COIL AND THE BEGINNING OF THE NEXT ARE TOGETHER CONNECTED TO ONE COMMUTATOR BAR

which by tracing out the connections, opposes to a certain extent the e.m.f. generated by the outside conductors. This is understood when it is seen that the current flowing flows back on the inside of the armature.

This disadvantage does not appear in the drum armature and reference to last month's diagrams will show that while the current flows in oposite directions on each side of the loop, the relative directions of the magnetic fields

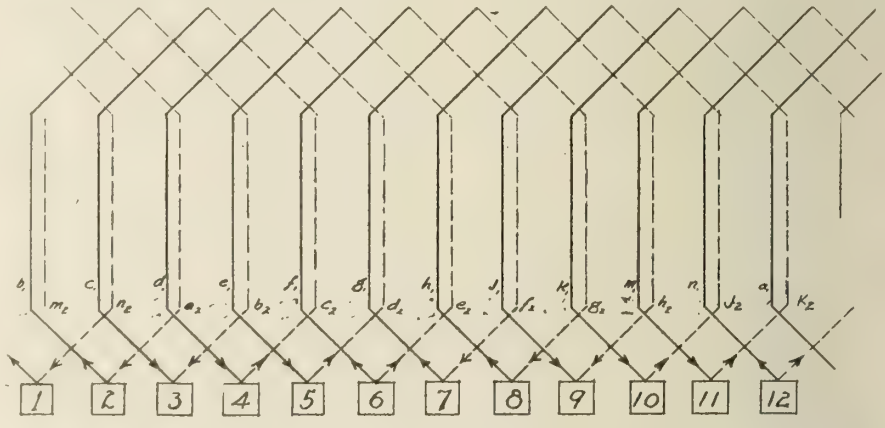


FIG. 4—DIAGRAM OF 4-POLE LAP WINDING 12 COILS. NOTE THAT THE BEGINNING AND END OF ANYONE COIL ARE ONLY ONE BAR APART, THAT IS THE BEGINNING OF A COIL IS CONNECTED TO THE NEXT COMMUTATOR BAR TO THAT ON WHICH THE COIL ENDS.

and the rotation of the armature are such as to strengthen this direction of current flow.

Drum Armatures

It is hardly necessary to say that the dynamo or motor as at present constructed has an armature of which the conductors are wound or placed over an iron core usually provided with teeth between which the conductors lie. These teeth serve several important purposes; they securely anchor the conductors in place, they protect them from injury and they very materially reduce the amount of power required by the field coils in generating the magnetic flux on account of the shorter air gap provided.

Eddy Currents and Laminated Armatures

If an armature be examined it will be seen that it is made up of numerous sheets of thin steel all mounted on the shaft or on a supporting spider of cast iron. The laminations of the core serve a very important purpose. In Fig. 2 is shown a section through a solid iron armature and a moment's reflection will show that revolving this mass of metal in a magnetic field is exactly analagous to spinning a conductor under similar conditions and as shown

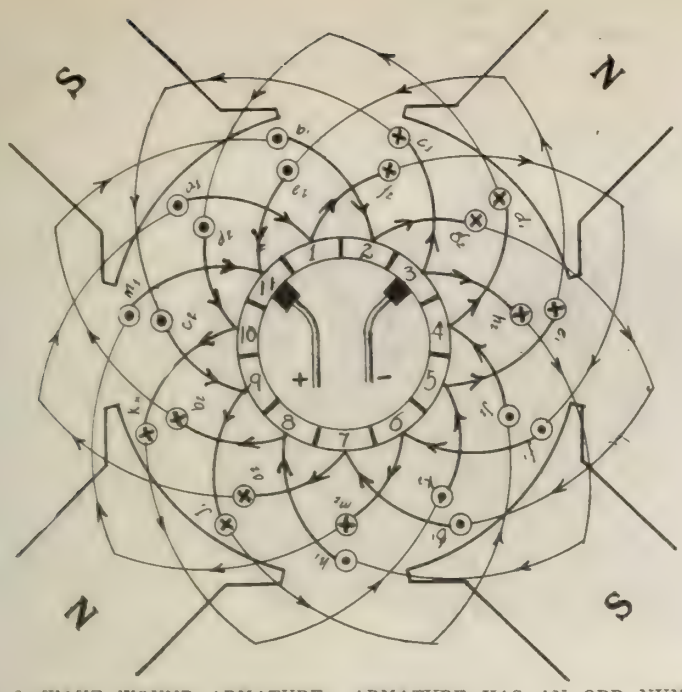


FIG. 5—WAVE WOUND ARMATURE. ARMATURE HAS AN ODD NUMBER OF SLOTS AND END OF ONE COIL IS CONNECTED TO A COMMUTATOR BAR NEARLY 180° AWAY FROM THE BAR TO WHICH THE BEGINNING IS ATTACHED.

in the diagram currents will be set up in the iron. These currents will be o considerable volume, will require energy for their generation, and further, will give rise to considerable heat in the core. Both these factors will reduce the capacity and efficiency of the machine.

By making the core of thin discs of metal and by lightly varnishing one side of the discs each one is electrically insulated from its neighbor and no eddy currents can flow.

Armature Connections

The element of an armature winding or a coil may be defined as that portion of a winding which, being traced from one commutator segment ends at some other segment, the next one encountered in tracing through the winding. A coil or element may consist of one or more turns depending on the voltage for which the machine is adapted and the design of the generator or motor.

That part of the winding in which the electro-motive force is induced or that part lying on the face or in the slots of the core, is called a conductor and for every turn there will be two conductors, each one occupying similar positions under poles of the field magets of opposite polarity.

Methods of Winding

Two modes of grouping the coils, with modifications are in use in the winding of armatures and each one leads to different results. These windings are termed lap or parallel and wave or series windings.

Fig. 1 shows a radial diagram of an armature winding; the circles represent the conductors on the face of the armature and these are shown two deep. The machine being shown with four poles the coils do not go 180° or half way around as in a bipolar type, but only 90° that is, while one side of a coil is under the influence of a north pole the remaining side is under the influence of a south pole in identically the same manner as was illustrated in last month's section.

In Fig. 3 if we start at any one of the bars on the commutator and go along the lead from it which goes to an outer circle we will find that the arrows lead always in the same direction until any one of four bars on the commutator are reached. Starting at bar 1 we go through a coil carrying current away from us to the back of the armature and towards us to the commutator segment (2), or the one next to that from which we started.

When we get to bar 3, we find both leads, which are attached to it, will be carrying current towards it and thus through the brush away from the armature. A little consideration will show that it is at the positions where the brushes are shown that they must be set to collect the currents. The two positive brushes must be joined together and connected to the positive main of the current; and the two negative brushes must similarily be joined to the negative main of the circuit. It now becomes evident that in this lap-wound four-pole armature there will be four paths all in parallel, through all of which current will flow. If the machine were delivering say, 100 amperes, 25 amperes would flow along each of the four paths. This is one of the properties of a lap-winding,—there will be as many paths through the armature as the machine has poles and there will be needed as many sets of brushes around the commutator as the machine has poles.

The type of winding above described is called the lap-winding and its most easily remembered characteristic is that the beginning and end of two adjacent coils are together connected to one bar of the commutator. The armature shown has two conductors in each slot, one above the other, this allows the use of as many coils and commutator segments as there are slots, or if there were twelve slots there would be twelve coils and twelve bars in the commutator. Another arrangement is to only place one conductor in a slot, thus making our twelve slot armature have only six coils and a twelve-bar commutator.

Fig. 4 shows a developed winding diagram of the above armature shown in Fig. 3, and it is considerably easier in some respects to trace out connections from this type of diagram. The coils shown full are those which lie on top of the armature, while those shown dotted are those in the bottom of the slots.

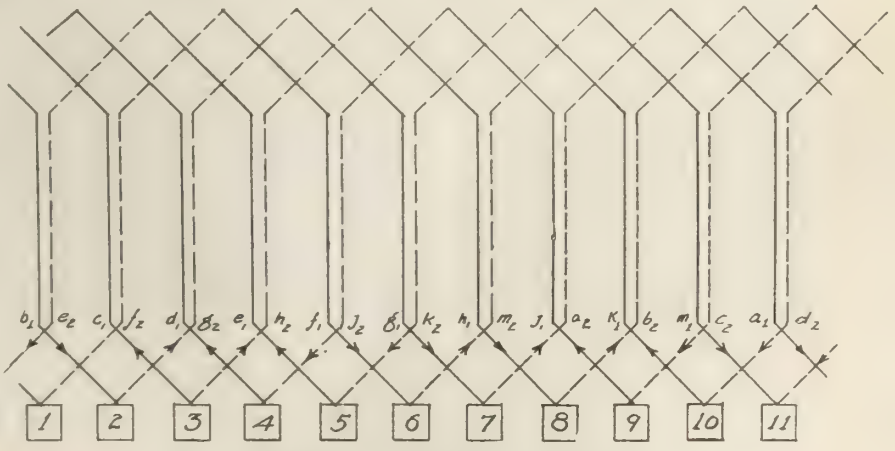


FIG. 6—DIAGRAM OF 4-POLE WAVE WINDING. 11 COILS.

Wave Windings

Fig. 5 shows a wiring diagram of a wave wound armature and it will be noticed in counting that the number of slots, coils and commutator bars is odd; in this case eleven. This is a peculiarity of the wave-wound armature and the number of slots must always be odd, in general it is usually one less than some multiple of the number of poles.

In tracing out the circuits in the armature and in figuring out the direction of current flow it will be found that there are only two points where the currents converge to or away from the commutator. These points are located where the brushes in the diagram are shown and it is one peculiarity of the wave-wound armature that only two brushes are needed no matter what the number of poles, whereas in the lap-wound armature there must be as many sets of brushes as there are poles in the field magnet.

If the winding be traced out from the brushes it will be found that there are only two paths through the armature, one with six coils in it and the other with five. This is just half the number which were present in the lap-wound armature before considered.

It has been remarked that there are six coils in one path and five in the other and this gives rise to the question as to whether the voltages generated in these two paths would be different. This is true to a slight extent, but in commercial armatures the number of coils is so great that the extra coil in one circuit does not have much influence and any coil which at one instant is in the path of the greater number is at the next instant when the adjacent commutator bar is reached in the path containing the fewer number.

This kind of winding is preferred for street car motors on account of the position of the brushes and on account of its adaptability for various speeds.

Both the above windings can be adapted to many other conditions and modifications exist which permit of using two, four or six paths through the armature of a multipolar machine.

Answers to Last Month's Problems

1.—Electricity is generated in a coil of wire by the action of a magnet when the coil and magnet are in movement relative to each other or when the magnetic flux of the magnet is increasing or decreasing.

2.—In a generator the energy used in the turning of the armature gives rise to an electric current through the cutting if the magnetic lines of force by the armature conductors. In the motor the armature is revolved and power given out by the magnetic drag of the field magnets on the armature conductors when they are carrying current.

3.—Read last month's text.

4.—Within limits the voltage generated by a dynamo increases directly as the speed increases, directly as the strength of the magnetic field is increased and increases as the product of the speed and the strength of the magnetic field.

This Month's Problems

1.—Why are the cores of armatures laminated or built up of thin sheets of iron or steel?

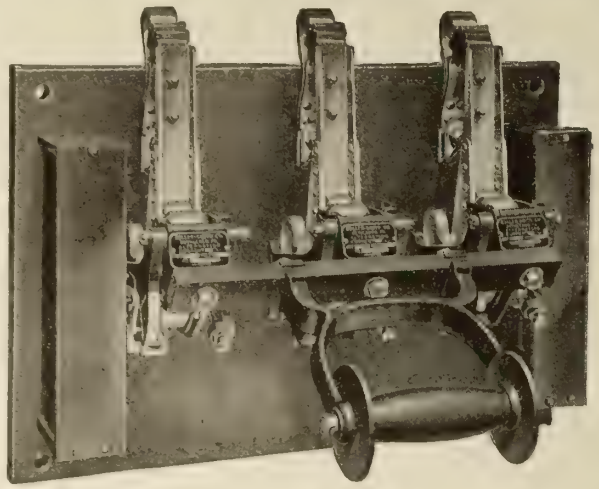
2.—What two general methods of winding direct current armatures are in use?

3.—What are the differences between these two methods?

4.—What differences exist in the brush arrangements used with these two windings?

SELF TIMING CIRCUIT BREAKER

COMPLETE protection of one common class of electrical load, a class well typified by the ordinary motor, requires something more than the usual instantaneous overload release circuit-breaker.



60 AMP. 250 VOLT 3-POLE RIGID ARM ,PLAIN OVERLOAD CIRCUI TBREAKER WITH TWO SELF-TIMING ATTACHMENTS

Take the common occurrence of a motor intermittently loaded. For such loads its safe maximum horse power capacity is evidently greater than with load continuously applied, and, if the installation is to be economical in cost and in operation, that capacity should be utilized. Dash pot delaying means fail to permit this in that they are necessarily restricted to short duration swings.

These requirements are admirably met with in the S.T. (self-timing) circuit breaker manufactured by the Roller Smith Co., New York, whose operation is extremely simple. The breaker itself is of standard construction tending always to trip instantaneously with the load, for which it is adjusted, applied. Interposed in the path of its trip armature is a pivoted hook shaped barrier under two independent controls. One control is thermal. The expansion of a metal rod heated at the same rate the motor is heated by the passage of the same current which drives the motor retracts the barrier and allows the breaker armature to trip if the heating is excessive, no matter how that excess comes about. This thus cares for the starting current and the variable motor loading protection requirements. The other control is electromagnetic, instantaneously retracting the barrier and allowing instantaneous trip if a heavy overload occurs.

Both controls are adjustable, that is to say, both maximum current which may continuously flow and emergency overload trip values may be independently varied by the purther adjustment.

NEW POWER STATION AT GLASGOW

The total power capacity of the new electric power station now under construction at Glasgow, and to be opened next year, is 150,000 kilowatts or 200,000 horse-power. The central station is at Dalmarnock, and electricity will be transmitted at a pressure of 20,000 volts (three-phase alternating 25 periods per second to distributing centres in other districts of the city.

A site measuring 13½ acres has been taken in hand bordering the River Clyde, and an ample supply of condensing water is obtained from that river. The first portion of the works already completed comprise a water intake, a screening house, two water culverts, switch house, turbine engine room, two boiler houses, workshop and store, and a complete coal-handling plant capable of dealing with 100 tons of coal per hour. The cost of this plant is £24,800.

The first instalment of the machinery will consist of three 15,000 kilowatts (20,000 h.p.) turbines, which will be coupled direct to alternating current generators; also three 1,000 kilowatt (1,300 horse-power) turbo sets for driving auxiliary machinery. It is proposed to add plant units of 15,000 kilowatts as the demand increases, while turbines of 30,000 kilowatts can be installed if found to be necessary.

UNIQUE OIL ENGINE-DRIVEN COMPRESSOR

By Frank C. Perkins

The accompanying illustrations show the design of fuel oil engine-driven compressors, developed at Chicago, Ill., to utilize low grade fuel oils and greatly increase the economy and sphere of usefulness of such machines. It is claimed that they have unquestionable reliability, sustaining low operating costs, indestructible flat disc air valves, totally enclosed construction and efficient automatic lubrication and regulation. These compressors have six standard strokes, 8, 10, 12, 14, 18 and 21 inches, with air and power cylinders, and the 8, 10 and 12 inch strokes only are arranged for portable and skid-mounted (semi-portable) use.

This low-grade fuel oil engine operates successfully on crude oil, fuel oil, residuum and stove oil, also on tops, tar oil, solar oil, gas oil, as well as engine distillate, coal oil, alcohol or naptha, benzol or gasoline. It has no valves, gears, carburetors, mixers, oil or air heaters, magnetos, batteries, timers, switches, coils, wires or spark plugs.

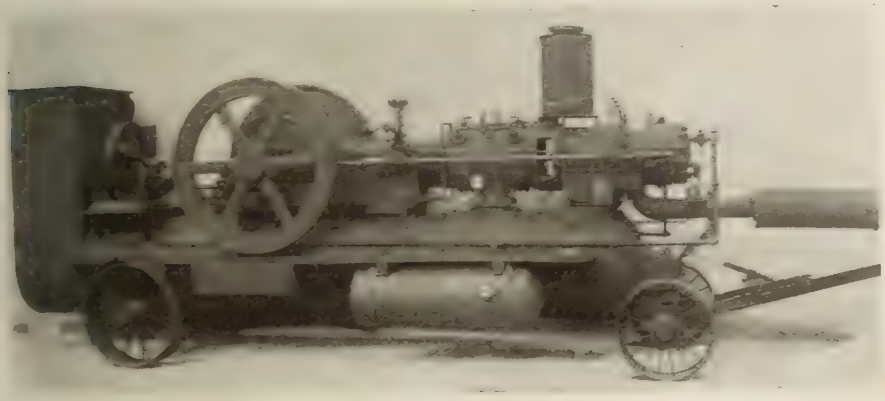
The employment of a single cylinder minimizes working parts and their consequent friction. The crosshead construction is extremely important, providing features of advantage over the trunk piston type that should not be ignored. The crosshead removes from the

piston head the angular thrust of the connecting rod with its tendency to wear the top and bottom of the cylinders more than the sides, with the result that oils of a heavy or asphaltum base will work back and under the piston rings, hardening there and causing excessive cylinder wear.

With the crosshead type all bearings are accessible, and by compressing in the front end of the cylinder instead of in the crank case, better compression is secured, there being no joints to offer opportunity for leakage and the compression space being greatly reduced. Lubricating oil from the crank case cannot possibly enter the combustion chamber and disturb regulation.

The cylinder of these engines is of the valveless, two-cycle low compression type, and the metal used is carefully distributed to withstand the stresses of hard service and at the same time maintain castings of as even thickness as possible. Water jackets are cast integral with the cylinders, but cover only that portion in which the combustion takes place. This construction simplifies the cylinder casting and facilitates the equalization of temperatures at all points.

The trunk type of piston is employed in these engines and provision is made for four self-adjusting eccentric spring rings. These are wider than the admission and exhaust parts, cannot catch or break, and effectually secure the compression which accounts for the efficiency of the engines. It is of interest to note that the method of igniting the fuel charge is positive and extremely simple, with no delicate parts involved and no sensitive adjustments necessary. A thin circular plate is rigidly secured to the piston and after the engine is started fuel injected against this hot plate is



SELF-CONTAINED COMPRESSOR MOUNTED ON TRUCKS FOR PORTABLE USE.

instantly gasified and ignited. By this system air only is compressed in the cylinders, the fuel is injected at the proper time and high sustained operating economies are possible.

STORAGE OF COAL

Some notes on the storage of coal with reference to the prevention of spontaneous combustion were given by Mr. John H. Anderson before the Institute of Marine Engineers, London.

The author said that his remarks were based in particular on experience gained with a heap containing just over 16,000 tons. The heap consisted entirely of small bituminous coal, of several kinds, washed and otherwise, some being of a character supposed to be dangerous for storing. Under these conditions extra care was exercised. Temperature readings were taken at 14 different places nearly every day, and occasionally also at the vent pipes, of which there were 50. Further, to find the hottest part, readings were taken at every foot from top to bottom at certain places. Previous experience indicated that the warmest place was between 6 ft. and 8ft. from the surface; hence 7ft. was established as a standard depth for temperature records. The temperature tubes were ¾in. or 1 in. gas tubing, driven in from the top to the bottom of the coal and long enough to project 2 ft. or 3 ft. above it. In most cases the vent pipes were old scrap tubes about 3 ft. long and 3 in. or 4 in. in diameter, and were driven down to the 7 ft. mark, their ends being flattened, chisel-shape, to facilitate driving.

By taking periodical readings of the temperature of the pile and comparing them with previous readings ample warning was obtained to prevent a fire. If a readying of 90° F., which was adopted as a warning temperature, was obtained at any place four other temperature tubes were driven down north, south, east and west about 10 ft. from the warm tube. The tube which gave the highest reading next day was then made the centre, and other pipes put down in its direction, the idea being to locate the source of heating. When the warmest place was found an additional vent pipe would be put in there, and this generally arrested the rise of temperature. If, however, it did not, a trench was dug a foot deep on each occasion—that is if the readings remained at, say, 100° for three days the trench would be 3 ft. deep. In fact a temperature of 100° was never reached, but on four occasions, when 95° was recorded at a point where the coal

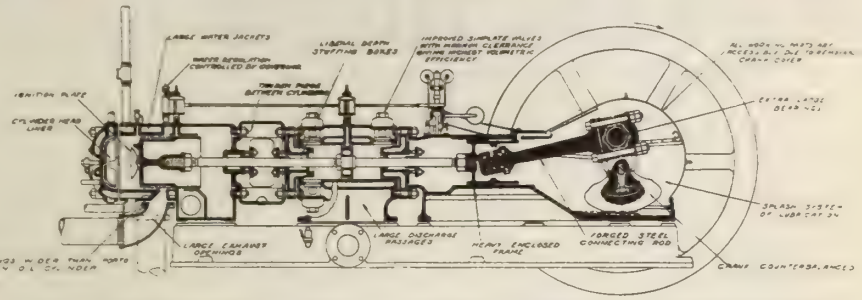


FIG. 2—LONGITUDINAL SECTION SHOWING DETAILS OF CONSTRUCTION.

was deposited to a depth of 16 ft., a trench was dug. Probably, however, this trenching would have been unnecessary had additional vent pipes been inserted. If a fire occurs, although plenty of water should be available to quench it, it is better to dig all round it, and if possible remove the hot coal.

In general the depth of the heap should not exceed 12 ft. to 14 ft. for small graded coals, or 9 ft. to 12 ft. for unwashed mixed coals. As regards slacks, a good deal depends on the composition. The author allowed two heaps of this material 10 ft. deep to rise to 120° before moving them, and they gave considerable trouble; even when they were reduced to 6 ft. there was a tendency for them to increase in temperature. Anything, such as pieces of wood, pit props, rags, waste, shavings, and straw, that ignites at a lower temperature than the fuel should be kept out of the heap. As a rule the greatest danger is up to about three months from the time the coal is taken out of the pit.

IN SOME hydraulic power stations there is, at certain seasons of the year, a surplus of energy available, which is commonly unavoidably run to waste. This has been the case (says Engineering) at the Leten power-station of the Zurich Electrical Power Company. At the same time it has been necessary to maintain for certain purposes a small steam plant. The company accordingly decided to utilize the surplus of power available for maintaining steam in a boiler for this plant. The boiler fitted has 1,800 sq. ft. of heating surface, and, with a maximum consumption of 84 to 86 kw., is able to supply 3,800 lb. of steam per twenty-four hours, which suffices to run the feed-pumps and to keep hot the machines and the piping.

Vancouver, B.C.—The Powell River Co., Ltd., 510 Hastings Street West, contemplates the installation of oil and coal burners costing $500,000 at Ocean Falls Mill.

The MacLean Publishing Company
LIMITED
(ESTABLISHED 1888)

JOHN BAYNE MACLEAN - - - - - - - President
H. T. HUNTER - - - - - - - - - Vice-President
H. V. TYRRELL - - - - - - - - - General Manager

PUBLISHERS OF

POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air, and Water Power, and to the design and operation of Refrigerating Machinery.

B. G. NEWTON, Manager. A. R. KENNEDY, Editor
Associate Editors:
J. H. RODGERS (Montreal) W. F. SUTHERLAND

OFFICES

CANADA—
Montreal—Southam Building, 128 Bleury St., Telephone Main 1004.
Toronto—143-153 University Ave., Telephone Main 7324.
Winnipeg—1207 Union Trust Building, Telephone Main 3449.
Eastern Representative—E. M. Pattison.
Ontario Representative—S. S. Moore.
Toronto and Hamilton Representative, J. N. Robinson.

UNITED STATES—
New York—R. B. Huestis, 111 Broadway, New York, Telephone 8971 Rector.
Chicago—A. H. Byrne, 900 Lytton Bldg., 14 E. Jackson Street. Phone Harrison 1147.
Boston—C. L. Morton, Room 733, Old South Bldg., Telephone Main 1024.

GREAT BRITAIN—
London—The MacLean Company of Great Britain, Limited, 88 Fleet Street, E.C., E. J. Dodd, Director, Telephone Central 11960. Address: Atabek, London, England.

SUBSCRIPTION RATE

Canada, $1.00; United States, $1.50; Great Britain, Australia and other colonies, 4s. 2d. per year; other countries, $1.50. Advertising rates on request.

Subscribers who are not receiving their paper regularly will confer a favor by telling us. We should be notified at once of any change in address, giving both old and new.

Office of Publication, 143-153 University Avenue, Toronto, Ontario.

Vol. XI. AUGUST, 1918 No. 8

PRINCIPAL CONTENTS

Modern Mechanical Draft for Furnaces 221-225
General 225
Cotton Cloth for Air Craft.
Engineer's Life Not a Bed of Roses When Things Go Wrong....226-228
General 228
Regulations for Dealers in Coal....A Vast New Oil Source ...Oils and Their Uses.
Power Plant Management and the Selection of Coal.....229-231
The Standardization of Electrical Switch Gear II.....232-235
Principles and Operation of Modern Electrical Equipment VI. 236-238
Self-timing Circuit Breaker 238
Unique Oil Driven Compressor 239
Editorial 240
Association and Personal 241
Operators' Point of View 242
Repairing a Line Shaft.... Welding a Large Alligator Shear Frame .... Oil and Water Separator .... Becoming an Engineer.
Selected Market Quotations 43

Greater Things in This World Than Dollars

A company with a large selling force has one man on its staff in the Eastern section of Canada who does a large business. He makes a lot of money for his firm, and he makes a lot of money for himself. He is regarded as a good business man. But he could do twice as much business if he only knew it.

A few weeks ago he sent in an order to the head office in an Ontario city for two carloads of goods. The price he had quoted was $4.50 per ton higher than the price on the company's accredited sheets for that period. The purchaser had been very keen to get a supply. The salesman was quick to realize this, and took occasion to pick off a few more dollars on the deal. The company could have filled the order at the higher price. It would have made some $400 on the shipment and the salesman would have been credited with that much extra.

The company did not stop to write. It wired first to the consumer stating that the order would be filled at a price $4.50 per ton less than quoted, and the next wire went to the salesman. It is not necessary here to state what that wire announced.

A letter followed stating that the company had one price for its goods. When an increase was made every buyer was notified in advance and no favors were shown.

It's too bad that more people can't get that same system worked in under their skins. There are so many people with a dollar bill or a fifty-cent piece jammed up and glued up against their eye that they can't for the life of them get a proper perspective. If they were permitted to gaze out upon the most wonderful sunset that the hand of the Almighty ever painted they could see nothing but the fifty cents or the dollar that might be gathered in from selling reserved seats to witness the production.

The man who is making his first thousand or his first ten thousand will tell you that grabbing money is the greatest occupation in the world. The man who has grabbed and gathered will tell you that he is just as keen to grab a hundred thousand as he was to grab his first ten.

The man who goes into business with the money-grabbing instinct burned into his brain is going to make a miserable failure in the long run. He may get a reputation for being keen—a few deluded individuals may even regard him as shrewd in his dealings. But allow for all that. What else is he getting out of life? Mighty little. And when he gets to the end of his string he will have the poor satisfaction of looking back over a lot of joyless days, penurious nightmares that he thought once were prosperous days—a trip barren of friendships and a career that will bring few mourners to his day of departure.

Real Economy in Burning All the Coal

THERE seems to be no end of advice given officially and otherwise to the Canadian public this year in regard to the necessity of saving coal, both in power plants and in the heating plants for the home. Occasionally there are some suggestions in regard to the proper methods of firing, and the securing of perfect combustion that have some real value, but there is a great deal of wasted and misspent effort in the advice given as a general thing.

Real results are going to be secured in making it certain that the greatest possible amount of heat is secured from the fuel we burn.

A steam engine is a waster at best. It is considered quite satisfactory to use 20 per cent. of the actual steam value delivered to the ordinary engine, and in many cases the figure will be well below that.

Boiler efficiency is another matter that has much to do with the amount of coal burned and the relative amount of heat obtained from it. There are, of course, boiler plants where as high as 80 per cent. of the heat in the coal will be secured, but that is above the average. Perhaps a figure around 60 per cent. would be much nearer.

There should be an effort made to induce power plant users to go ahead and introduce in their premises appliances that will make it certain that they will secure the maximum amount of heat from every ton of coal that goes into their furnaces.

Very little is going to be gained by simply keeping up a harangue that the people should burn less coal. That will probably result in decreased efficiency all round.

The big drive should be to see to it that we burn coal instead of letting a large percentage of the combustible material drift up and out of the smokestack.

Association and Personal

L. W. Adams has tendered his resignation as general superintendent of the Nova Scotia Steel & Coal Co., New Glasgow, N.S., effective Sept. 1. His successor has not yet been appointed.

Edward J. Albert, who for five years has been manager of the mining and power departments of Canadian Allis-Chalmers, Ltd., Toronto, Ont., resigned recently. He now is sales manager of the Thwing Instrument Co., Philadelphia.

William Starke, president of Starke-Seybold Ltd., Montreal, and a well known business man, died last Friday after an illness lasting only ten days. He was born in Montreal and had spent the whole of his life here, being known in many circles. He was 57 years of age and was a son of the late George Kinloch Starke. He received his education at local public and high schools, and his first business appointment was in a hardware establishment.

Captain Edward H. Phillips, E Co., 104th Infantry, an employee of the L. S. Starrett Co., of Athol, Mass., was killed in action in France on the 25th of July. Captain Phillips was an example of the finest type of young American manhood. Last spring he received the Croix de Guerre from the French Government. He was a sergeant when the company was formed and was rapidly promoted to second lieutenant, first lieutenant and captain. The L. S. Starrett Company has one hundred and twenty-four employees in the military or naval service of the United States and Great Britain.

One more official of the Dominion Steel Corporation has been lost in the person of F. W. Gray, who severed his connection with the company and left for New Glasgow. Mr. Gray has been attached to the company since 1904 and during his 13 years' mining experience here had done much to modernize and improve conditions. Graduating in mining from Sheffield university, Mr. Gray obtained training from G. Blake Walker, who is now president of the Institute of Mining Engineers. He is a member of the council of the Canadian Mining Institute, a member of the executive and editor for the Nova Scotia Mining Society and a member of the Institution of Mining Engineers.

Mr. Gray has written extensively on coal and has done much to advertise the coal fields and industries of Nova Scotia. Besides writing a monograph on the coal fields of eastern Canada, he has been a frequent contributor to technical periodicals. It was Mr. Gray who introduced the oxygen breathing apparatus into Nova Scotia. He has taken great interest in first aid work and matters relating to miners' relief societies and the compensation of workmen for injuries.

COMPRESSED AIR FOR CLEANING MOTORS

By Meredith.

In a great many manufacturing plants, especially those working in wood or a similar material, the driving motors have a tendency to become clogged with dust in a short time. Such accumulation of dust is a fire hazard, particularly if the motors are overloaded and liable to have coils burn out; and if a motor is not overloaded it may heat if the air ducts are filled with dust. Moreover, the motor is not able to carry the peaks when called upon, for the reason that the additional heat cannot be dissipated. Motors should be cleaned frequently, but such cleaning with the means ordinarily at hand is a rather difficult procedure since the air ducts are necessarily usually small and difficult to clear with a brush. The windows may be brushed off externally but such cleaning does not reach the real seat of the trouble.

One of the best methods is compressed air under considerable pressure. If the air is not available from some source already in use, it is advantageous to use a small motor driven compressor and a storage tank. The compressor should have a capacity of from 4 to 10 cubic feet of air per minute at a pressure of 100 pounds per square inch, and the tank should hold from 40 to 100 cubic feet. This size will take care of the average plant.

In piping a factory the air line can be in 1 in., ¾ in. and ½ in. pipe. Since the amount of air used in cleaning any one motor is small, a large pipe is not necessary. An outlet with a valve should be placed near each motor, or if they are grouped, several motors can be reached from one outlet with ½-inch or ⅜-inch hole. The smaller size is more easily handled. The nozzles can be made up of bras rod of suitable sizes and shapes, which, however, must have very small openings, as a large nozzle opening would consume too much air. Probably the most useful sizes would be 3/32 inch, 1/16 inch, and 3/64 inch, and these three nozzles will meet most conditions.

The Storage of Bituminous Coal.—The more general storage of coal during the spring and summer months is coming to be recognized as the only practical means of avoiding a coal shortage during the winter. Many corporations and individuals will this year undertake, for the first time, to store large quantities of coal. The storage of bituminous coal presents certain difficulties because of its tendency toward spontaneous combustion with its attendant dangers and losses. The methods to be employed in avoiding combustion have not generally been well understood and those which have seemed successful in some cases have failed in others. The engineering experiment station of the University of Illinois has just completed a study of the problems involved in coal storage and has published the results in a 200-page illustrated book designated as Circular No. 6, "Storage of Bituminous Coal." The study was made under the direction of H. H. Stock, Professor of Mining Engineering. The reasons and advantages of storing coal are given, the kinds and sizes of coal which may be safely stored are described, and the many factors entering into successful storage are discussed. Copies of Circular No. 6 may be had by addressing the Engineering Experiment Station, Urbana, Illinois. The price is forty cents per copy.

Many attempts have been made to weld the particles of tungsten together by working at a very high temperature. No headway has been made in this direction. To be workable, a piece of tungsten must be substantially non-porous—that is, the individual particles must have been previously welded together at a temperature near the melting point of tungsten in an atmosphere of hydrogen or other gas which is either helpful or at least not harmful to the tungsten. Sometimes the swaged tungsten rods split during the swaging operation. Attempts have been made to weld these split portions together by working at a high temperature. The highest temperature available was 1700 -1800 deg. C. It was not found possible to weld the tungsten in this manner. Tungsten can be welded electrically at temperatures near fusion.

Montreal, Que.—The Imperial Tobacco Co. is building an extension to its power house.

The Operators' Point of View

WELDING A LARGE ALLIGATOR SHEAR FRAME

By J. H. Rodgers

ABNORMAL conditions are often mainsprings of unprecedented industrial developments, and these circumstances, coupled with the essential need of maximum conservation of certain materials, are undoubtedly important factors in expansion of many enterprises. The stupendous demand for iron and steel during period of war activities has almost if not entirely eliminated the so-called scrap pile; parts of machinery, and in some instances complete machines that in normal times would be considered as useless, have been given a new lease of life as a result of the great difficulty experienced in obtaining the required article in its initial state, from its original source. Probably no other agency in the wide field of engineering has done so much to reduce the size of the scrap heap as the art of welding, be it the blacksmith, the autogenous or the thermit process. Each method has its own particular sphere of usefulness, careful judgment being frequently necessary to determine which is the best system to adopt to meet the needs of the situation. However, it is reasonably safe to assume that for welds on heavy bulky sections of machinery the best practice to follow would invariably be the last mentioned, that of the thermit process.

An interesting repair by the thermit welding process was recently performed at the plant of the St. Lawrence Welding Co., of Montreal, views of which are shown in the accompanying illustrations. The casting here shown is that of a large steel aligator shear frame, broken through the central rib and the back housing, as a result of the upper jaw being forced sideways through careless work on the part of the operator. Owing to the inability of getting immediate delivery on a new casting it was decided to have the part repaired by welding, so the method here described was adopted and the repair successfully accomplished.

Preparation

In preparing the frame for welding it was located directly beneath a skylight to permit of free egress of the heat and gases, as the ceiling was low and of wood construction. Before proceeding with the placing of the mold, the oxy-acetylene torch was used to cut away

VIEW OF FRAME WITH WELD COMPLETED.

the metal adjoining the crack, leaving a channel about two inches wide through the entire length of the broken portion; this being an essential feature in connection with welds of this character. The space thus provided is then filled with a special yellow wax which acts as the pattern; this wax is generally banked up above the ordinary level of the casting to provide additional metal at the broken section. This practice is not absolutely necessary, but where no interference will result the surplus metal is preferable as an added assurance of safety. During the preheating operation this wax is melted, leaving the hollow chamber for the fluid metal.

With the wax in position the sheet steel casing was placed over the broken portion in such a manner as would permit of placing the pouring gate and riser patterns in their desired location. This also applied to the heating gates, one of which was placed on either side and close to the bottom of the mold. Provision was made at the top of the mold in the form of a large basin, to carry the slag.

When ready for preheating the crucible was supported above the mold by means of a girder placed across the skylight opening. The preheating apparatus, shown in the background of Fig. 2, is a Thermit gasoline compressed air unit for generating the gas required for the preheating of the broken section, preparatory to the actual welding operation. This particular type is provided with a device for removing the moisture from the air before the same mixes with the oil; it is also equipped with two independent hose connections for operating two burners.

Preheating

The preheating on this job required considerable time, due to the heavy section of the broken portion and also to the fact that the pressure was insufficient to maintain a capacity flame at the heating gate. When the part was near the desired temperature the thermit —350 lbs. of which was required—was placed in the crucible, the latter being additionally supported on rails laid across the top of the molding frame. The burners were then removed and the heating gates plugged and banked with floor sand.

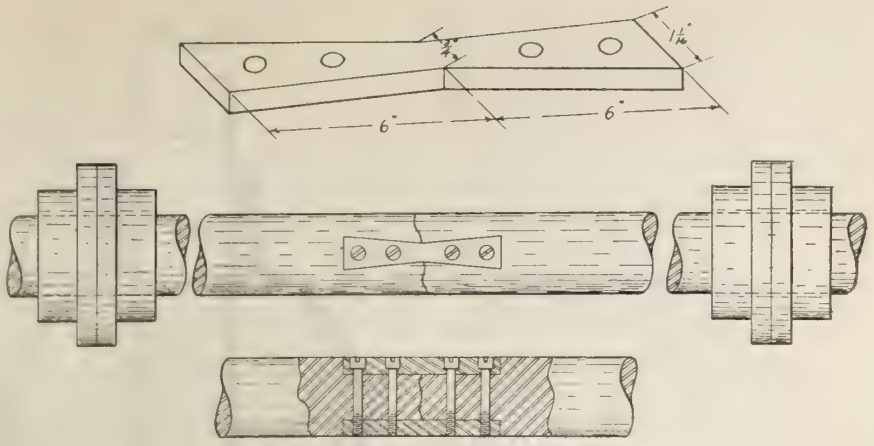
With everything in readiness the welder in charge places about one-half teaspoonful of the ignition powder on the top of the thermit in the crucible and then places the cone-shaped cover in position. A red hot rod is then inserted through the top of the cover and into the ignition powder, which is immediately ignited, and the chemical reaction is so rapid that within ten seconds the 350 lbs. of metal is converted into a molten mass at a temperature of over 5,000 degs. Fahr. In this particular instance, owing to the low heat of the casting before pouring, the metal was tapped less than ten seconds after ignition, so that the final stages of the

reaction process would take place in the mold, thus assisting the fusing of the surrounding metal.

Detail Reference

Fig. 1 shows the work during the preheating operation, with the gas hose leading to either heating gate, and the crucible suspended in position. Fig. 2 shows the pouring process twelve seconds after the initial ignition. Fig. 3 shows a close up view of the finished weld with the pouring gate, riser, and one of the heating gates, before removal by the oxy-acetylene torch. The method of reinforcing the weld is clearly illustrated. The total weight of the casting was over 7 tons, and the completed weld was entirely satisfactory in every particular.

One of the great advantages of the thermit method of welding is the uniformity of expansion and contraction, a factor that is of vital importance in the greater number of machinery repairs, particularly where these are bulky and irregular in shape. The gradual rise in temperature during the preheating operation and the almost instantaneous distribution of the molten metal to all parts of the section to be welded virtually eliminates the possibility of internal stresses being set up in the material.



DETAIL OF REPAIRS TO LINE SHAFT.

REPAIRING A LINE SHAFT

By J. H. Houldsworth.

A main line shaft broke between two couplings as shown in sketch, and was repaired in the following manner:

The shaft was 6 inches diameter, and the repair had to be executed as quickly as possible. The first thing done was to take a bar of steel and make two keys ¾ inch wide at the centre and 1 1/16 inch at the ends by ⅞ inch thick and 12 inches in full length. The keyway was drilled out with the shaft in place with a portable electric drill, then chipped out with an air gun and the keys made a good fit, two being placed diametrically opposite each other.

Four ½-inch holes were drilled and tapped in the shaft and fillister head screws were made with a long head to allow them to be screwed home tight.

Although a new piece of shaft was secured, we had no occasion to use it, as since the repair was made the whole thing was welded with a portable outfit which made a very satisfactory job and at a much less cost.

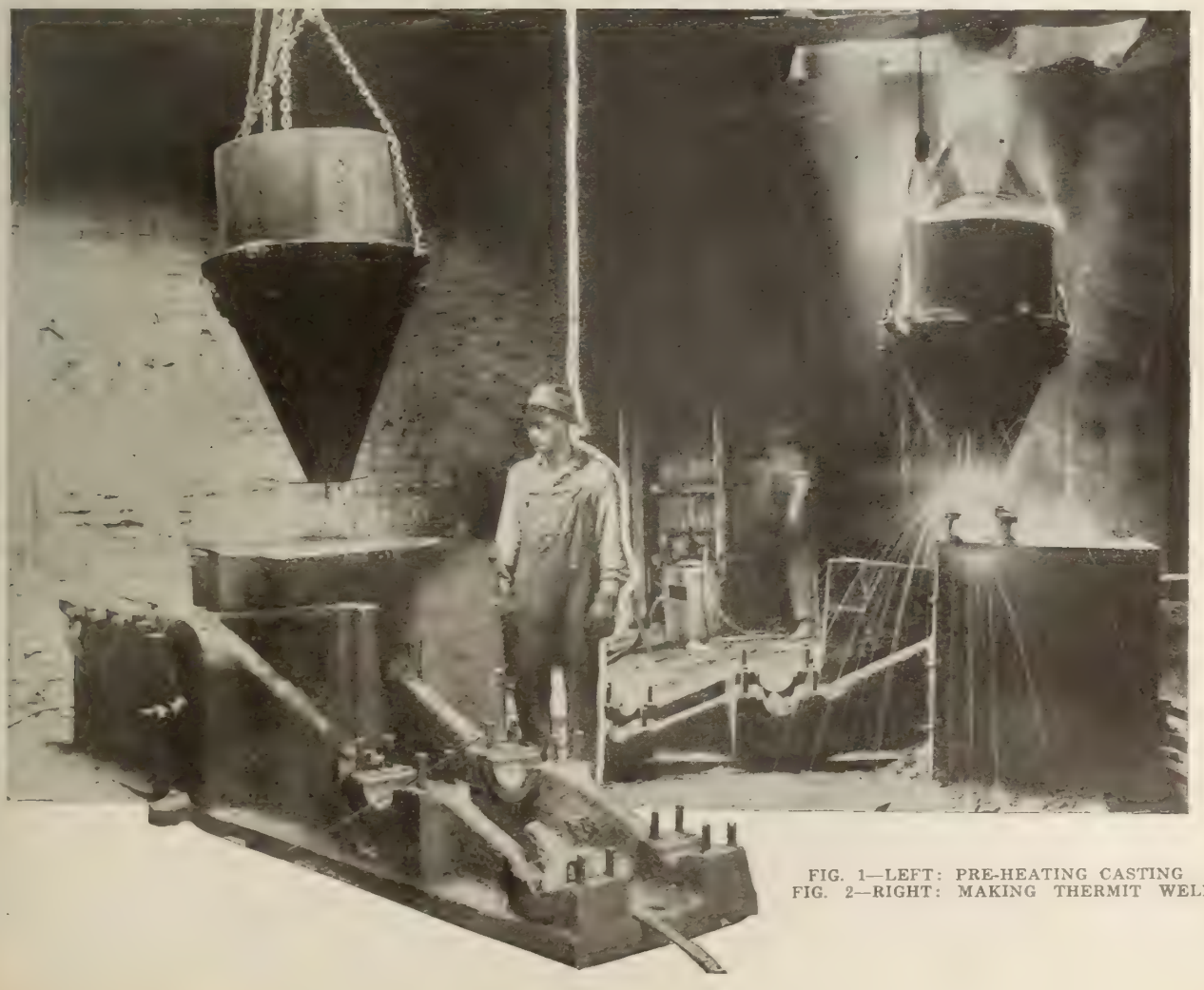
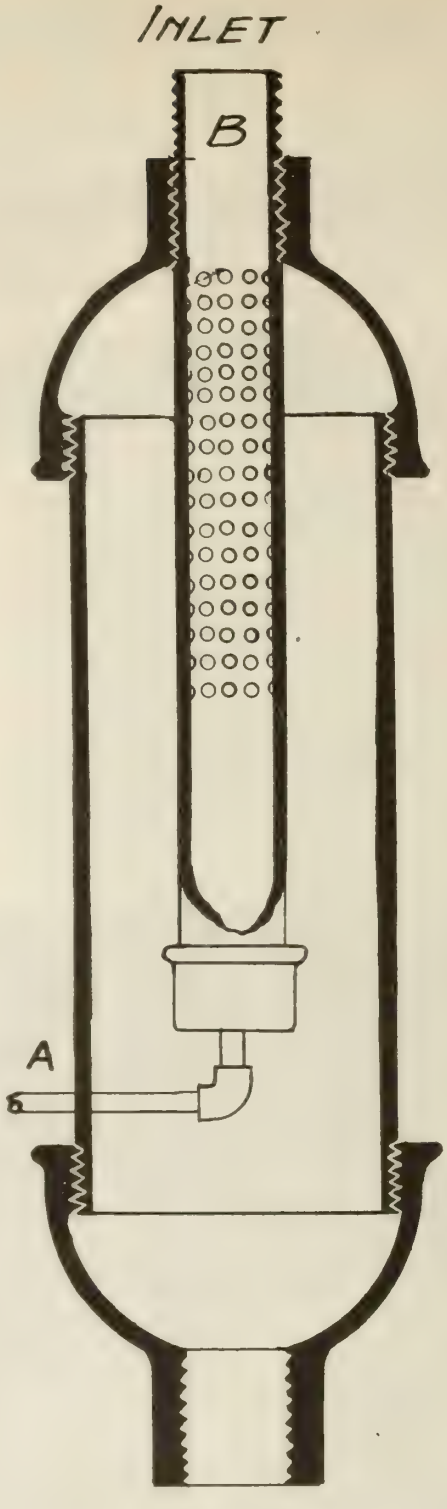


FIG. 1—LEFT: PRE-HEATING CASTING
FIG. 2—RIGHT: MAKING THERMIT WELD.

OIL AND WATER SEPARATOR

By J. E. Noble

FIG. 1 shows an article easily made from pipe and fittings. When used as an oil and water separator from a steam engine exhaust, the pipe A is run to an oil trap where the oil can be collected and saved for refiltering, or if it is not desired to save the oil, the drip can be run from the oil trap to the sewer, or direct from the separator to the sewer. A small gate valve should be placed upon the pipe A. The small holes shown should, in the aggregate, be equal in area, or greater, than the area of pipe B. If the device is used on a live steam pipe as a water separator only, the pipe A can be run to the hot well or feed water heater; in either case it would be good engineering to connect A to a small steam trap. The device may be used as an exhaust silencer on a gas engine, in which case the small holes can be extended down to the cap or a shorter pipe used, and the small pipe A dispensed with.



OIL SEPARATOR.

THE WOOD WORKING ENGINEER

By D. A. Hampson

GASPER Chase was a self styled "wood working engineer" and really there seems to be no good reason for objecting to such a term. Chase had a shop that made wood specialties from wooden nutmegs to picture frames. He himself knew the business from A to Z and had the respect of all in his own line who knew him. They phoned to us one day to know if we had any babbitt, good for spindle bearings. Said they had been buying of the F—— Co., who did their repair work, but the babbitt didn't give satisfaction.

Well, we supplied them with Mongolia and genuine babbitt and No. 4 metal during the succeeding year but they complained a good deal about all three. To our queries they replied that they most certainly did not overheat the babbitt, they used a good grade of mineral oil, they did not set the boxes up too tight but still they had trouble with the bearings and journals roughing up. They lost much time re-pouring and with hot bearings.

Frank, our outside man, was going past their shop one day and we asked him to stop and see if he could find any reason why they were having so much trouble. It happened that he was just in time. The men who did their babbitting had finished pouring the boxes of a planer and had scraped them to a fair fit. When Frank entered the room, he was putting the final touches on with a piece of emery cloth wound around a [illegible] smoothing the babbitt with emery. Frank asked if he didn't know that the particles of emery would stick in the babbitt and cut the shaft and would work lose and roll around tearing up the surface of the box. No, they hadn't heard of that and thought emery cloth was the proper thing to use on all metal.

Before Frank left he had thoroughly instructed the force in the babbitt scraping process which requires no finishing. Mr. Chase was called in to O. K. the change. He had seen the man emerying the boxes but did not know that it was wrong, "I'm a wood working engineer you know and so far as I knew that was the right way to do—but a man can't know everything." They got results from any grade of new babbitt after that.

READERS' QUERY

Question.—In a single truck trolley car having two motors one motor makes 100 revs. per min. more than the other. In what manner is the speed of the motor reduced to that of the other?

Answer.—The speed at which the motors of a trolley car run is a function of the size of the car wheels. As the wheels may vary slightly in size from one pair to another the speeds of the motors are not necessarily the same. This variation in speed is taken care of in the design of the motors, and a slight variation in speed caused by different wheel diameters is not objectionable, a slightly greater amount of power being given by one of the motors. The motors used are series wound for this reason as a slight variation in speed at the usual operating speed does not involve much variation in current consumption.

Question.—What horsepower is required to run an air compressor at 250 revs. per min. delivering air at 10 lb. per sq. in. and having a single cylinder 18 by 14 in.?

Answer.—The horsepower required depends on the number of cub. ft. free air delivered per minute and the pressure at which it is delivered. In this case the number of cub. ft. free air per min. will be about 1,000. To compress one cub. ft. free air to 10 lbs. pressure requires about .0361 h.p. and to compress 1,000 cub. ft. will require about 36 h.p. This does not take into consideration the friction losses etc. of the compressor and about 40 h.p. would be required all told.

IN a power plant the attendants are making clever use of the periscope idea. In order to read the temperature of the oil in transformers it has been necessary in the past to use a step-ladder to reach the thermometer mounted on the top of each unit. By using a simple periscope on each transformer it is now possible for the attendants to read the thermometer scale, which is illuminated by a lamp suspended near it, from the floor. —D. S.

* * *

LEAKAGE past the valves and piston will materially reduce the intake capacity of an air compressor. If the area of the intake valves is too small the cylinder will not be filled with air at atmospheric pressure, and, if the area of the discharge valves is too small all the air compressed will not be discharged. Poppet valves depend upon a difference in pressure on the two sides of 2 to 5 oz. for their action and may reduce volumetric efficiency by as much as 2 to 4 per cent. Mechanically operated valves of the Corliss type are very satisfactory but must be maintained in correct adjustment.

Hull, Que.—The Hull Electric Co., proposes to build an addition to its plant at a cost of $30,000.

THE TROUBLES OF AN EMBRYO ENGINEER

By Batiste Lefore

My name is Batiste Lefore, I am ze french mans, I have been having ze troubles wis ze steam plant las week.

I was ze sweep de floor man in ze factory but every time de engineer clean out dose boilers he ask for Batistee to help hem. Well dat engineer he go to fight de hun and me Batistee being old fellow, I stay home. De boss say Batistee, how you like to be engineer and mak tree dollar a day. I say, sure for dat is fine job, all dere is to do is shovel in coal to keep dat steam up, oil up de engine and shafting, lace de belts, sharpen de knives, wash de windows, and sit down when nobody can find anyting for me to do. Sure, I make a grab for such a snap and de next morning I am on de job at 5 a.m. I fill up the fire hole wid coal and at 7 a.m. de whistle I blow for start work, de big valve called safety she be blowing at de same time.

After awhile de Boss come in and say, damn it Batistee why you let dat safety valve below. I say I tink she do dat for safety. He look at de glass and say where is de water, I tell him it is in de boiler I nevaire take eet out. He yelled pull out your fire or she will blow up, den he runs away and I runs after him. Well pretty soon de fire goes out and we get the boiler men to fix her up again and de boss show me how to put in de water and say do not let the safety valve plow so much. I am getting on fine and one day when I am painting de walls a feller comes in and says are you de engineer, I tell him I am him. He say I am inspector Dan Sharpise. Where is your certificate? I say, what is dat. He say a licence. I tell him I am not a dog and do not need a tag. He say you go to dose examiners and get a licence or I put you in ze coop. I say sacre, I not go in any hen coop. I go to see dese examiner fellow. He say Batiste vos you an engineer? I say sure. He say describe de engine you run. I tell him dere is a pipe to take de steam in and anoder one to take it out and a rod runs out and in and turns de wheels around. McGee he say. Ha name de valve on de engine. I tell him de only valve on de engine is de one de Boss called de trottle. He say, hang it man, I mean de valve in de steam chest. I tink dat McGee he been having some 2½ per cent. to talk about chests on de engine.

He ask me do I know how much lead and lap de valve. him got. I start to laugh for I tink he joke me. I say sure McGee. I tie de string to dot valve and lead him around de mill and let him lap up some milk like a cat. Den McGee be get red in de face and say damn some times more. Den McGee ask me if it is good plan to put valve between boiler and safety valve, and I say, sure, because if I had valve dere I could shut him when de steam gets high pressure. He say damn again. He say to me I expect if de water got out of de glass and a big fire on you would run away. I say, sure, again, dat is just what I did do a little while ago. He say, see here Batistee, you no damn good as an engineer, go away and learn sometings and come back next year. Anyhow I am going to write to dose correspondence schools on Yongs street, Toronto, and pretty soon I will be a mail order engineer wid a salary of $3 a day, and noding for Sunday or overtime work. By gar, dere is a lot to learn in dat engineering.

THE PRODUCTION OF LIQUID AMMONIA

By Mark Meredith

Until the beginning of the war Holland was dependent for its supply of liquid ammonia upon England, Germany and more particularly Belgium. At the commencement of 1915 no liquid ammonia was to be had in Holland, as not only the ammonia itself, but also the steel cylinders for containing it, had been commandeered in the belligerent countries, or declared contrabrand of war. This caused much trouble to the industries making use of low temperatures. Calculation showed that the total annual consumption of Holland would amount to something like 27,000 kilogrammes.

At the Arnheim gasworks all the ammoniacal liquor produced was generally converted into pure concentrated ammonia solution: but during the war the high prices of sulphate, and the national need for artificial fertilisers, led to part of the ammonia being sent out as sulphate. The ammonia as driven off is saturated with water; but it is important now to obtain it as dry as possible, to ensure the safe working of refrigerating machines. The restrictions in this connection are therefore of increasing severity. Whereas some twenty years ago 0.9 to 1 per cent of water was permitted in liquified ammonia, the maximum now allowed has been lowered to 0.4 to 0.5 per cent. The drying properties of chloride of lime cannot be made use of, as it combines with ammonia. Caustic soda too is valuable in these days, so there remains only as an available drying agent burnt lime. This, however, has insufficient drying effect, except under pressure. With the pressure at normal, the lime generally left 0.9 to 1 per cent of water in the gas. The most effective means of producing totally anhydrous ammonia—with 0.05 per cent of water—is by evaporating the liquified ammonia, and subsequent reliquifying of this volatilised first product.

At the Arnheim works efforts have been made to eliminate the greater part of the water by cooling. To the current of wet ammonia gas, there is added liquified ammonia at a regular temperature. By the evaporation of the liquified gas the temperature falls as low as 15 deg. C. Thus the water is condensed, after which the gas is led through the drying apparatus. The condensed water is of course saturated with ammonia and leaves the compression plant through a syphon. The amount of liquid ammonia, about 7 per cent of the total bulk produced, is naturally not lost, as it is liquified again. It is taken from cylinders and not from the general storage holder, to permit of control of the quantity used. After this treatment the gas passes through two towers filled with lumps of burnt lime; the inlet being at the upper side, the outlet at the under side. Provision is made for subsequent treatment of the gas with caustic soda lumps in a separate tower.

After these processes the gas passes to a large storage holder, from which it goes to compressing plant very similar to that in use for the manufacture of ice, except that there is no brass and the compression cylinder stands in circulating cooling water. Mineral oil is used for lubrication, an oil-separator being placed after the compressor for removing the surplus oil. In spite of this cooling, the ammonia gas when compressed at from 7 to 10 atmospheres becomes warm. It is condensed in a large cooling coil, and then collected in a storage receiver of about 70 gallons capacity, thereafter being emptied from this into the steel bottles.

On the pressure side of the compressor, and above the cooling coil, there is a blow-off tap. The permanent gases, and more especially the air, which accompany the ammoniacal gas from the stills are blown off during the working, and conducted through water for the retention of the ammonia. From the storage receiver the ammonia is charged into steel bottles, after these have all been emptied by a small pump operated by the The chemical and physical properties of gaseous and liquified ammonia are well known; but there is one peculiarity which may be referred to—the high expansion co-efficient of the liquid. At ordinary temperatures this expansion is less marked, but at slightly raised temperatures the increase becomes very marked gramms.

At 10.0° C.	pressure is	88.2 lb.	per sq.	in.
" 50.0° C.	"	" 294.0 lb.	"	
" 65.7° C.	"	" 455.7 lb.	"	
" 67.7° C.	"	" 860.0 lb.	"	

Thus, for a rise of temperature of only 2 degrees C., the pressure is almost doubled. The filling of the bottles therefore needs special care, for when the expansion is not taken into account an explosion of the bottle is to be feared. The delivery of high ammonia during the first year amounted to 40,000 kilogrammes.

SELECTED MARKET QUOTATIONS

A Record of Prices Current on Raw, Semi-finished, and Finished Materials Entering Into the Manufacture and Operation of Power Plant Equipment

BOILER TUBES

Size	Seamless	Lapwelded
1 in.	$36 00	$.....
1¼ in.	40 00	.....
1½ in.	43 00	36 00
1¾ in.	43 00	36 00
2 in.	50 00	36 00
2¼ in.	53 00	38 00
2½ in.	55 00	42 00
3 in.	64 00	50 00
3¼ in.	.....	58 00
3½ in.	77 00	60 00
4 in.	90 00	75 00

Prices per 100 feet, Montreal and Toronto.

PLATES

	Montreal	Toronto
Plates, ¼ to ½	$10 00	$10 00
Heads	10 30	10 25
Tank plates, 3-16 in.	10 50	10 10

WROUGHT PIPE

Effective Jan. 7, 1918.
Standard Buttweld.

Size.	Black Per 100 feet	Galvanized Per 100 feet
⅛ in.	$ 6 00	$ 8 00
¼ in.	5 16	7 29
⅜ in.	5 16	7 29
½ in.	6 55	8 12
¾ in.	8 28	10 41
1 in.	12 24	15 39
1¼ in.	16 56	20 82
1½ in.	19 80	24 89
2 in.	26 64	33 49
2½ in.	42 72	53 53
3 in.	55 85	70 00
3½ in.	70 84	87 86
4 in.	83 93	104 10
Standard Lapweld		
2 in.	29 60	36 08
2½ in.	44 46	54 70
3 in.	58 14	71 53
3½ in.	72 68	90 62
4 in.	86 11	107 37
4½ in.	97 79	122 56
5 in.	114 00	142 82
6 in.	147 80	185 28
7 in.	180 80	241 57
8 in.	233 30	292 32
9 in.	279 50	350 18
10 in.	333 70	418 18

Prices—Ontario, Quebec and Maritime Provinces

WROUGHT NIPPLES

4" and under, 45%.
4½" and larger, 40%.
4" and under, running thread, 25%.
Standard couplings, 4" and under 50%
4½" and larger, 15%.

IRON PIPE FITTINGS

Malleable fittings, class A, 20% on list; class B and C, net list. Cast iron fittings, 25% off list. Malleable bushings, 25 and 75%; cast bushings, 25%; unions, 45%; plain cast iron tees, 50% off list. Malleable fittings: Class B black, 24½c lb.; Class C black, 15¾c lb.; galvanized, Class B, 34c lb.; Class C, 24½c lb. F.O.B. Toronto.

COLD ROLLED SHAFTING.

At mill ..... list plus 60%
At warehouse ..... list plus 50%
Discounts off new list. Warehouse price at Montreal and Toronto.

FINISHED IRON AND STEEL

Per lb. to Large Buyers (Cash)

Iron bars, base, Toronto	$5 25
Steel bars, base, Toronto	5 50
Steel bars, 2" to 4" base	6 00
Iron bars, base, Montreal	5 25
Steel bars, base, Montreal	5 50
Reinforcing bars, base	5 25
Small shapes	5 75

SHEETS

	Montreal	Toronto
Sheets, Black, No. 28	$ 8 00	$ 8 25
Sheets, Black, No. 10	10 00	10 00
Canada plates, dull, 52 sheets	9 00	8 65
Canada plates, all bright	9 50	9 50
Apollo brand, 10¾ oz. galvanized	....	....
Queen's Head, 28 B.W.G.	....	....
Fleur-de-Lis, 28 B.W.G.		
Gorbal"s Best, No. 28.		
Colborne Crown, No. 28	....	....
Premier, No. 28 U.S.	....	9 20
Premier, 10¾ oz.	....	9 50

PROOF COIL CHAIN B

¼ in.	$14 35
5-16 in.	13 85
⅜ in.	13 50
7-16 in.	12 90
½ in.	13 20
9-16 in.	12 70
⅝ in.	12 50
¾ in.	12 40
⅞ in.	12 90
1 in.	12 65
Extra for B.B. Chain	1 20
Extra for B.B.B. Chain	1 80

ELECTRIC WELD COIL CHAIN B.B.

¼ in.	$13 00
3-16 in.	12 50
¼ in.	11 75
5-16 in.	11 40
⅜ in.	11 00
7-16 in.	10 60
½ in.	10 40
⅝ in.	10 00
¾ in.	9 90

Prices per 100 lbs.

FILES AND RASPS

	Per Cent.
Great Western, American	50
Kearney & Foot, Arcade	50
J. Barton Smith, Eagle	50
McClelland, Globe	50
Whitman & Barnes	50
Black Diamond	37½
Delta Files	37½
Nicholson	37½
Globe	50
Vulcan	50
Disston	50
P.H. and Imperial	50

OILS AND COMPOUNDS

Castor oil, per lb.	....
Royalite, per gal., bulk	18
Palacine	21
Machine oil, per gal.	26½
Black oil, per gal.	15
Cylinder oil, Capital	49½
Cylinder oil, Acme	39½
Standard cutting compound, per lb.	06
Lard oil, per gal.	2 60
Union thread cutting oil antiseptic	88
Acme cutting oil, antiseptic	37½
Imperial quenching oil	39½
Petroleum fuel oil	13½

BELTING—No. 1 OAK TANNED.

Extra heavy, single and double	30-5%
Standard	40%
Cut leather lacing, No. 1	$1 95
Leather in sides	1 75

COAL AND COKE.

Solvay Foundry Coke	.....
Connelsville Foundry Coke	.....
Steam Lump Coal	.....
Best Slack	.....

Net ton f.o.b. Toronto.

BOLTS, NUTS AND SCREWS

	Per Cent.
Coach and lag screws	25
Stove bolts	55
Plate washers.....list plus	20
Machine bolts, 7-16 and over	net
Machine bolts, ⅜ and less	10
Blank bolts	net
Bolt ends	net
Machine screws, fl. and rd. hd., steel	27½
Machine screws, o. and fil. hd., steel	10
Machine screws, fl. and rd. hd., brass .....add	20
Machine screws, o. and fil. hd., brass .....add	25
Nuts, square blank .....add	$1 50
Nuts, square, tapped.....add	1 75
Nuts, hex. blank .....add	1 75
Nuts, hex. tapped .....add	2 00
Copper rivets and burrs, list plus	30
Burrs only list plus	50
Iron rivets and burrs	15
Boiler rivets, base ¾" and larger $8	50
Structural rivets, as above	8 40
Wood screws, flat, bright	72½
Wood screws, O. & R., bright	67½
Wood screws, flat, brass	37½
Wood screws, O. & R., brass	32½
Wood screws, flat, bronze	27½
Wood screws, O. & R., bronze	25

MISCELLANEOUS.

Solder, strictly	0 60
Solder, guaranteed	0 70
Babbitt metals .....18 to	1 00
Soldering coppers, 3 to 6 lbs.	0 64
Putty, 100-lb. drums	5 20
White lead, pure, cwt.	16 20
Red dry lead, 100-lb kegs, per cwt.	15 50
Glue, English	0 35
Gasoline, per gal., bulk	0 33
Benzine, per gal., bulk	0 30½
Pure turpentine, single bbls., gal.	1 03
Linseed oil, raw, single bbls.	1 95
Linseed oil, boiled, single bbls.	1 98
Lead wool, per lb.	0 15
Plumbers' oakum, per cwt.	9 00
Sandpaper, B. & A....list plus	20
Emery Cloth.....list plus	20
Sal Soda	0 03½
Sulphur, rolls	0 05
Sulphur, commercial	0 04½
Rosin "D." per lb.	0 03
Rosin "G." per lb.	0 03½
Borax crystal and granula.	0 14
Wood alcohol, per gallon	1 80
Whiting, plain, per 100 lbs.	2 20

COPPER PRODUCTS

	Montreal	Toronto
Bars, ½ to 2 in.	$42 50	$43 00
Plain sheets, base 16 oz. and heavier	46 00	44 00
Copper sheet, tinned, 14x60 in., 14 oz.	48 00	48 00
Copper sheet, planished, base 16 oz. and heavier	57 00	45 00
Braziers' in. sheets, 6x4 base	45 00	44 00
Tubing T.P.S., base ¾ in. up to 3 in.	60 00	60 00

Above prices are full sheets and bars. Cut sheets and bars are 5c per lb. higher.

BRASS PRODUCTS.

Brass rods, base ½" to 1" rd.	$0 43
Sheets 24 oz. and heavier base	0 48
Brass tubing, seamless	0 55
Tubin, I.P.S., 1" base	0 55

POLISHED DRILL ROD.

Discount off list, Montreal and Toronto ..... Net

RUBBER BELTING

Standard	10%
Best grades	15%

WASTE

White.	Cents per lb.
XXX Extra	21
Peerless	21
Grand	19¾
Superior	19¾
X L C R	18½
Atlas	18½
X Empire	17¼
Ideal	17¼
X press	16
Colored.	
Lion	15
Standard	13½
No. 1	13½
Popular	12
Keen	10½
Wool Packing	
Arrow	25
Axle	20
Anvil	15
Anchor	11
Washed Wipers	
Select White	11
Mixed colored	10
Dark colored	09

This list subject to trade discount for quantity

MILLED PRODUCTS

	Per Cent.
Set screws	25
Sq. & Hex., Head Cap Screws	20
Rd. & Fil Head Cap Screws	Net
Flat & But. Hd. Cap Screws plus	Net
Fin. & Semi-fin. nuts up to 1 in.	25
Fin. and semi-fin. nuts, over 1 in., up to 1½ in.	20
Fin. and semi-fin. nuts, over 1½ in., up to 2 in., list plus	10
Studs	20
Taper pins	40
Coupling bolts, pins	10
Planer head bolts, without fillets .....list plus	10
Planer head bolts, with fillet list plus 10 and	10
Planer head bolt nuts, same as finished nuts.	
Planer bolt washers	net
Hollow set screws..list plus	20
Collar screws...list plus 30,	10
Thumb screws	20
Thumb nuts	65
Patch bolts .....add 40,	10
Cold pressed nuts to 1½ in.	add $4 50
Cold pressed nuts over 1½ in.	add $7 00

METALS

	Montreal	Toronto
Lake copper	$31 00	$29 50
Electro copper	31 00	29 50
Castings, copper	30 00	28 50
Tin	125 00	125 00
Spelter	11 50	11 00
Lead	10 00	10 00
Antimony	17 50	18 00
Aluminum	55 00	58 00

Prices per 100 lbs...

ROPES AND PACKING

Packing, square braided	0 34
Packing, No. 1 Italian	0 40
Packing, No. 2 Italian	0 32
Pure Manila rope	0 39
Transmission rope, Manila	0 45
Drilling cables, Manila	0 41

LEAD SHEETS

	Montreal	Toronto
Sheets, 3 lbs. sq. ft. lb.	$12 00	$13 25
Sheets, 3½ lbs.	12 00	13 25
Sheets, 4 to 6 lbs.	13 00	12 50

Cut sheets, ¾c per lb. extra. Cuts sheets to size, 1c per lb. extra.

"Good Work, Alexander! Let Loose Your Lusty Crow"

Your work was well done. You remembered that tube cleaning is divided into TWO parts:

1st—removing the scale.
2nd—doing it without injuring an otherwise sound tube.

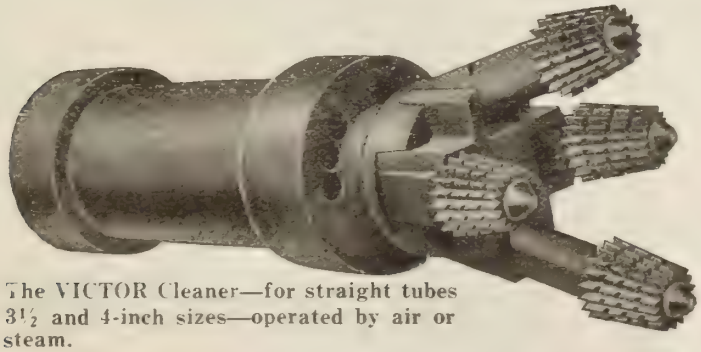
Think well of these *two* aspects of tube cleaning.

Remember, it isn't just a question of getting scale from the tubes—dynamite might do that.

Call in Alexander, the VICTOR Tube Cleaner. He handles tube cleaning from both angles.

He is a success from beak to spurs!

Write for Catalog 14 with facts on the full line of Liberty Tube Cleaners



The VICTOR Cleaner—for straight tubes 3½ and 4-inch sizes—operated by air or steam.

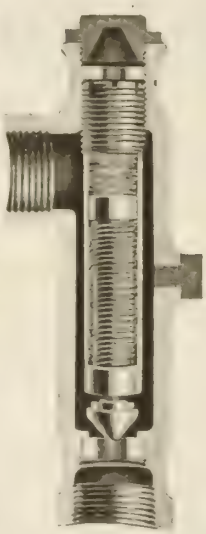
Liberty Manufacturing Company

443 Diamond Street, Pittsburgh, Pennsylvania

Steam Trap SARCO

is Automatically Operated by its Own Hydraulic Pressure.

The strongest and most convincing argument we can offer is a free trial of this wonderful, powerful and efficient steam trap. Put one to work at once and by actual experience and test learn its many advantages.



Steam Trap Sarco will fit any steam line as an elbow, or angle connection requiring no building up nor pit digging.

Its operation is simplicity itself. Only one moving part. The Sarco after once adjusted will automatically keep any steam line free of condensation without waste of steam.

Small in size. Easily installed. Automatic in operation. Equal in capacity to float or bucket trap. For high and low pressure. Unusually small in cost.

Try one and check up these points of merit.

Sarco Company Inc.

Woolworth Bldg., New York City

Ellicott Square, Buffalo
[illegible] Bldg., Detroit
[illegible] Bldg., Philadelphia
Monadnock Block, Chicago
Williamson Bldg., Cleveland
and representatives in all principal cities.
[illegible] Brothers, Montreal.

TRADE GOSSIP

Montreal, Que.—Lamontagne Ltd., are building a factory and power house to cost $55,000.

Amherst, N.S.—The International Engineering Works will build an extension to its factory.

Sudbury, Ont.—A new boiler house will be built at St. Joseph's Hospital. H. D. Evans has the contract.

Tillsonburg, Ont.—The Tillsonburg waterworks tower has been destroyed by fire. Loss estimated at $50,000.

Toronto, Ont.—The J. Whitefield Co. will build an addition to the plant at 33 Sherbourne street, to cost $6,000.

Toronto, Ont.—The Lancashire Dynamo & Motor Co. will build an addition to its machine shop to cost $3,000.

Guelph, Ont.—The installation of a pumping machine, $16,000, is contemplated by the City Water Commissioners. Engineer, F. McArthur.

Prince Rupert, B.C.—The Prince Rupert Hydro-Electric Co. contemplate the erection of a waterpower plant. City engineer, P. Lorenzen.

Levis, Que.—Plans are being prepared for a $100,000 filtration plant for the City Council. Engineer, Edouard Hamel, St. Peter street, Quebec.

Lauzon, Que.—The construction of waterworks costing $10,000 for the Town Council is under contemplation. Engineer, E. Hamel, 21 St. Peter street, Quebec.

Woodville, Ont.—A by-law will be voted on by the ratepayers on August 19 to raise $1,500 to provide for the cost of completing plant for the distribution of hydro-electric power.

Rainy River, Ont.—A by-law was submitted to the ratepayers on August 12 to authorize an expenditure of $31,000 to purchase the plant and equipment of the Rainy River Electric Light & Power Co.

Calgary, Alta.—The Dominion government is about to undertake the work of testing the gases of all the Alberta fields with a view to ascertaining the gasoline contents in each. The work will commence in the Calgary field under the supervision of D. R. Dawling, of the Canada Geological branch.

Less Anthracite for the Railways.—The supply of anthracite coal for Canadian householders next winter will be helped out by an order of the Canadian Railway War Board, directing the railways to use no anthracite in stations or elsewhere, except in the Baker heaters used in passenger cars when heat from the engine is unavailable. These require anthracite. In addition to the annual 10,000,000 tons of bituminous coal required for locomotives and in railway shops, the roads had estimated their requirements of anthracite this year at 96,000 tons. Of this amount the new orders of the Canadian Railway Board will save over 60 per cent.

To Speed Up Cape Breton Mining.—Hon. A. K. Maclean expects to leave for Sydney, C.B., at the end of the week in an endeavor to stimulate production of coal from the Cape Breton fields. Advices received here are that production in this area is much below capacity and must be speeded up if a coal crisis is to be avoided next winter. At the present time the outlook is admittedly serious. A number of manufacturing firms are reported to be without prospect of securing necessary supplies and may have to close down. Complaint is made that owing to the high wages the miners now receive many of them are not working the full week, and production is suffering in consequence.

Kipawa Fibre Co.'s New Mill.—According to advices to hand, the preliminary work of erecting the large sulphite plant of the Kipawa Fibre Co. at the foot of Lake Temiskaming is under way. This plant is a subsidiary concern of the Riordon Pulp and Paper Co. Three hundred and fifty men are engaged in construction work by the George A. Fuller Co., which has the contract for the building of the new mill. The site for the mill, about 80 acres in all, has been cleared, and the contract has been let for the clearing of the townsite. The work of putting in the footings for the digesters and the shipping room is under way, the rock is being blasted away from the site of the power plant, and a coffer dam is to be erected soon. Sulphite pulp and all kinds of wood fibre will be turned out at the plant when completed, and the capacity will be large.

Crude Rubber Supply Curtailed.—Radical curtailment of the amount of crude rubber available for manufacture into pneumatic automobile tires may be expected in the near future. Conditions throughout the rubber business are such that the war necessities of the United States government are also certain to call for a sharp cut in the use of pleasure cars within 60 days. These two facts form the outstanding results of the meeting of all branches of the rubber industry on Wednesday at the Waldorf-Astoria, when representatives of the War Industries Board explained the situation to representatives of the rubber trade. The government expects the manufacturers to cut in two their output of pneumatic tires for pleasure automobiles during August and September. The programme also calls for restriction in production of many other semi-essential rubber products for the next two months.

Scarcity of Coal in U.S.—Coal miners and operators are called upon in a proclamation by President Wilson to give their maximum effort to the production of coal to the end that threatened shortage next winter may be avoided. The President asks the miner particularly to work full time, and urges those who are essential to the industry to accept deferred classification in the draft. "The existing scarcity of coal," said the proclamation, "is creating a grave danger—in fact the most serious which confronts us, and calls for prompt and vigorous action on the part of both operators and miners. Without an adequate supply our war programme will be retarded; the effectiveness of our fight-

ing forces in France will be lessened; the lives of our soldiers will be unnecessarily endangered, and their hardships increased and there will be much suffering in many homes throughout the country during the coming winter."

CATALOGUES

Silent Chain Drive.—Link-Belt Co., Chicago. Book No. 312. Describes the application of a silent chain drive for operating machine tools of all types. There is a brief description of the construction of the chain, but by far the larger portion of the 40 pages comprising the book are given over to views of the chains in actual use.

Oil Engines.—Buckeye Machine Co., Lima, Ohio. Catalog. Illustrates a semi-Deisel engine using low grade fuel oil. Among the features of the engine upon which emphasis is laid are ready accessibility of all working parts and the elimination of overhanging flywheels. These points are brought out by a series of illustrations which supplement the description of the engine. Mention is made of the special expanding type friction clutch which is provided.

Welding and Cutting Apparatus.—An attractive loose-leaf catalogue has been issued by the Bastian-Blessing Co., Chicago, Ill., describing the "Rego" line of oxy-acetylene welding and cutting apparatus, lead burning equipment, regulators, etc. The "Rego" outfits are illustrated and described, followed by full details covering the "Rego" cutting and welding torches. The "Rego" diaphragm regulator is also described fully, together with matter relating to other regulators for cutting and welding.

Twist Drills and Cutters.—Butterfield & Co., Inc., Rock Island, Que., has issued to the trade a twist drill, gear and milling cutter catalogue "A" which covers a full line of the product and also contains much useful information for the use of customers. The catalogue is arranged in four sections, cutters, high power cutters, drills, arbors and general information. The first section contains some useful data on cutting gears and tables of cutter sizes, and prices, etc. The drill section contains instructions for grinding twist drills and price lists covering the full line. The general information section contains B & S tapers, tables of cutting speeds and decimal equivalents, etc. This is a handy catalogue to have in the shop for reference.

FOR SALE

FOR SALE CHEAP—ONE 30 K.W. GENERATOR Set 220 Volt D.C. Ideal Engine—Westinghouse Generator on sub-base—Switchboard; one 20 K.W. Generator Set on sub-base, same as above. These two sets are in perfect condition and we offer decided bargain for quick sale. Winnipeg Machinery Exchange, Sutherland and Gladstone Sts., Winnipeg.

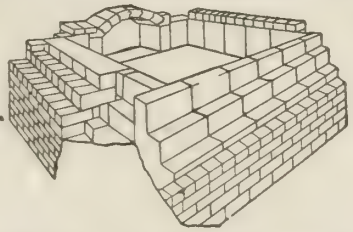
POSITION WANTED

STATIONARY ENGINEER WANTS A POSITION. Can handle all makes of engines or boilers. First-class man. Holder of certificate. Apply to Chas. Mismer, 920 Concession Street, Mt. Hamilton. (p11h)

WALTER J FRANCIS, C E. FREDERICK B BROWN, M.Sc
M. Can. Soc. C.E. M. Can. Soc. C.E.
M. Am. Soc. C.E. Mem. Am. Soc. M.E.
M. Inst. C.E. Mem. A.I.E.E.
WALTER J. FRANCIS & COMPANY
CONSULTING ENGINEERS
Head Office, 232 St. James St., Montreal
Cable Address, "Walfran, Montreal"—W.U. Code.
Long Distance Telephone, Main 5643.

Mackinnon Steel Co., Limited
Formerly
MacKinnon, Holmes & Co., Ltd.
Sherbrooke - - Quebec

ENGINEERS, MANUFACTURERS AND ERECTORS OF STEEL STRUCTURES
Miscellaneous plate and structural work of every description used in connection with power plants furnished in short order. Engineering, manufacturing and erecting steel structures is our specialty. Write for prices.



Gates Boiler Furnace
Patented 1916
Will last three times as long as ordinary good grade Fire Brick. These blocks are inter-locking, and made so that any handy man or fireman can renew them without disturbing any of the other brick work.
WRITE FOR PARTICULARS.
John W. Gates 2 St. James St., MONTREAL, QUE.

The **LONG Patent Steam Trap**
Automatically drains jacket kettles, separators and steam mains. Nine hundred to 1,500 feet of one-inch pipe isn't beyond its ability. Also used with splendid success in drying room systems.
Only One Movable Part
Works against 1 and 200 pounds of pressure—no possibility of freezing. Has **two outlets** so it can be installed in any position.
Circular gives full particulars.
Write to-day.
J. T. LONG
84 Adam Street
MONTREAL, CANADA
If your dealer does not sell it, write direct

NON-CORROSIVE CYLINDER OIL
MANUFACTURED ONLY BY
E. H. KELLOGG & CO.
NOS. 242 & 244 SOUTH ST. NEW YORK, U.S.A.
FRICTION LOSS
An overload is often a necessity. But it is hard on an engine. To successfully carry an overload so that there will be no after effects on the engine a very careful selection of your oil should be made. An oil that is not free from impurities will cause a greater wearing on the bearings, a great friction loss will occur. You will need to fire the boiler more often because the engine will be harder to run. In this manner you lose out. You work harder, have larger operating costs, and less power all because of your oil. Do as a great many Canadian engineers have done—give Kellogg's "Non-Corrosive Cylinder Oil" a trial. Absolutely pure. Write us regarding it.
E. H. KELLOGG & CO.,
New York, U.S.A.

MONCRIEFF'S "UNIFIC" WATER GAUGE GLASSES
Stand in a Class by Themselves for Quality, Efficiency and Economy
A trial will convince you. Write for Catalog
W. J. WALL, 134-136 BLEURY ST., MONTREAL
(Canadian Representative)

Success and Your Associates

ALWAYS associate with men who are earning more money than you are. Such is the advice given by a man whose name is known the world over for his own success and the business which he created. It is good advice of a certainty, but we are not urging that it is the best advice. At the same time it is wise to associate with better or bigger men than you are yourself, because you are likely to be lifted up to their levels.

Most of us would probably like to be the intimates of J. P. Morgan, or of John D., or of Charlie Schwab, or Canny Andrew. If we had a speaking acquaintance with John Wanamaker, or Lord Beaverbrook, or Lord Shaughnessy, and with other distinguished and successful men, we would take comfort from the fact.

And most of us would feel rather small and uncomfortable if we were placed beside President Woodrow Wilson at a dinner table, or beside Sir Robert Borden, Sir Herbert Holt or Sir Wm. Mackenzie. And the reason would probably be that we know so little of the knowledge that really counts. If these successful business men engaged us in conversation we would probably find ourselves knowing very little about the things that matter.

This will illustrate the point:

Here's a true story. A Toronto manufacturer found himself on a train going to Albany in company with a number of distinguished Americans about to attend the inaugural ceremonies of a State Governor. A washout led to a delay, and the Canadian was thrown into close association with senators and congressmen and prominent lawyers. They bantered the little Canadian about Canada. He had the pluck of a bigger man. He had been a constant reader of THE FINANCIAL POST, and had absorbed many facts about Canada. He surprised his American travelling companions with his positive, well-informed and wide knowledge of Canada. When the company reached Albany, the Canadian was persuaded to attend the ceremonies and was introduced as the man who knew all about Canada. The Governor was interested in Canada, and said so, and the little Canadian found himself telling the story of Canada very ardently to a very attentive listener, much to the amusement of his friends who introduced him.

This man made a hit on that journey, and many friends. One of the company gave him a stock market tip worth a fortune.

The point of this story is: You, as a Canadian, can make yourself informed very fully and intelligently if you become a regular reader of THE FINANCIAL POST. You can make yourself a worthy companion and intimate of presidents and magnates. The world likes to listen to men who know something well, and who can talk interestingly and informingly on the subject of their study.

You can become worth listening to if you know your Canada well. And you can get the kind and amount of knowledge concerning Canada which will make you interesting to others if you will read THE FINANCIAL POST regularly each week.

IF you read THE FINANCIAL POST REGULARLY you will find yourself keeping company with the highest paid staff of editors engaged on any publication in Canada—trained men who know how to make others know what they know and learn.

You will find yourself living in a most interesting world—the great, throbbing world of business. You will have your thoughts tremendously stimulated and helpfully directed. You will find yourself becoming a fit table companion for big men — this because you will have knowledge of a quality that will keep you from shame.

What is it that keeps you and THE POST separated? It cannot be its subscription price of $3. Probably it is because you are not very well acquainted with this paper.

We are going to put it to you this way: If you have the desire to be worthy of association with big men, then prepare yourself for such association by reading THE POST, and to make acquaintance easy, we provide the coupon below. It offers you THE POST for four months for a dollar bill.

The MacLean Publishing Company, Limited,

143-153 University Ave., Toronto.

Send me us THE FINANCIAL POST for four months for One Dollar. Money enclosed to be remitted

(Signed)

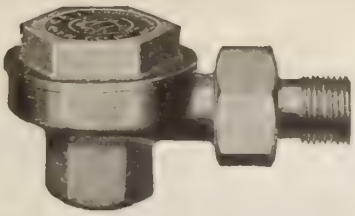
.....

P.H. .....

You Can Help Him Save Fuel

Every employer in Canada realizes that he must use with greater efficiency what coal he can get, or possibly reduce his output.

Proper use of the coal in the boiler room is one way of saving it; here you can help directly. Keeping all valves tightly packed is another helpful way. But the biggest waster of coal is caused by water and air in radiators. It is this waste that is stopped by the Dunham Radiator Trap. Tell your employer about it.



The Dunham Radiator Trap makes every radiator give more heat at less cost. This statement we can prove by facts from installations in which remarkable fuel savings have been made. Dunham Radiator Traps can be installed without necessitating expensive alterations. Ask us to tell you how.

The DUNHAM HEATING SERVICE

You can get five to ten inches of vacuum **without use of jet water**—and superior and easily maintained circulation on low pressure —and with no broken vacuum due to leaky traps.

Write to-day for all the facts.

C. A. DUNHAM CO., Ltd.

TORONTO, CANADA

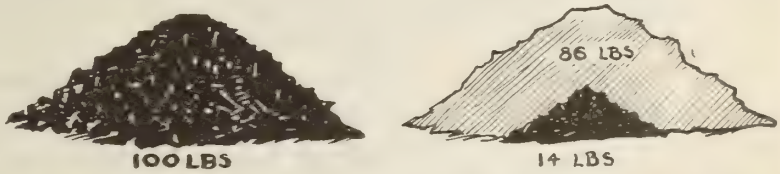
Halifax Montreal Ottawa Winnipeg
Vancouver Calgary

R.D. Wood & Co.

Philadelphia, Pa., U.S.A.

Water and Gas Work Supplies,
Cast Iron Pipe and Castings,
Mathews Hydrants and Valves,
Hydraulic Presses and Accumulators,
Operating Valves,
Mechanically Operated Gas Producers.

Study The Piles



Seven Times the Power for the Same Coal

The first pile represents coal used making steam to feed boiler using direct steam pump.

The black part of the second pile shows the relative amount of coal necessary to do the work with a Cole Return Trap.

In other words, you get seven times the power for the same coal—or 86% of the fuel saved.

If you want further proof get our latest folder on boiler feeding—No. 9.

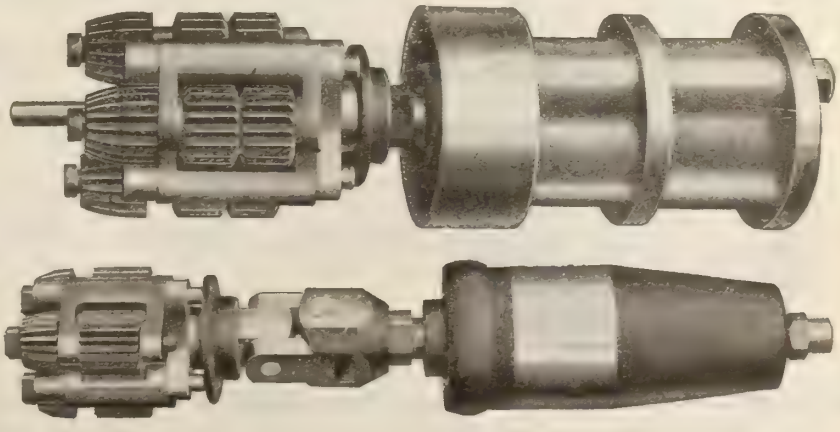
GEO. W. COLE, Ltd. 2002 Dundas St. W. TORONTO

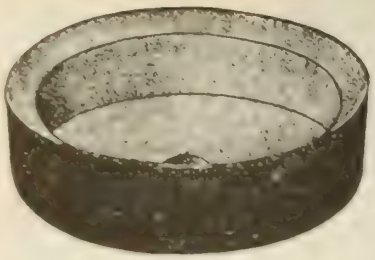
ROTO TUBE CLEANERS

Type A.D.—Driven by Air or Steam
Type W.D.—Driven by Water Pressure

The use of Roto Cleaners is essential to the most efficient operation of Boilers, Condensers, Economizers, Evaporators, etc.
Roto succeeds where all others fail. It is faster, safer, more thorough and the standard of the largest steam power plants.

THE ROTO COMPANY
HARTFORD, CONN.
WRITE FOR CATALOG





"VIM" MECHANICAL LEATHERS

"Double the Wear" Guarantee on Vim Leather Packings Over Any Others Made

There is a difference of 15 per cent. between the Production of a Machine on which the Packings are giving Perfect Service and one on which the Packings should be replaced.

Consider the following factors:

1—Gain or Loss in Production.

2—Gain or Loss in Power by Friction.

3—Gain or Loss in non-leakage or leakage.

4—Loss of service of Machine while Packing is being replaced.

5—Loss of Service of Machines and Labor due to idle Press.

6—Cost of Labor in replacing.

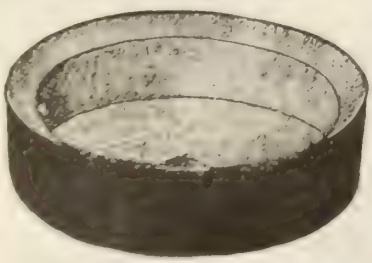
7—Cost of Packing.

"Double the Wear" Guarantee Cuts the Cost of the First Six Items in Half

Send Us Your Blueprints.

ORDERS FILLED IN 3 DAYS.

CANUCK SUPPLY COMPANY LIMITED

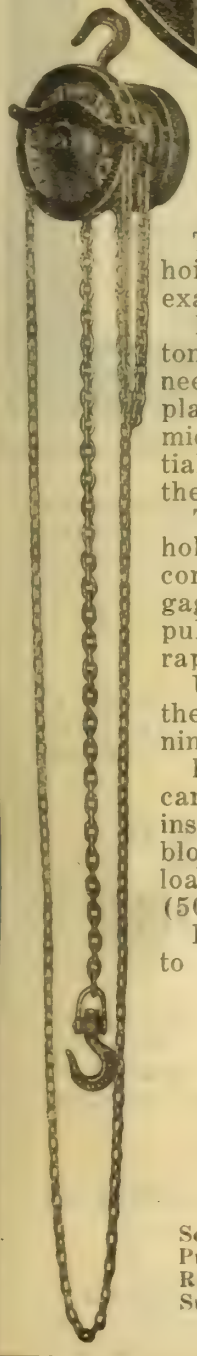


Montreal Toronto Winnipeg

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

TRADE YALE MARK

Yale Blocks Setting Heavy Machinery



YALE HOISTS

For CRITICAL Hoisting

There is a demand for Yale hoists wherever hoisting of an exact nature is required.

Made in capacities ¼ to 40 ton, there is a size to meet every need—whether it is in a small plant where the safe and economical handling of loads is essential, or in a great industry where the load problem is a vital factor.

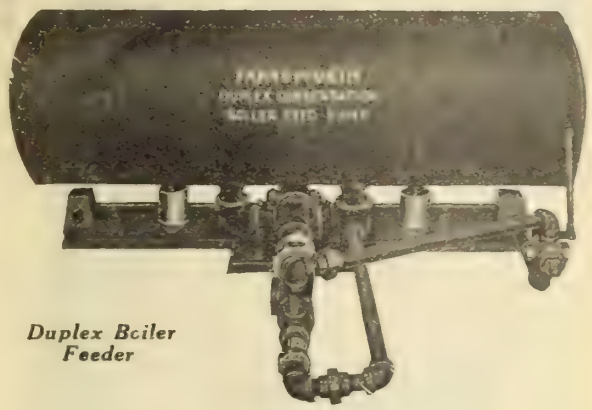
The Yale Spur-geared block holds the load positively, and the continuous chain guide prevents gagging at high speed of side pull. It lowers smoothly and rapidly.

Unusually large teeth reduce the strain and give an easy running gear system.

Each part of the Yale Block is carefully inspected as a unit and inspected again in the assembled block—which must pass a test load of 3,360 lbs. to the rated ton (50% overload).

Put your hoisting problems up to us.

Farnsworth



Duplex Boiler Feeder

One Canadian Factory has in use over $10,000 worth of Farnsworth Traps.

It claims a saving of 4,000 tons of coal per year. Another mill states that its saving will be 3,000 tons of coal.

The conservation of coal is a duty in which Farnsworth Traps will materially assist. The Farnsworth system provides for the return of all condensation to the boiler at the highest possible temperature.

Farnsworth Boiler Feeders are designed for installation above the boiler and will take high pressure condensation from heating systems, heated apparatus, dry kilns, etc., and deliver it to the boiler at temperatures beyond the capacity of any pump to handle.

The Canadian Government is asking the manufacturers to substitute other pumping apparatus for the inefficient steam pump. Farnsworth Traps will give the greatest saving of any pumping apparatus on the market.

Farnsworth Traps are made in several types to handle anything from the highest vacuum to high pressure steam.

Full information on request.

Everything in Mechanical Goods

The Canadian Fairbanks-Morse Co., Limited

"Canada's Departmental House for Mechanical Goods"

Departments

Scale, Valve, Auto Accessory, Engine, Pump, Electrical, Machinery, Transmission, Railway and Contractors, Machine Shop Supply, Marvel Mill, Pulp and Paper.

Sales Offices

Halifax, St. John, Quebec, Montreal, Ottawa, Toronto, Hamilton, Windsor, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria.

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

EASY ECONOMY

The fuel loss due to scale is not difficult to obviate. Some of Canada's leading power plants have found

METLSKIN BOILER PRESERVATIVE

Neither "Compound" nor "Cure-all"

a decided help in removing old scale and preventing its further formation. The cost, compared to results, was so slight as to make METLSKIN an actual dividend-payer.

The existence of boiler-scale nowadays is a misdemeanor against conservation.

If you have scale trouble send for this little book. It will prove instructive.

The CANADIAN FAIRBANKS-MORSE CO., Limited

St. John, Quebec, Montreal, Ottawa, Hamilton, Toronto, Windsor, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria.

III IMPORTANT THINGS

TO CONSIDER ABOUT A SEPARATOR.

I. THE PLAN—Is it sensible, will it work, no matter how large the Separator or how well made?

II. THE SIZE—Is it big enough regardless of plan, will it hold a good dose of water?

III. THE CONSTRUCTION—Is it strong enough, are flanges heavy, how will it look by the side of a nicely finished engine? Send for catalog and note these points in

Sweet's Separators

DIRECT SEPARATOR COMPANY

820 Geddes Street - SYRACUSE, N.Y.

General Sales Agents:

Canadian Fairbanks-Morse Company, Limited

St. John, Montreal, Quebec, Ottawa, Toronto, Hamilton, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria

FOR Steam or Air Drill, Pneumatic Tools, Boiler Flue Cleaning, Syphon Connections, Suction Lines.

For all kinds of Oil, Gasoline, Paints, Hydraulics, Gas.

"PENFLEX" METAL HOSE

INTERLOCKING

An all Metal Flexible Hose. Manufactured in Bronze or Galvanized Steel. Will withstand highest pressures. Is unsurpassed for durability and pressure resisting qualities.

Large Stock Carried in Canada

Pennsylvania Flexible Metallic Tubing Co.

Philadelphia, Pa.

Canadian Agents:

The Canadian Fairbanks-Morse Co., Limited

St. John, Quebec, Montreal, Ottawa, Toronto, Hamilton, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria

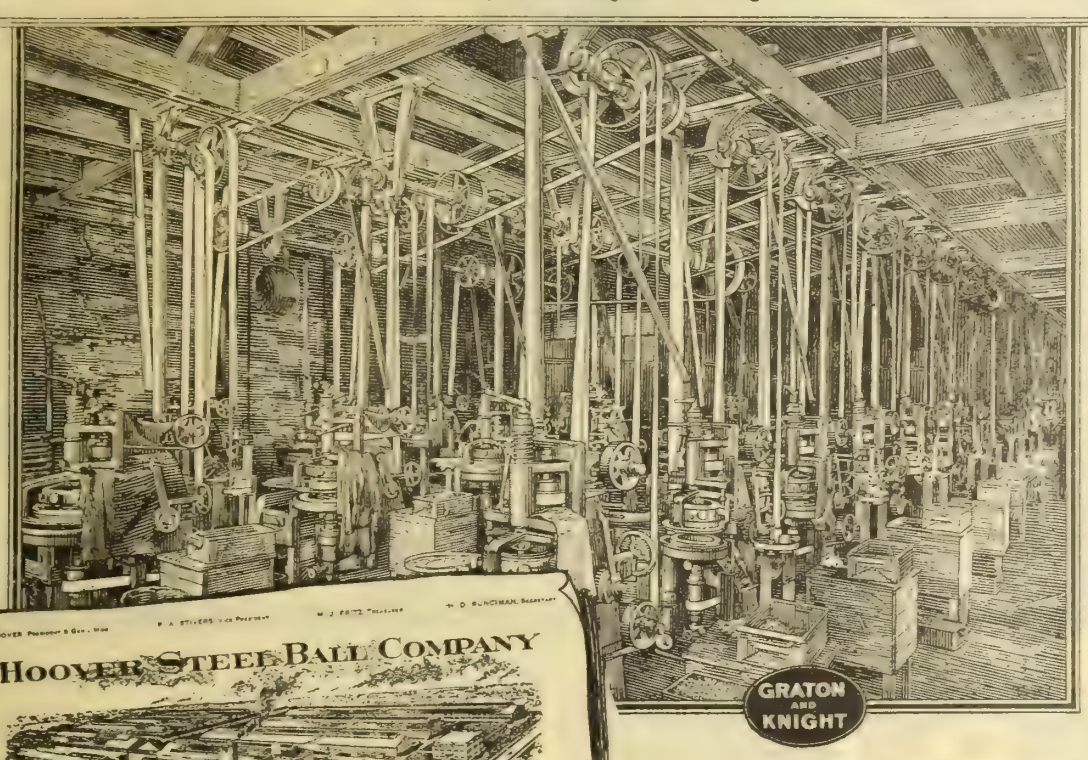
THE CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED

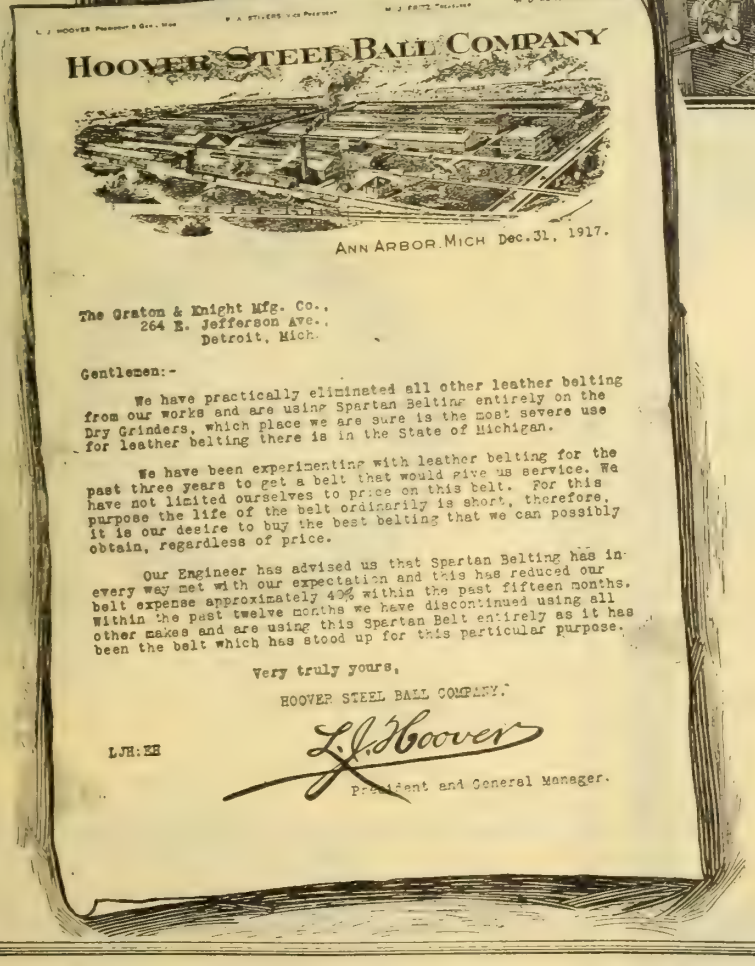
GRATON & KNIGHT

Standardized Series

LEATHER BELTING

Tanned by us for belting use





HOOVER STEEL BALL COMPANY

ANN ARBOR, MICH Dec. 31, 1917.

The Graton & Knight Mfg. Co.,
264 E. Jefferson Ave.,
Detroit, Mich.

Gentlemen:-

We have practically eliminated all other leather belting from our works and are using Spartan Belting entirely on the Dry Grinders, which place we are sure is the most severe use for leather belting there is in the State of Michigan.

We have been experimenting with leather belting for the past three years to get a belt that would give us service. We have not limited ourselves to price on this belt. For this purpose the life of the belt ordinarily is short, therefore, it is our desire to buy the best belting that we can possibly obtain, regardless of price.

Our Engineer has advised us that Spartan Belting has in every way met with our expectation and this has reduced our belt expense approximately 40% within the past fifteen months. Within the past twelve months we have discontinued using all other makes and are using this Spartan Belt entirely as it has been the belt which has stood up for this particular purpose.

Very truly yours,

HOOVER STEEL BALL COMPANY.

L.J. Hoover

President and General Manager.

LJH:EH

"the most severe use of leather belting" (see letter)

The advantages of standardized belting stand out *most conspicuously* in severe use, but they are *just as truly present* in less exacting conditions. Dollars are valuable whether you save them by tens or by hundreds.

The steps in acquiring transmission-wisdom run somewhat as follows: A poor belt is better than none at all. A good belt is better value than a poor one. But the scientifically right belt for each machine is the highest economy of all—and that is Standardization. It also explains why there is greater demand for Graton & Knight Standardized Series Leather Belting than for any other brand in the world.

Write for information about Standardization as applied to Belting.

The Graton & Knight Mfg. Co.
Worcester, Mass., U. S. A.

Oak Leather Tanners, Makers of Leather Belting, Lace Leather, Packings, and Specialties.

The Canadian Graton & Knight Ltd., Montreal, Canadian Representatives: The Canadian Fairbanks-Morse Co., Ltd., St. John, Montreal, Ottawa, Toronto, Hamilton, Quebec, Calgary, Saskatoon, Vancouver, Windsor, Winnipeg, Victoria.

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

DURABLA

No defects in manufacture pass these men, who inspect every sheet.

The Durabla sheet is a quality sheet, and we guarantee every gasket cut from it to make a permanently tight joint.

Only quality promotes Efficiency. Only standardizing on the best proves true economy.

Durabla Mfg. Co.
NEW YORK
Distributors for Canada:
The Canadian Fairbanks-Mosre Co., Limited

P&C CO

PRATT & CADY VALVES

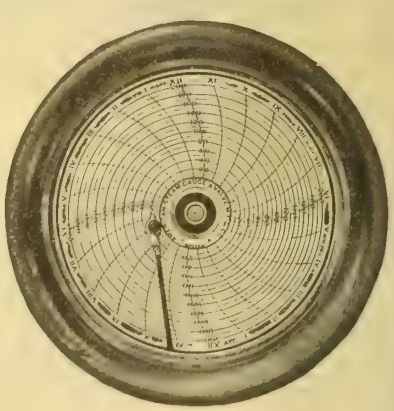
Asbestos-Packed Cocks

With hardly an exception the more prominent engineers in Canada insist on the use of Valves and Cocks that bear the above trade-mark, because by long experience they know that products so marked are **better** in design and workmanship; they know there is no service of engine room or high pressure pipe line too severe for P. & C. products to meet successfully.

Pratt & Cady Company, Inc.
HARTFORD, CONN.

Canadian Agents:
Canadian Fairbanks-Morse Co., Limited
Toronto Montreal
St. John, Quebec, Ottawa, Hamilton, Windsor, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria

American Recording Gauges



Help to maintain Uniform Pressures and to make permanent Records of Efficiency.

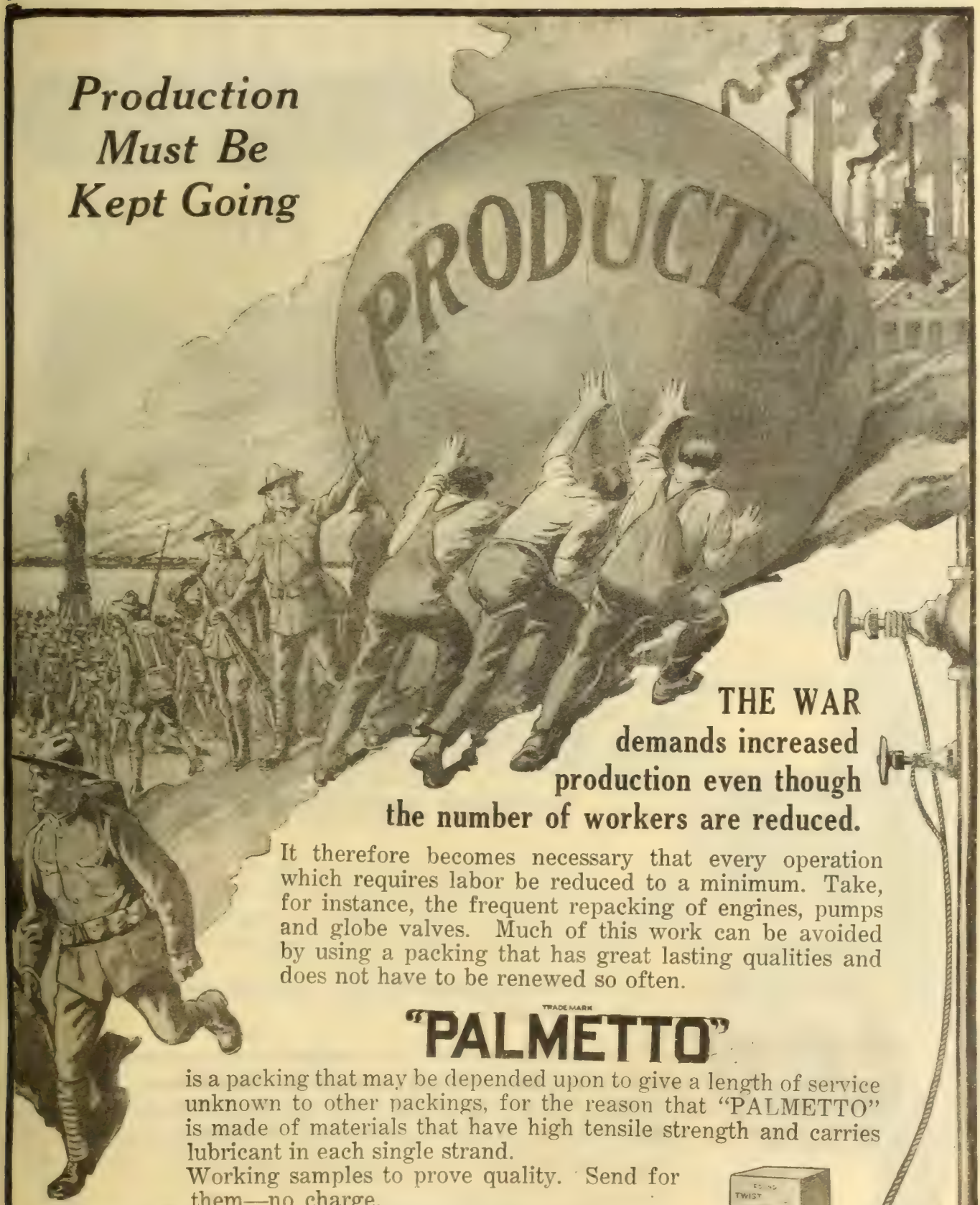
Send us details of your needs

Canadian Agents: Canadian Fairbanks-Morse Co., Limited
MONTREAL, TORONTO, QUEBEC, ST. JOHN

AMERICAN STEAM GAUGE & VALVE MFG. CO.
New York, Chicago, BOSTON, Atlanta, Pittsburg

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

Production Must Be Kept Going



THE WAR demands increased production even though the number of workers are reduced.

It therefore becomes necessary that every operation which requires labor be reduced to a minimum. Take, for instance, the frequent repacking of engines, pumps and globe valves. Much of this work can be avoided by using a packing that has great lasting qualities and does not have to be renewed so often.

TRADE MARK
"PALMETTO"

is a packing that may be depended upon to give a length of service unknown to other packings, for the reason that "PALMETTO" is made of materials that have high tensile strength and carries lubricant in each single strand.

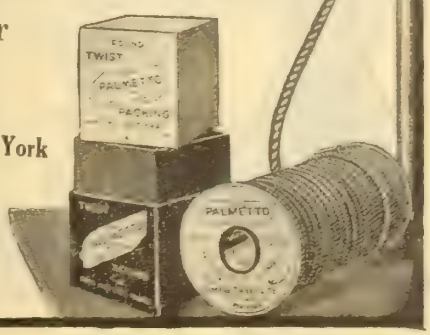
Working samples to prove quality. Send for them—no charge.

GREENE, TWEED & CO.

Sole Manufacturers 109 Duane St., New York

Canadian Agents:

The Canadian Fairbanks-Morse Co., Limited, St. John, Toronto, Quebec, Hamilton, Montreal, Ottawa, Vancouver, Victoria.



THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

Every Tube Perfectly Free to Move

Never will one buckle or bend or split, because all are perfectly free to expand or contract.

Alberger Water Heater

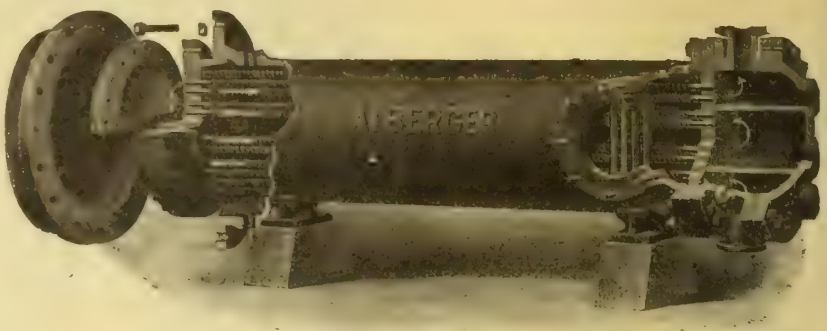
the multi-head heater without a fault.

There can't be trouble from expansion or contraction strains, because of the floating heads.

There can't be clogging of the tubes because of their corrugations.

There **can** be hot water as fast as it can be drawn, because Alberger Heaters transmit 50% more heat than plain tube heaters of corresponding size.

Catalog explains in detail. Ask for your copy.



ALBERGER HEATER COMPANY

BUFFALO, N.Y. Manufacturers of Alberger Multi-Head Heaters

GENERAL SALES AGENTS:

CANADIAN FAIRBANKS-MORSE COMPANY, Limited

St. John, Montreal, Ottawa, Toronto, Hamilton, Quebec, Calgary, Windsor, Vancouver, Winnipeg, Victoria.

STARRETT HIGH SPEED INDICATOR No. 104, Value $1.00 Given for two yearly paid-up subscriptions.

You May Have This Speed Indicator without Spending a Cent

if you are a subscriber to "POWER HOUSE." If you are not a subscriber, send in your own subscription together with two others, and the indicator you are entitled to will be mailed to you immediately.

To subscribers who send us two NEW yearly paid-up subscriptions we will send this $1.00 indicator.

"POWER HOUSE" is designed to give Canadian Engineers, Superintendents and Power Users all the latest and best information in the engineering field. A little work among your engineer friends and acquaintances will earn for you this handy indicator without any trouble. Try it and see how easy it will be.

PUBLISHED MONTHLY AT $1.00 PER YEAR
Start in TO-DAY to earn one of these Handy Tools

POWER HOUSE 143 University Ave., **Toronto**

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

SKF

PLEASED—

Ordering large shipment of

S K F Hangers

The illustration shows a department in the plant of the Flint Varnish Works, Flint, Mich., equipped with SKF Ball Bearing Hangers.

The service records of SKF Transmission Equipment in this and other departments have saved appreciable amounts of power and oil, besides doing away with shutdowns from hot boxes.

Their experience has been so satisfactory that they write: "We are very well pleased with the way SKF Ball Bearing Hangers have acted and are now ordering a large shipment to come in, to be used in connection with the new equipment being installed."

Why not get better acquainted with the money-saving possibitities of SKF equipment in your plant?

The SKF Transmission Bulletin contains complete information. Send for it.

Canadian SKF Company

TORONTO, ONT. 47 King St. W. — LIMITED — MONTREAL, QUE. 128 Coristine Bldg

Agents for SKF Transmission Bearings:

The Canadian Fairbanks-Morse Co., Limited

St. John Quebec Montreal Ottawa Toronto Hamilton Windsor Winnipeg Saskatoon Vancouver Calgary Victoria

"You Will Yet Be Glad"

PRIVATE PEAT, who has sprung into fame through his books and extensive platform work, contributes an article to the August issue of MACLEAN'S MAGAZINE under the above heading. It is a cheery, optimistic message, contrasting conditions in 1914 with things as they are to-day. Private Peat, always a "headliner," is at his best in this article. But

Private Peat is only One of Many Features

In August MACLEAN'S there are half a dozen other writers with just as much "pull." Glance at this list:

"The Strange Adventure of the Man from Medicine Hat," a striking mystery story. By *Arthur Stringer*

"The Three Sapphires," a splendid serial story. By *W. A. Fraser*

"Keeping Border. in London," a fearless summary. By *Lt.-Col. John Bayne Maclean.*

"The Enemy Under the Earth," an article on the most terrifying phase of modern warfare—sapping warfare under the earth. By *Lt. C. W. Tilbrook.*

"Uplifting the Press," a satire on certain activities of the Dominion Government. By *One of the Uplifted.*

MACLEAN'S presents the vital and interesting things dealing with Canada—the most fearless criticism, the most entertaining comment, the biggest exclusive stories. Contributors to MACLEAN'S are the best writers and the most interesting personalities that the Dominion has produced. It is brimful of "features."

AUGUST MACLEAN'S

"Canada's National Magazine"

At All News Stands - - 20 Cents

This book should be in the hands of every pump user. A postal will bring your copy promptly

MARSH and AMERICAN

Steam and Power Driven Pumps and Air Compressors

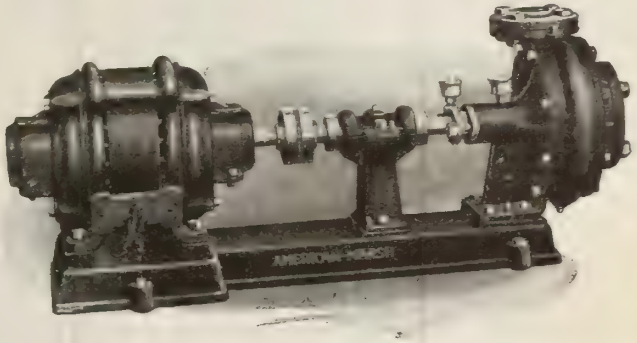
Marsh and American Pumps are especially adapted for long, hard service because they are *extra heavy* in design and of *extremely rigid construction*. Every unit is built amply strong to withstand 24-hour-a-day service and to stand up under any unforeseen strain which may be placed upon it. Piston rods on the steam pumps are extra large and made of solid bronze. The water ends are equipped with heavy cast bronze removable bushings.

This superior construction not only insures continuous and satisfactory operation, but practically *eliminates expensive shut-downs*. Marsh and American Pumps are the product of over 25 years' experience in the design and construction of high grade pumping machinery. Over 135,000 in actual service throughout the world.

The AMERICAN-MARSH LINE OF CENTRIFUGAL PUMPS is composed of both single and double suction types which are designed for heads up to 125 feet. They are equipped with wide ring oiled bearings and the single suction type has overhanging casing enabling the discharge to be taken at any angle desired.

CANADIAN AGENTS

A. R. Williams Machinery Co., Toronto.
Williams & Wilson, Montreal.
London Engine Supplies Co., London, Ont.
Stuart Machinery Co., Winnipeg.
Mechanics' Supply Co., Quebec, Que.
Gorman, Clancy & Grindley, Limited, Edmonton and Calgary.
Taylor Engineering Co., Ltd., Vancouver, B.C.

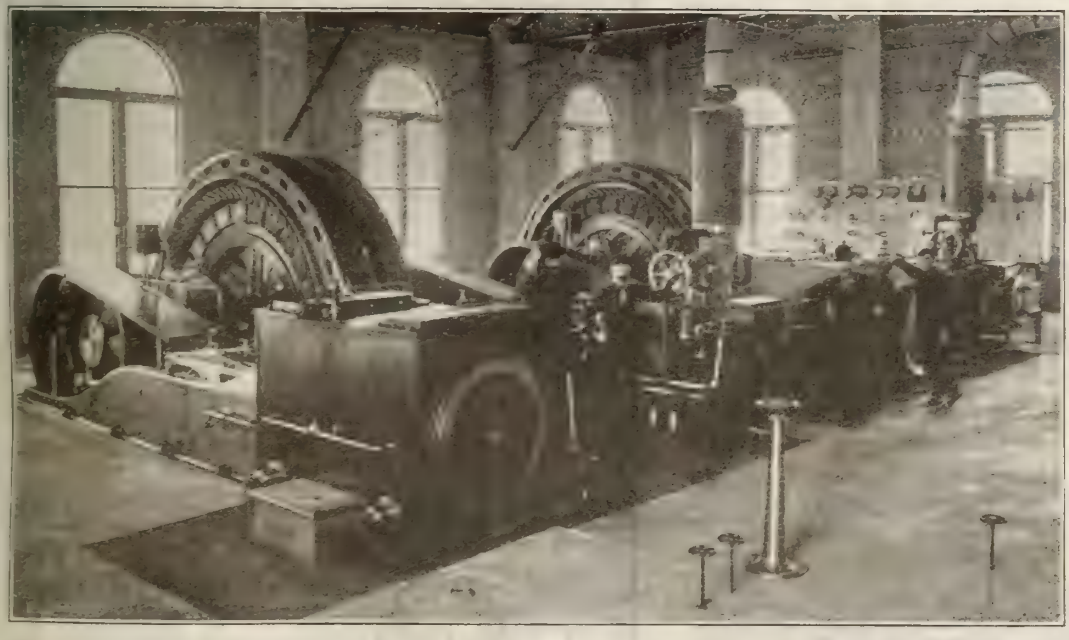


American-Marsh Centrifugal Pump.

American Steam Pump Company

Battle Creek, Mich.

25 Cycle Engine Generator Sets For Sale



1—250 KW.
1—300 KW.

25 Cycle
3 phase
Westinghouse
Generators
Direct
connected to
McIntosh &
Seymour Cross
Compound
Gridiron Valve
Engines 150
R.P.M.

These units were in use only seven months and are in first class condition. Write for further particulars and quotations.

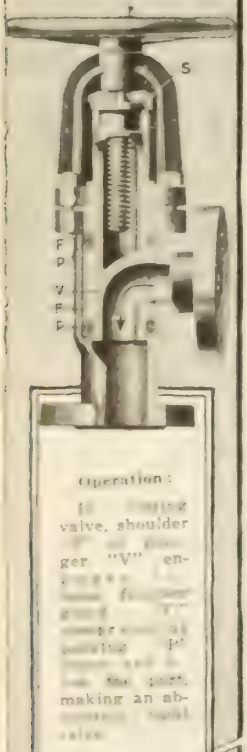
Power Plant Equipment Co., Dominion Bank Building Toronto, Ont.

In the Big Steel Mills

During these days of intensive manufacturing, we are confronted repeatedly with the names of big steel mills, both Canadian and American.

All are noted for their efficiency, and the high character of equipment used. Of particular interest to us is the fact that each uses Yarway (formerly Simplex) "Seatless" Blow-Off Valves.

Dominion Iron & Steel Co., Ltd.	has	20
Bethlehem Steel Co.	"	227
Cambria Steel Co.	"	129
Carnegie Steel Co.	"	51
Republic Iron & Steel Co.	has	80
American Rolling Mills Co.	has	30
American Steel & Wire Co.	has	30
Lorain Steel Co.	"	24
Corrigan McKinney Co.	has	55



Operation:

valve, shoulder

ger "V" en-

making an ab-

Yarway (formerly Simplex) "Seatless" Blow-Off Valves have neither seats nor discs. The design is simple. Construction is strong and durable. Port is wide and unrestricted. Packing is protected and rarely needs renewing in less than two or more years.

Try a Yarway (formerly Simplex) for 60 days, subject to return. Write to-day, stating size of line, whether screw or flange, angle or straightway.

Yarnall-Waring Co.
7604-20 Queen Street
CHESTNUT HILL
Philadelphia

Canadian Representative:
A. McLELLAN
301 Read Building
MONTREAL

YARWAY
Seatless Blow Off Valve
formerly the
SIMPLEX

"VULCABESTON" RED FIBRE STEAM SHEET PACKING "VULCABESTON" RED FIBRE STEAM SHEET PACKING "VULCABESTON" RED FIBRE STEAM SHEET PACKING

Outlasts Them All

Because of the fact that it is made of *long-fibre* asbestos and is strongly resistant to the action of heat and chemicals,

VULCABESTON

Red Fibre Sheet Packing

is the most enduring packing made therefore the most economical.

Joints made with Vulcabeston stay tight—and that is what you want, so give Vulcabeston a trial. The long fibre is your guarantee that the packing will not pulp or squeeze out of the joint. Ask your dealer or ask us.

The Johns-Pratt Company

Hartford, Conn., U.S.A.

Montreal, Que., Ross & Greig, Toronto, Ont.; James Morrison Brass Mfg. Co., Ltd.; Vancouver, B.C., Fleck Bros, Ltd.; Winnipeg, Man., Crane Co.

J-P J-P

—any man that has to get a ladder—to close or open overhead valves knows it's a waste of time and effort. Ladders are dangerous, costly and unnecessary.

Babbitt Adjustable Sprocket Rims make valves that are ten feet above your head as easy to open or close as those within reach of your hand just pull the chain. They attach to any valve. Get our circular.

Babbitt Steam Specialty Co.
New Bedford, Mass.

Manufactured in Canada, under Canadian Patents, exclusively by the Engineering Specialties Company, Limited, 1080 King St. West, Toronto, Ont. 93-22

The Fire Brick Speaks

DON'T blame me, says the firebrick, if your settings fail too soon. For practically every premature setting failure is directly traceable to the use of an inadequate or improper mortar. Give bricks the protection of the right kind of a binder—not a fireclay, but a heat-resisting cement—face the brick with a good coating cement and your setting will outlast the ordinary kind many times over.

With every desired element of heat resistance, adhesion and durability, Johns-Manville High Temperature Cements afford a practical solution to all boiler setting problems. The bonding cements—applied as mortar between bricks—are so strong mechanically and so elastic that the contraction and expansion of furnaces will not rupture them or cause them to fall away. The coating cement which faces off the whole setting of the new brick protects the faces against spawling and cracking due to high heats or rapid temperature changes. And because of its resiliency it stays keyed to the setting despite expansion and shrinking.

Ask any branch to send you the High Temperature Cement Booklet. It tells which cement is suited to the working temperature of your furnaces and contains interesting data.

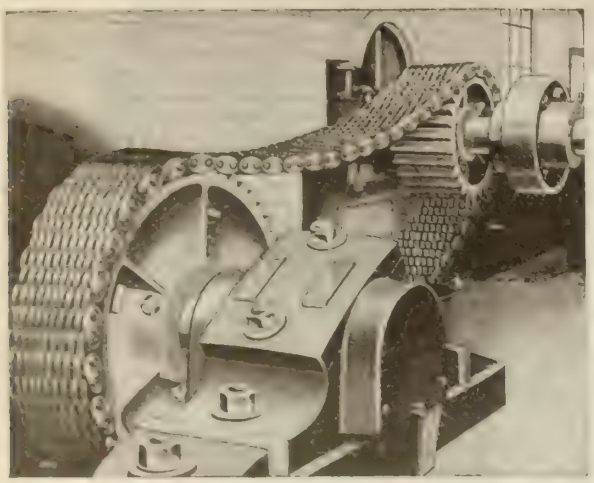
THE CANADIAN H. W. JOHNS-MANVILLE CO., LTD.

Montreal Toronto Vancouver Winnipeg
Hamilton London Ottawa

JOHNS-MANVILLE SERVICE COVERS THE CONTINENT

Johns-Manville
High Temperature Cements

If any advertisement interests you, tear it out now and place with letters to be answered.



COVENTRY NOISELESS CHAINS

For all kinds of power transmission — Main and Countershaft Drives, Pumps, Fans, Air Compressors, and at all times 98 per cent. of power being transmitted.

Write for our handbook C-3 on chain gearing, post free for the asking.

Head Office and Works:

"THE COVENTRY" CHAIN CO., LTD.
COVENTRY, ENGLAND

Cables: Chains, Coventry.

Codes: A.B.C., 4th and 5th editions. Western Union.

London Office: 47 Victoria St., S.W. 1.

Agencies in all the principal countries in the World.

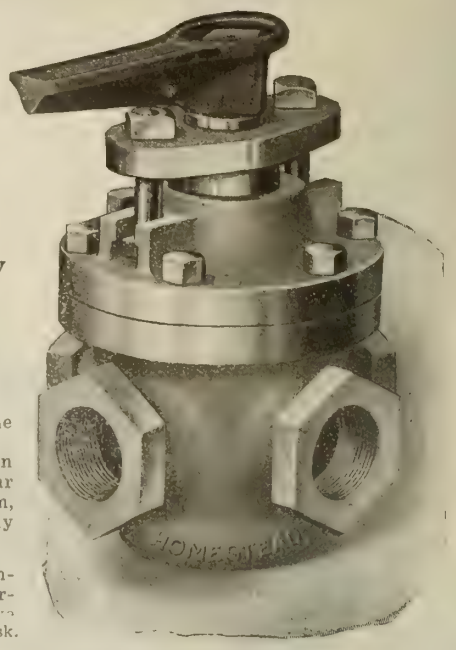
HOMESTEAD
Quarter Turn VALVES

A Valve for Every Purpose

Straightway
Three-way
Four-way
Angle

Try one of the "HOMESTEAD" Quarter-Turn Valves on your water, air, steam, gasoline or any other line.

Remember—we unconditionally guarantee [illegible] valve —you take no risk.



Homestead Valve Mfg. Co.
Homestead, Pa.

THE USE OF

Williams' Superior Drop-Forged Wrenches

GUARANTEES

Best possible fit, no injury to corners of nuts, greatest wear and utility, and entire satisfaction to all machinery and power-making mankind.

About 1,000 sizes of 40 patterns for all purposes carried in stock.

Immediate shipment.

Ask for "Wrench" Booklet—it's free.

J. H. Williams & Co.
"The Wrench People"
78 Richards St., Brooklyn, N.Y.
78 So. Clinton St., Chicago

The A. G. Low Co., Ltd.,
78 Pacific Ave., Saskatoon, Sask.
Agents for Manitoba, Saskatchewan, Alberta & British Columbia

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

These Items Spell

QUALITY

FIRST COST + OPERATING COST + MAINTEN-ANCE COST + ADAPT-ABILITY + EFFICI-ENCY + EFFECT ON PRODUCTION + SATIS-FACTION

in Lamps

FIRST COST alone is **never** the criterion by which to gauge QUALITY – there is **no** "Quality" that does not contain **most** of these elements. LACO LAMPS contain them **all.** You may hesitate at the larger investment, but don't let the bogey of "First Cost" run away with your better judgment. If you **want** QUALITY in your purchase, you **must** pay for it. Analyze the LACO standard :—

First Cost – slightly higher than the best "ordinary" lamp.

Operating Cost—30 to 50% less current consumption per 1,000 hours for same quantity of light. One official test, for instance, showed 4 Laco Lamps burning 936 watts, gave the same light as 4 competitive lamps burning 1443 watts.

Maintenance Cost--25 to 40% longer life. (Replacement cost of 4 brands in same 1000-hour test averaged $12.68 – LACO none.) Guaranteed life of ordinary 1000 watt lamp is 1000 hours – LACO users frequently get two to three times this service; we can quote LACO Lamps that lived over 10,000 hours.

Adaptability—LACO Tungsten Lamps are made in sizes up to 60 watt; LACO Nitro are made in sizes 60, 100, 200, 250, 300, 350, 400, 500, 750 and 1000 watt—a LACO size for every need.

Efficiency—A clear, brilliant, colour-true, daylight ray.

LACO LAMPS

Effect on Production—
Government statistics have proved that the LACO quality of lighting will increase workers' earnings; one example alone showed 11.4 .

Satisfaction Is found in hundreds of letters from big operators in every line of business all over the country, telling their experience with LACO LAMPS. Read examples quoted.

Without cost to you — our nearest office will have official laboratory tests made of your lamps to prove our claims. Our lighting engineers will plan and submit an installation to meet your exact requirements in the best and most economical way.

Write us to-day for descriptive literature

British Columbia Electric Railway Co., Limited

Hastings and Carroll Sts., Vancouver, B.C., March 8, 1918.

Canadian Laco-Philips Co., Limited
Standard Bank Bldg., Vancouver, B.C.
Attention of Mr. Willard.

Dear Sir:—

We take pleasure in writing you of the excellent service given by Laco-Philips Lamps, and we are particularly impressed with the satisfaction our customers obtain, the percentage of defective lamps being extremely low.

We are also using your series lamps for street lighting and find that they give excellent satisfaction.

Yours truly,
(Sgd) Edmund E. Walker,
Sales Engineer.

The Robert Simpson Co., Ltd.

Toronto, Nov. 10, 1917

Laco-Philips Co., Toronto.

Gentlemen:

Our store has been equipped throughout with your LACO Nitrogen filled lamps since September, 1914, with very satisfactory results. During that time we have kept a very close record of the life of the various sizes in use, and the following is a list of the average hours burning:

500 watt	average	2788 hours
400 "	"	2232 "
350 "	"	1600 " "
250 "	"	2306 " "
100 "	"	1200 " "

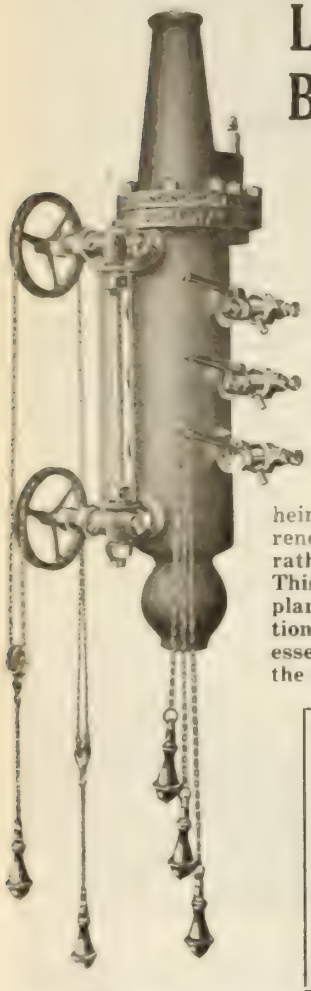
We have also installed several of your Nitro Lamps in our Toronto and Regina Mail Order Buildings, along with your 40 and 60-watt Tungstens with equally good results.

The Robert Simpson Co., Limited
W. Dutton, Chief Engr

Canadian Laco-Philips Company, Limited:

Montreal Toronto Winnipeg Vancouver

Proving their Economy



LUNKENHEIMER Boiler Mountings

are demonstrating their efficiency in power plants everywhere under the strain of increased production.

Correct designs and the high quality materials used peculiarly adapt them for high pressure steam service, and as a safeguard against interruption or delay every part is made to gauge and is interchangeable, permitting the repair or renewal of all parts.

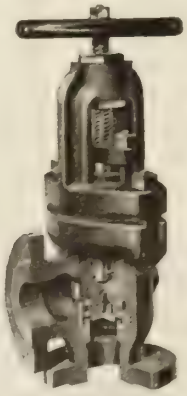
Users should profit by the advantages embodied in Lunkenheimer Boiler Mountings and repair or renew a part when occasion requires, **rather than discard the entire device. This will contribute to economy in plant maintenance and the conservation of equipment, both of which are essentially necessary to our success in the war.**

OUR "WAR-PERIOD" APPEAL

Engineering Appliances are Prime War Essentials

Stocks of distributors and facilities of manufacturers must be adjusted to care for essential needs.

Lunkenheimer patrons are earnestly requested to assist in the common cause by confining their War Period specifications to requirements for essential plants, craft, vehicles or equipment.



THE LUNKENHEIMER CO.
"QUALITY"

Largest Manufacturers of High Grade Engineering Specialties in the World

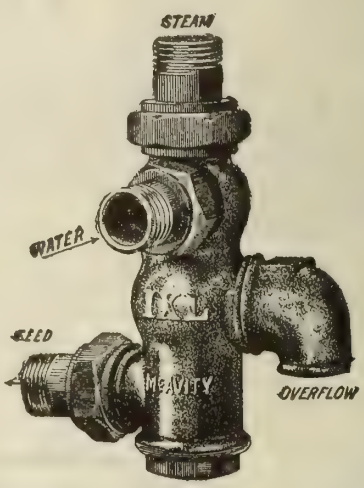
CINCINNATI

New York Chicago Boston London

"McAVITY" IXL

AUTOMATIC RE-STARTING

INJECTOR



The Best and Most Economical Automatic Injector on the Market

These "IXL" Injectors have increased areas where cones fit in body, enabling them to do more work and give better satisfaction than any other automatic single tube Injector.

EVERY INJECTOR TESTED

Price List upon Application.

T. McAVITY & SONS

LIMITED

St. John, N.B., Canada

MONTREAL
T. McAvity Stewart
157 St. James St.

TORONTO
Harvard Turnbull & Co.
207 Excelsior Life Bldg.

WINNIPEG

If what you want is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

Books for the Engineer's Library

Hawkins' New Catechism of Electricity

It contains 550 pages with 300 illustrations of electrical appliances; it is bound in heavy red leather, with full gold edges and is a most attractive handbook for electricians and engineers. One-third of the book is devoted to the explanation and illustrations of the dynamo, with particular directions relating to its care and management—$2.10 post paid.

Engineers' Examinations

By N. Hawkins, M.E.

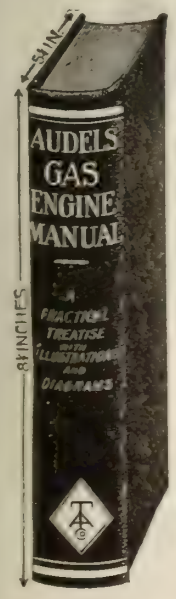
It presents in a condensed form the most approved practice in the care and managerment of steam boilers, engines, pumps, electrical and refrigerating machines, with examples of how to work the problems relating to the safety valve, strength of boilers and horse power of the steam engine and steam boiler.—$2.10 post paid.

Steam Turbines

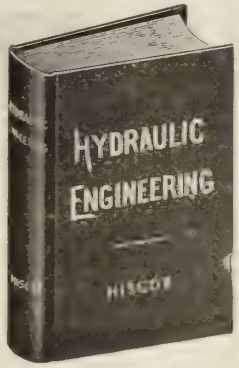
By Leland.

A reference work on the development, advantages and disadvantages of the steam turbine; the design, selection, operation and maintenance of steam turbine plants and turbo-generators. 135 pages. Illustrated.—$1.00.

Audel's Gas Engine Manual



A practical treatise relating to the theory and management of gas, gasoline and oil engines, including chapters on producer gas plants, marine motors and automobile engines.—$2.00.



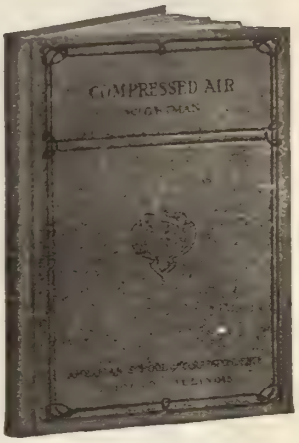
Hydraulic Engineering

By G. D. Hiscox.

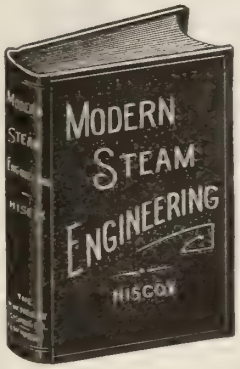
This comprehensive book of Hydraulics written by an experienced engineer, is a practical treatise on the properties, power and resources of water for all purposes, including the measurement of streams, the flow of water in pipes or conduits; the horse-power of falling water; turbine and impact water wheels; wave motors, etc. All who are interested in Water Works Development should have a copy. 320 pages, 305 illustrations. Price $4.15 post paid.

Compressed Air

By L. I. Wightman, E.E.



A reference work on the production, transmission and application of compressed air; the selection, operation and maintenance of compressed air machinery; and the design of air power plants. Illustrated.—$1.10.



Modern Steam Engineering in Theory and Practice

By Hiscox.

This book has been specially prepared for the use of the modern steam engineer, the technical students, and all who desire the latest and most reliable information on steam and steam boilers, the machinery of power, the steam turbine, electric power and lighting plants, etc. 450 pages. 400 detailed engravings.—$3.15 post paid.

Boiler Construction

By Kleinhans.

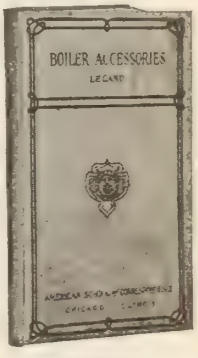
The only book showing how locomotive boilers are built in modern shops. Shows all types of boilers used; gives details of construction; practical facts, such as line of riveting punches and dies, work done per day, allowance for bending and flanging sheets and other data that means dollars to any railroad man. 421 pages, 324 illustrations, six folding plates.—$3.00.

Compressed Air, Its Production, Uses and Application. *By G. D. Hiscox, M.E.*

Comprising the physical properties of air from a vacuum to its liquid state, its thermodynamics, compression, transmission and uses as a motive power in the operation of stationary and portable machinery, in mining, air tools, air lifts, pumping of water, acids and oils and the numerous applicances in which compressed air is a most convenient and economical transmitter of power.—Price $5.15 post paid.

Boiler Accessories

By Walter S. Leland. S.B.

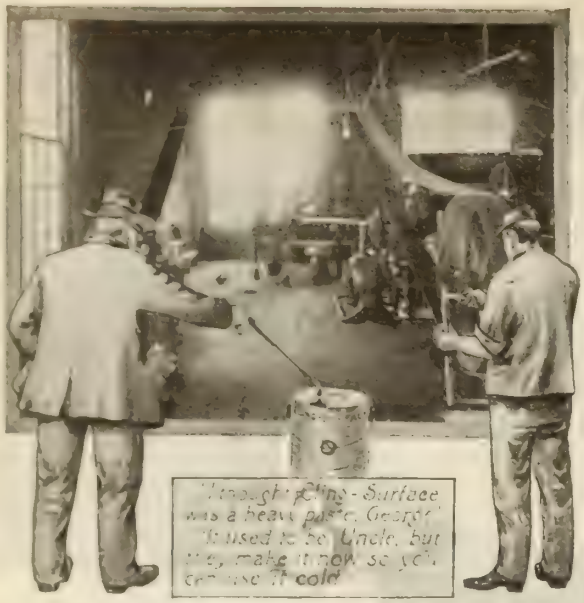


Assistant Professor of Naval Architecture, Mass. Institute of Technology, American Society Naval Architects and Marine Engineers. 144 pp., 80 illus. Cloth binding. A treatise giving complete descriptions of the various accessories of the boiler room and engine room essential to economical operation, such as evaporators, pumps, feed-water heaters, injectors, mechanical stokers, etc., with practical instruction in their use.—Price $1.10 post paid.

Technical Book Department

MacLean Publishing Company **143 University Ave., Toronto**

If any advertisement interests you, tear it out now and place with letters to be answered.



WE watched them run the big truck out of the yard; smoothly, almost noiselessly, it glided away. And in our minds we contrasted this with the noisy vehicle of ten years ago.

But almost any product can show improvement. Our own particular line has seen this change. The workman who objects to CLING-SURFACE "because it is hard to use" reminds one of the old lady who doesn't like automobiles because "they make so much noise." For the new semi-liquid CLING-SURFACE is perhaps easier to use than any belt dressing you can buy.

* * *

Changing it from the heavy paste of twenty years ago to the semi-liquid of to-day was not a simple problem. Not until 1915 were we ready to place it on sale. The preservative nature of CLING-SURFACE would not permit the use of any solvent, such as gasoline or turpentine. Nothing evaporative could be employed, as CLING-SURFACE must not oxidize, turn rancid or form sediment, for what it does in the open it will do in the belt, and there it should preserve and lubricate the fibres.

So, while twenty years ago it was necessary to heat the CLING-SURFACE, to-day (in ordinary temperatures) it is used cold.

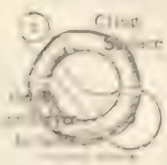
CLING-SURFACE is applied with a stick, say two feet long by one or two inches wide and half an inch thick, around one end of which is wound and wired a cloth bandage. At no time, therefore, is the operator in danger, for he is able to keep away from all moving parts.

* * *

CLING-SURFACE immediately stops the belt slip and removes any static electricity in the drives. Its continued use means mellow, pliable, waterproof and slip-proof belts, long-lasting and hard-working, saving you in power, oil, belting, coal, trouble, and men's and machines' time an amount annually which makes the price of CLING-SURFACE insignificant.

Ask us for the plan 10,000 firms have found successful. Our co-operation is free and our guarantee means something.

Remember, use CLING-SURFACE and you wont need belt dressings.



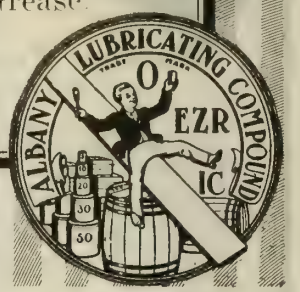
Cling-Surface Co.

1057 Niagara Street
Buffalo New York

ALBANY GREASE

for over 50 years has given a perfect lubrication service in power and industrial plants throughout the world. It is used by large industrial companies as well as small concerns equally successfully on their mechanical equipment. Albany Grease will keep all bearings and gears operating cool and easy at all times. Send for samples—now, if you are not using Albany Grease.

Albany Lubricating Co.
708-10 Washington Street
New York, U.S.A.
Established 1868



The Gripping Power of a Giant

is the gripping power of "Spiro" couplings; in fact, they have a 50% greater gripping force than any other compression coupling. The tigher the pull on the two halves of the coupling the tighter the grip on the entire length and circumference of the sleeve on the shaft.

A spiral slot in the sleeve is a patented Bond feature that allows a tremendous gripping force to be applied. There are no keys to break or work loose and cause time and labor to be wasted in fixing it.

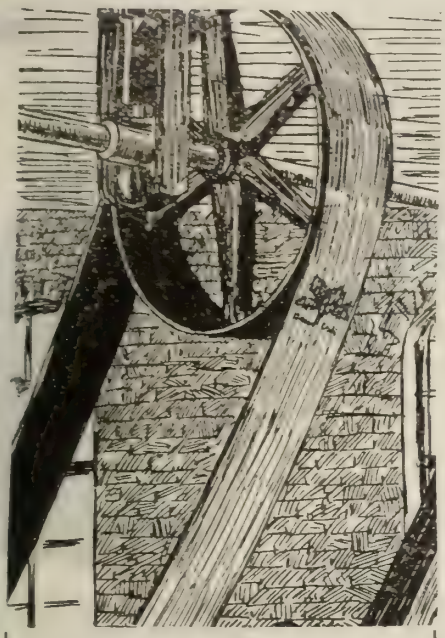
"SPIRO" Couplings Cannot Slip

Write for our catalog on Power Transmission Machinery to-day.

Canadian Bond Hanger & Coupling Co., Ltd.
ALEXANDRIA, ONTARIO

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

Whose Belting Turns the Pulleys in Your Plant?



It may be transmitting power at a power loss of 10 or 20 or 30 per cent., and still be a fairly good belting. But why should you lose 30 or 20 or even 10 per cent. of the power generated with high-priced fuel when a better belting

D. K. McLaren's
Genuine British Oak-Tanned
Leather Belting

would hold the loss to less than 3 per cent?

Simply because D. K. McLaren's Leather Belting is as nearly stretchless as a belting ought to be.

Simply because D. K. McLaren's Leather Belting does not slip.

Simply because D. K. McLaren's Leather Belting is made exclusively from close-trimmed butts of the finest selected hides, which are tanned the Genuine British Oak Method until extremely durable and pliable and tough.

For all the Facts write—to-day

Beware of Beltings that are *fairly good*

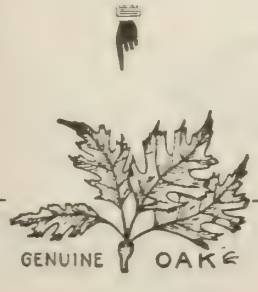
Particularly if you have tried many kinds

For you may conclude yours is as good as any

And once you do that you accept losses that you could eliminate

By using D. K. McLaren's Belting

Which has this Oak Leaf stamped upon it.



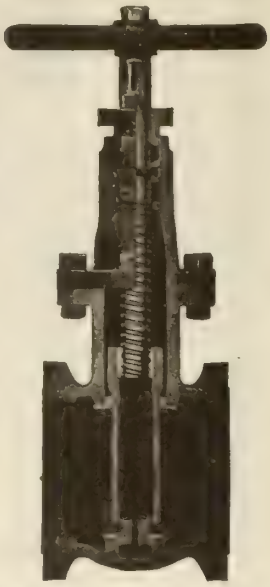
D·K·McLAREN LIMITED

HEAD OFFICE AND FACTORY:
351 ST. JAMES ST., MONTREAL, P.Q., CANADA

VANCOUVER, B.C. 849 Beatty St.
TORONTO, ONT. 194 King St., West
ST. JOHN, N.B. 90 Germain St.

KERR
("New KEYSTONE" Pattern) GATE VALVES

If you have not used any of these New Pattern Valves, specify "KERR" in your next order. We want you to get acquainted with the most reliable valve on the market.



If you have been using them, we are confident that our satisfaction will bring us your repeat orders. These valves will never cause you or your customer the slightest trouble. Their high quality is consistent.

When you buy a "KERR" Valve you get a guaranteed article that is backed by a reliable firm. Many of the largest distributers of valves in Canada have sold "KERR" Valves for over 25 years, and are still recommending them as the "Best Valve." Write us for particulars.

Kerr Engine Co., Ltd., Valve Specialists **Walkerville, Ont.**

Morehead
Back to Boiler SYSTEM

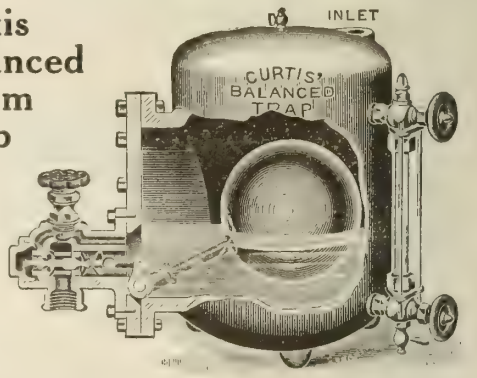
Drains Your Steam Lines Back to Boiler Automatically Without Pumps

After steam's expansive energy is exhausted, there are heat units left. These the Morehead System returns to your boiler as pure HOT feed water. It lowers your fuel cost by 10 per cent

It would pay you to talk with the owner of a plant in which the Morehead System is installed. **Write.**

Canadian Morehead Mfg. Company
Dept. A
Woodstock, Ontario

Curtis Balanced Steam Trap



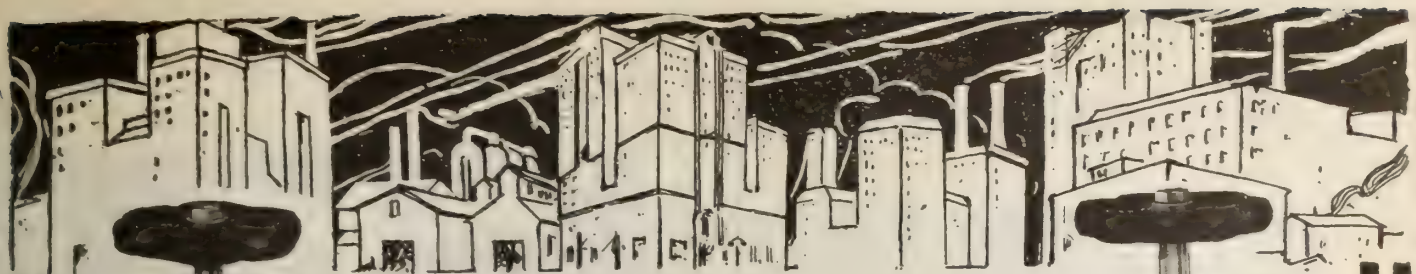
Five Superior Features of the Curtis

1. A perfectly balanced valve.
2. An absolutely frictionless valve.
3. The valve can be removed without breaking a joint, starting a gasket, or taking out a bolt.
4. The valve being frictionless and balanced, the whole power of the float is available for opening and closing the valve.
5. Each trap will operate perfectly on pressure varying from one to 250 lb.

Write for catalog of Curtis Engineering Specialties.

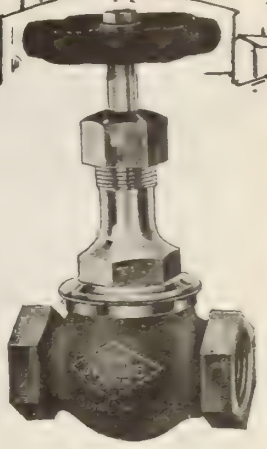
JULIAN D'ESTE COMPANY
Main Office, 26 Canal St., Boston, Mass.
Agencies: 216 Fulton St., New York City; 174 N. Market St., Chicago, Ill.

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.



Jenkins Bros.

Valves



EVEN an apparently insignificant hiss of steam past a poorly seating valve will cause a material fuel loss per year. Multiply this figure by the number of valves in the average plant and the loss becomes appalling.

Dependable valve service is essential—more so now than ever before in view of the great scarcity of fuel.

No matter what the type of building or plant, the best valve service is necessary. Installing good valves at the start saves repair and replacement charges and the labor costs of re-installations later.

Whether you require valves for industrial plants, public or private buildings, **Jenkins Bros.' Valves** should be your choice. You can rely upon them under conditions where other valves would fail.

They will hold absolutely tight under steam, water, air and gas pressure for very long periods of service without attention. The design is heavier than the usual commercial standard pattern of other makes, enabling us to guarantee them for 175-lb. steam or 250-lb. water-working pressure.

All are fitted with renewable Jenkins discs made of a softer composition than the metal and which will seat perfectly tight in spite of inequalities or rough spots in the metal surfaces. When worn the discs may be replaced at trifling cost and the valves will become as tight as when new. The composition of the discs is varied to suit the particular requirements of each class of service.

Furnished in brass or iron body, in globe, angle, cross, check, Y or blow-off, hose whistle and other patterns.

TRADE JENKINS MARK Jenkins Bros

Jenkins Bros. LIMITED

TRADE JENKINS MARK Jenkins Bros

Head Office and Works: 103 St. Remi Street, Montreal, Canada

Agencies in all the Principal Countries of the World

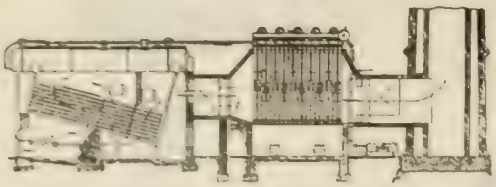
European Branch: 6 Great Queen Street, London, W.C.2, England

TRADE JENKINS MARK Jenkins Bros

For 54 years Genuine Jenkins Valves have rendered faithful service in over 103 industries.

Every genuine Jenkins Valve bears the diamond trademark—the seal of an iron-clad guarantee.

ARE YOU
SAVING TO HELP WIN THE WAR?



GREEN'S ECONOMISERS

save 10 to 15 per cent. of your coal bill by using heat that would otherwise be wasted up the stack.

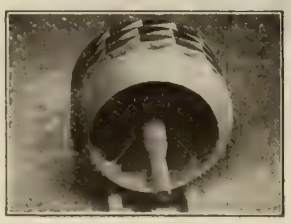
They have been doing this for 75 years.

Our Engineers will be glad to explain their operation.

GREEN'S ECONOMISER, LTD.
TORONTO

MONTREAL WINNIPEG NEW YORK

BETTER FANS—



Green's Forced Draft Fan.
210,000 cu. ft. per min. at 6" pressure.

GREEN'S
HI-EFFICIENCY HI-SPEED
RADIAL FLOW FANS

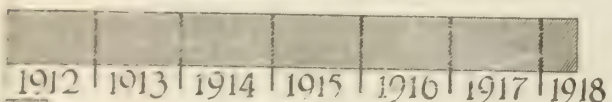
as their name indicates, require less power to drive and operate at higher speeds allowing direct connection to smaller motors or turbines than are usually required.

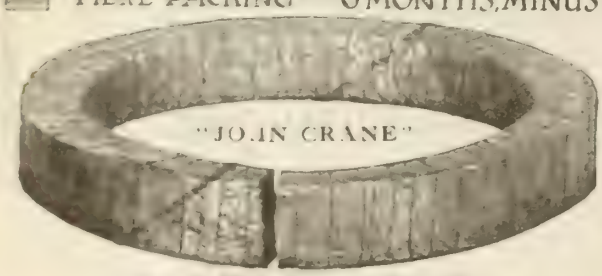
Our Engineers will be glad to quote on your needs.

GREEN'S ECONOMISER, LTD.
TORONTO

MONTREAL WINNIPEG NEW YORK

"JOHN CRANE"—6 YEARS, PLUS





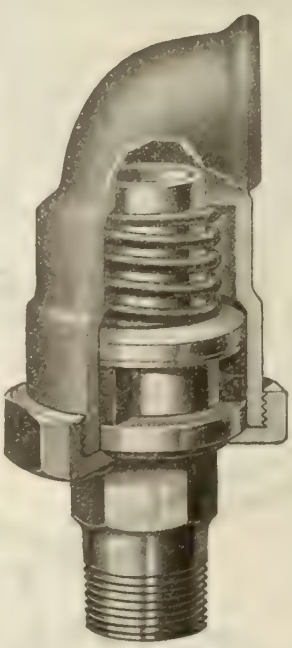
LONG LIFE

of packing depends largely on (1) material, (2) tightness and (3) lubrication. Discussing these in order (1) "John Crane" is made of babbitt which absorbs less power than any other material in contact with rubbing rods or shafts. (2) The construction of "John Crane" is such that the pressure to maintain leaklessness is minimized. Babbitt foil is so thin and the laminations in this packing so many that pressure simply cannot get through. Lastly

"JOHN CRANE" Soft Flexible Metallic Packing

Ask for our trial proposition and Bulletin No. 1

Crane Packing Company Box 241, Windsor, Ont.
General Office and Factory, Chicago, Ill.



Tuxeda
SWING JOINTS
Provide one of the easiest ways to save coal

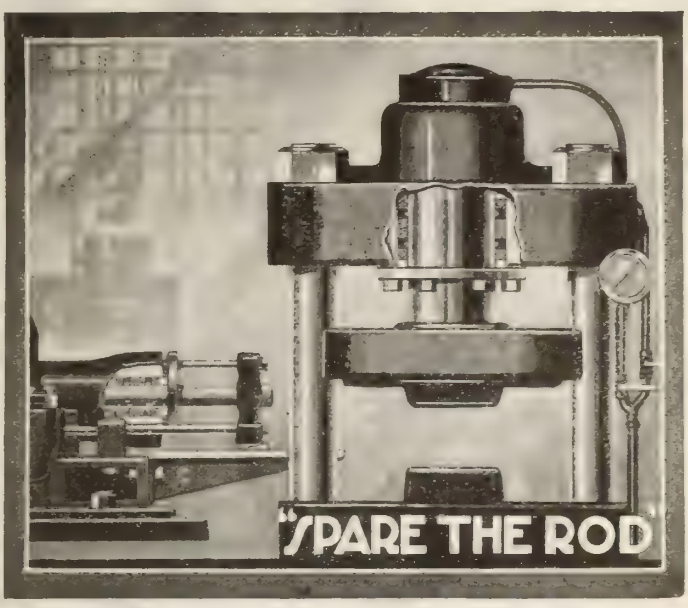
Every pound of steam that escapes through a leaky connection represents a certain amount of coal wasted. Do you know that an average leak will waste 3,400 pounds of steam a month? Investigate your flexible steam connections at once and then investigate the Tuxeda Swing Joint.

A Guaranteed Solution for Your Flexible Connection Problems

Send for Bulletin "A" to

FRANKLIN WILLIAMS, INC.
New York City
General Sales Agents: Canadian Fairbanks-Morse Co., Ltd.

GARLOCK PACKINGS



FOR GENERAL HYDRAULIC SERVICE

In steel mills and blast furnaces, where pressures vary by thousands of pounds, and where rams and plungers are often exposed to grit and corrosion,

Garlock Style No. 960

is guaranteed to give entire satisfaction. This combination is made up of braided copper, metal wedge and waterproof hydraulic rings. It will hold a pressure of 3,000 pounds.

Write for our catalog.

THE GARLOCK PACKING COMPANY, - Hamilton, Ont.

BRANCHES:

Montreal, Quebec - - - - - - - 409 Shaughnessy Bldg.
Toronto, Ontario - - - - - - 404 Continental Life Bldg.
Winnipeg, Manitoba - - - - - - - - - - - Galt Bldg.

Superior Quality---
Superior Service

The World's Best

OILS

Numidian Cylinder Oil

Velox Engine Oil

Preferred by the leading power plants of the country. They go farthest and prove more efficient than any other oils of their kind on the market.

Give them a trial and you'll quickly appreciate why they are in constant demand. Prices upon request—quick deliveries.

C. C. SNOWDON

Oils Refiner, Manufacturer and Importer, Pennsylvania Lubricating and Refined Oils, Gasoline, Potato Scale Powder, Liquid Soap, Disinfectants, Polish, Waste, Oil Tanks, etc.
Winnipeg—Cor. Notre Dame and Pine Streets, P.O. Box 1984. **Vancouver**—823 Powell Street. **Calgary**—1810-1840 Eleventh St. East, P.O. Box 1384. P.O. Drawer 166. **Edmonton**—Cor. 13th Ave. and 83rd St., P.O. Box 977.

Genuine Daniel's P.P.P. Packing
Ebonite Sheet
Ebonite Stop Valve Packing

Prompt Shipment

Thomson-Gordon Limited

Packings

Hamilton, Ontario

BOILER INSPECTION

The Steam Boiler Act, Chapter 252 R.S.O., 1914
With Amendments Chapter 58—6, George V.

STEAM BOILERS.

All Steam boilers constructed for use in Ontario must be built from designs which have been approved and allotted a registration number by the Steam Boiler Branch.

Used boilers, boilers sold or exchanged, and unregistered boilers brought into the Province must be inspected prior to being put into operation.

Notice of repairs to steam boilers, stating the nature and extent of same, must be sent to the Steam Boiler Branch, and should such repairs be considered extensive by the Chief Boiler Inspector, the boilers will require to be inspected.

In each and every case the inspections must be made by Inspectors authorized to inspect boilers under the Steam Boilers Act, who are employed only by the Steam Boiler Branch of the Department of Public Works. Official certificates with the maximum working pressure stated thereon are issued to the owners of the boilers so inspected.

STEAM PIPING.

Drawings and Specifications of all high pressure steam piping must be approved and registered by the Steam Boiler Branch before any work of installation is commenced. The drawings submitted should show clearly the dimensions and layout of the main steam lines. Full particulars should be given as to the material used in the construction of the piping, and all valves and other fittings used in connection therewith must be of approved make.

Any deviation from the above requirements shall be deemed a violation of the Steam Boilers Act.

All communications in this respect should be addressed to the Steam Boiler Branch, Department of Public Works, Parliament Buildings, Toronto.

HON. F. G MACDIARMID, Minister of Public Works and Highways
W. A. RIDDELL, M.A. Ph.D., Supt. Trades & Labour Branch

D. M. MEDCALF,
Chief Inspector of Steam Boilers.

WHEN You Plan Your Drives, PLAN for
SERVICE, DURABILITY and EFFICIENCY

COST-FINDING and COST-KEEPING are the Essentials of Prudent Management and Success

Read! Think! Consult every authority on belting, power transmission, belt speeds, slip, pulley surfaces, cling surfaces, belt dressings.

Figure the sum total of your series of losses and expense in your series of power-driving units.

Trace your daily power loss to the source.

Morse Rocker Joint Silent Chain is the only 99% efficient power transmission not dependent on an Oil Bath for Service and Durability. Positive as Gears. Flexible as a Belt.

MORSE ENGINEERING SERVICE

AIMS by thorough analysis of your power service to determine what can be done to increase production at the same time lowering costs and maintenance, submitting reports of the individual specializing expert, going deep into your problem showing the saving in space and construction costs.

Let us have your layout and design a chain drive to meet the special existing conditions.

MORSE Drives insure profits against competition.

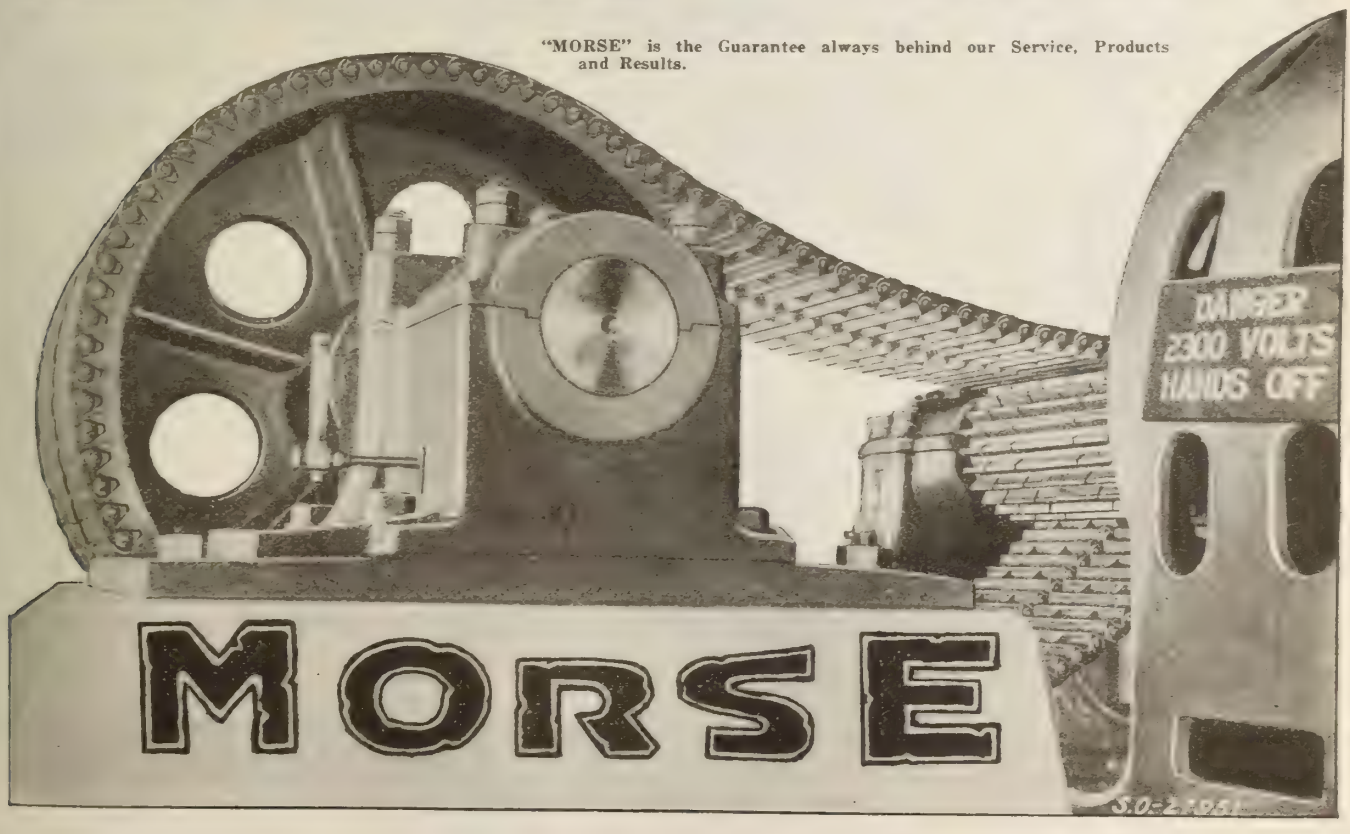
MORSE CHAIN CO., Largest Manufacturer of Silent Chains in the World ITHACA, N.Y.

Morse Service — *Address Nearest Office* — **Assistance Without Obligation**

BOSTON, Mass. .....141 Milk Street
CHICAGO, Ill. .....Merchants Loan & Trust Bldg.
CLEVELAND, Ohio .....421 Engineers Bldg.
DETROIT, Mich. .....1003 Woodward Ave.
GREENSBORO, N.C. .....805 Ashboro Street
NEW YORK CITY .....50 Church St., Hudson Term. Bldg.
PITTSBURGH, Pa. .....Westinghouse Bldg.
SAN FRANCISCO, Cal. .....Monadnock Block

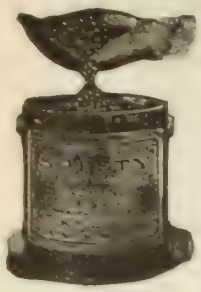
ATLANTA, Ga. .....Earl F. Scott, M.E., 702 Candler Bldg.
CANADA .....Jones & Glassco, Regd., Montreal, St. Nicholas Bldg., Toronto., Traders Bank Bldg.
KANSAS CITY, Mo. .....Morse Engineering Co., R. A. Long Bldg.
MINNEAPOLIS, Minn. ....Strong-Scott Mfg. Co., 413 Third St. S.
ST. LOUIS, Mo. .....Morse Engineering Co., Chemical Bldg.
Licensees for Europe.....The Westinghouse Brake Co., Ltd., 82 York Road, King's Cross, London, N.

"MORSE" is the Guarantee always behind our Service, Products and Results.



250 H.P. "Morse" Norfolk & Western Ry. Co.

Self-Lubricating



In Bulk

SAFETY PLASTIC

METALLIC PACKING

FOR STEAM, WATER, AIR, GAS, ETC.

Pat. Dec. 22, 1903 Highest Award World's Fair, St. Louis, 1904

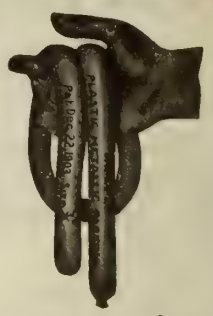
GUARANTEED TO LAST THREE YEARS

WITHOUT RENEWAL

Drop us a line and let us tell you all about this Remarkable Packing.

STEEL MILL PACKING CO., WINDSOR, ONT. Established 1899

Practically Frictionless



In Cotton Tubes

BOWSER ESTABLISHED 1885

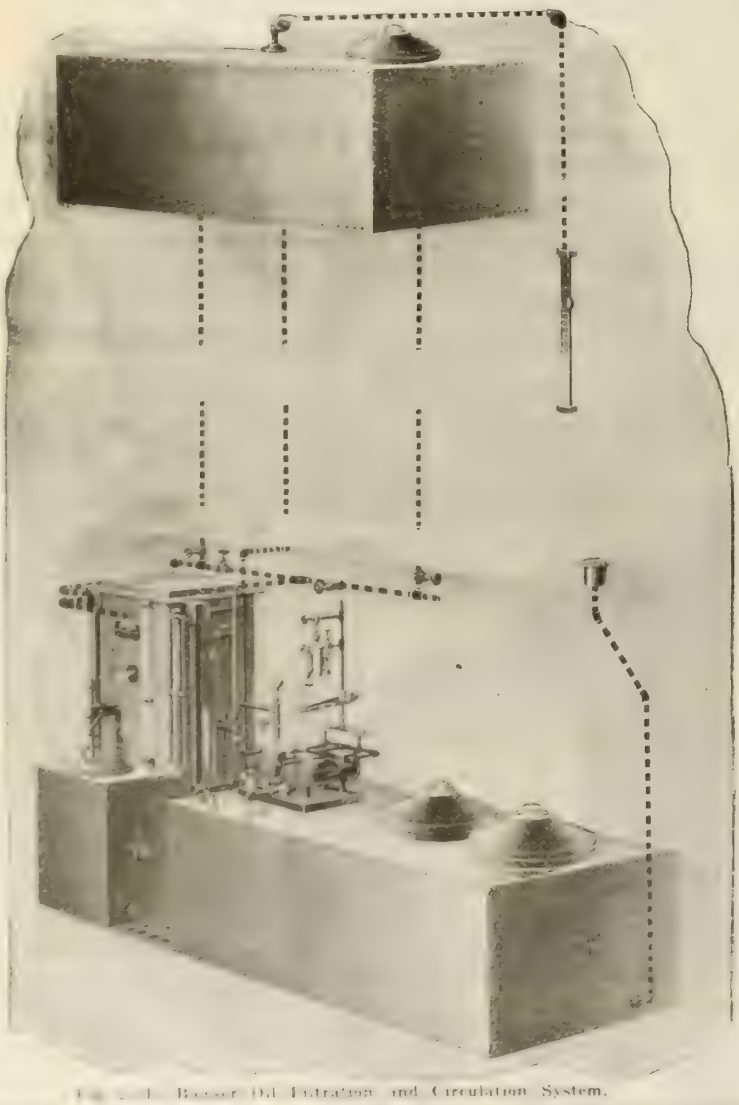


Fig. 1—Bowser Oil Filtration and Circulation System.

Oil Filtering and Circulating Systems

Why continue your present expensive hand-oiling practice when a Bowser system will save this labor and prevent waste of oil. Excess friction losses are stopped by the constant dependable stream feed of a Bowser System.

A decided cut in your oil bill will be effected by Bowser Filtering and re-use of your lubricants.

Why not place your plant on a more economical and profitable basis?

Let us give you some suggestions.

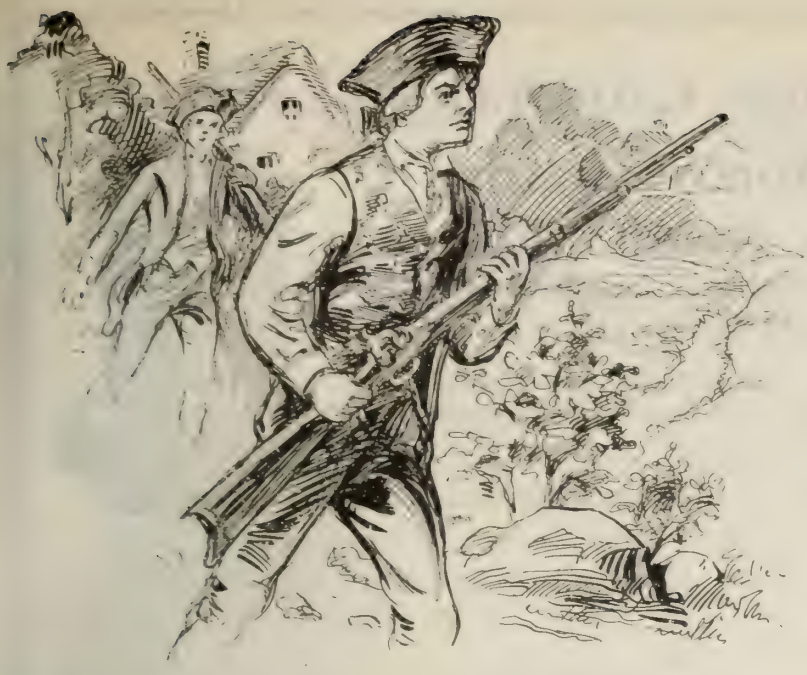
Ask for Booklet 30

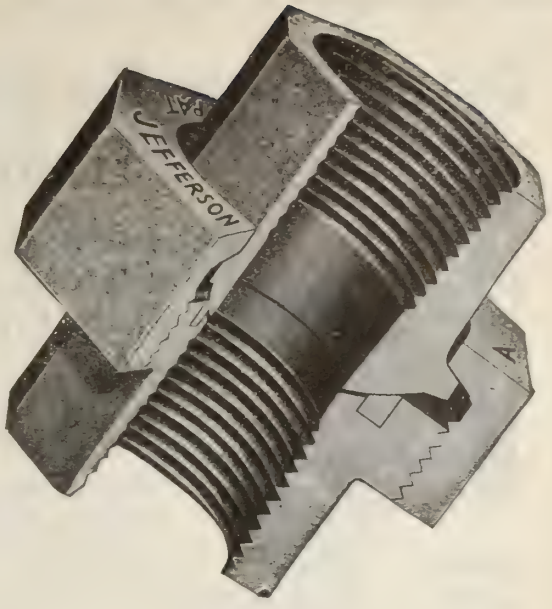
S.F. Bowser & Co.

INCORPORATED

FORT WAYNE, INDIANA, U.S.A.

Mention This Paper When Writing Advertisers





Adding Fame to the Home of the Minute Man

Just as the colonial Minute Man typifies the real spirit of American freedom, so JEFFERSON UNIONS stand for freedom in their own line—freedom from annoying leaks and costly shutdowns.

JEFFERSON UNIONS

JEFFERSON UNIONS are more than just unions — they represent pipe-line efficiency and perfect union service. When you are tempted to install a "just-as-good" union, just consider that it costs just as much to install and when it fails you have to stand the added expense of replacing, besides the annoyance of leaks and power losses.

JEFFERSON UNIONS are built extra heavy, of high-grade, air-refined, malleable iron. They will not stretch or distort, no matter how hard they are set-up. The brass-to-iron joint cannot corrode, so that it is always an easy matter to take down a JEFFERSON.

Your jobber has JEFFERSON UNIONS awaiting your call. Ask him what he thinks of JEFFERSONS —he handles others and can tell you all you want to know. Our Catalog "UNIONS" shows our complete line.

Write to-day for your copy.

The Jefferson Union Company

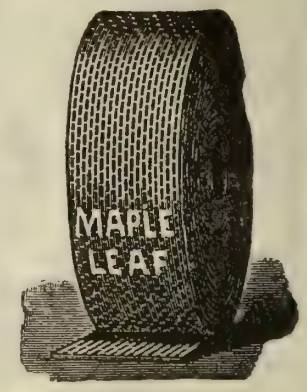
Lexington, Massachusetts

Dominion Belting Company, Limited
Hamilton, Canada

Sole manufacturers of the celebrated "MAPLE LEAF" Brand Stitched Cotton Duck Belting and Belt Dressing.

The demand for our products has steadily increased because the standard of quality has been maintained.

We make only one grade, the best that can be produced.



"MAPLE LEAF" is the strongest, truest running, most economical and efficient belt on the market for transmission of power, conveying, etc.

Being thoroughly waterproof it is suitable for running in wet or dry places. **"MAPLE LEAF"** Belt Dressing is different to others offered in that it is equally good for all kinds of belting, leather, rubber or Balata, as well as our own make.

Write us for prices, and if desired we will be pleased to furnish samples and further information.

A trial order will convince you of their utility.

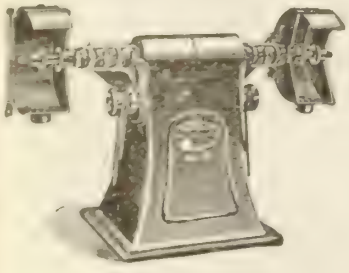
DOMINION BELTING CO. Ltd., Hamilton, Canada-Quebec Branch: 51 Duluth Bldg., Montreal

TRADE MARK

MAGNOLIA ANTIFRICTION METAL

TRADE MARK

FOR POLISHING AND BUFFING



EXCELSIOR TOOL & MACHINE COMPANY,
Engineers, Founders, Machinists.
East St. Louis, Illinois.

Magnolia Metal Co., Sept. 4, 1917.

Gentlemen,—We use Magnolia Metal exclusively for lining the bearings of the spindles of our "Excelsior Double Arbor Labor Saving Polishing and Buffing Machines" with most satisfactory results.

These arbors run at speeds ranging from 1800 to 2300 R.P.M. and we have found the Magnolia lining to be greatly superior to ball bearings or to other grades of babbitt metals.

Among the concerns who commend our machines very highly is the FAVORITE STOVE & RANGE CO., of Piqua, Ohio, who installed twenty-six of these machines. In letter received from them two years after they say, in one paragraph:—

"The usual speed of the machines has been maintained and the boxes are apparently as good as when the machines were installed."

The wisdom of our selecting Magnolia Metal has been amply confirmed by our own experience as well as the favorable commendation of our customers.

We are pleased to be able to make this favorable report on Magnolia Metal.

Yours truly,
EXCELSIOR TOOL & MACHINE CO.,
T. T. PHILIPPI, President.

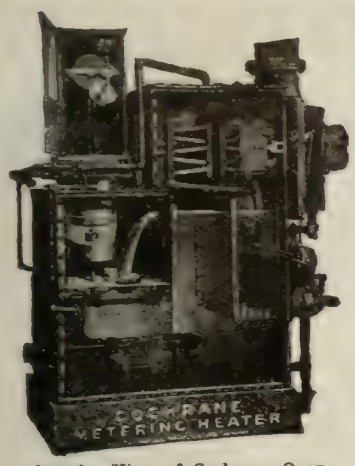
PRACTICAL ENGINEER POCKET BOOK:
Over 600 pages. A valuable reference work imported from England and sold as an advertising medium at the low price of 40c post paid.
Address Montreal Office.

SOLD BY LEADING DEALERS EVERYWHERE OR BY

MAGNOLIA METAL CO.

OFFICE AND FACTORY:
225 St. Ambroise St., MONTREAL

STEAM SPECIALTIES
for
The Power House



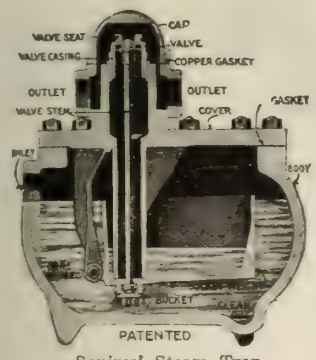
Interior View of Cochrane Open Feed Water Heater

Cochrane Heaters as used in Heating, Metering, and Softening water for boiler feed and other purposes.

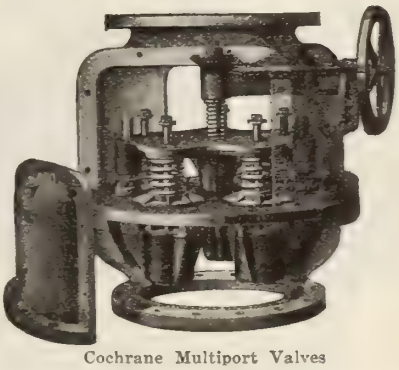
Cochrane Separators for removing water from live steam, water and oil from exhaust steam and compressed air.

Cochrane Steam Separator

Cochrane Multiport Safety Exhaust Outlet Valves are designed to release steam and prevent accumulation of pressure, and are the only valves of the kind absolutely free from sticking, pounding or overloading.



Squires' Steam Trap


Cochrane Multiport Valves

The merits of the Squires' Steam Traps have repeatedly been demonstrated in marine service, high pressure power plants, low pressure heating systems, on laundry machinery, steam separators, vulcanizers in rubber plants, dry kilns, drying rolls of paper machines, and other places where steam traps are required.

CANADIAN ALLIS-CHALMERS
LIMITED

Head Office: Toronto Sales Offices: Montreal, Quebec, Halifax, Sydney, Ottawa, Cobalt, South Porcupine, London, Winnipeg, Calgary, Edmonton, Nelson and Vancouver.

If any advertisement interests you, tear it out now and place with letters to be answered.

HINTS TO BUYERS

DOMINION COAL COMPANY LIMITED

"Dominion" and "Springhill" BITUMINOUS STEAM and GAS COALS

GENERAL SALES OFFICE

112 St. James St. Montreal

NOTICE

TO

Stationary and Hoisting Engineers

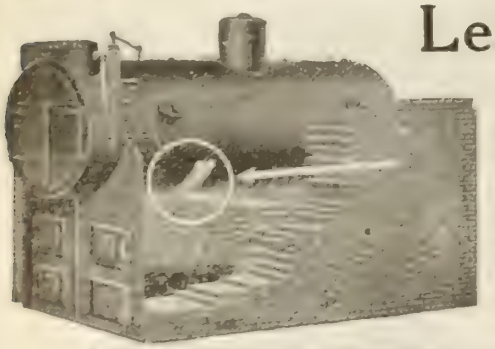
Everyone operating a STATIONARY steam plant of 50 h.p. or over in the Province of Ontario must hold a Stationary Engineer's Certificate from the Board of Stationary and Hoisting Engineers. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary and Hoisting Engineers' Act.

Everyone operating a HOISTING steam plant working at a pressure of 20 pounds or over, irrespective of horse power, and used for hoisting in structural operations or excavating purposes, in the Province of Ontario, must hold a Hoisting Engineer's Certificate from the Board of Stationary and Hoisting Engineers. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary and Hoisting Engineers' Act.

Application forms for obtaining STATIONARY or HOISTING Engineers' Certificates, may be had upon applying to the Chairman.

HON. F. G. MACDIARMID, Minister of Public Works and Highways. W. C. McGHIE, Chairman of Board.

W. A. RIDDELL, M. A. PH. D., Superintendent, Trades & Labour Branch.



Leakage Stopped

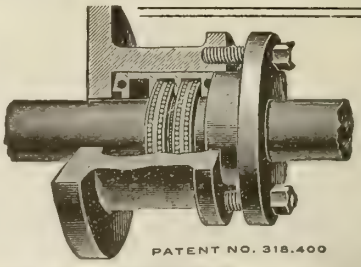
Permanently stopped by the National Boiler Seam Protector, which anyone can attach in 30 minutes. It will also save your boiler from fire cracks, mud cracks and blisters. Write for long list of pleased users.

Free trial on request.

NATIONAL BOILER SEAM PROTECTOR CO. OF CANADA

Head Office: 910 New Birks Bldg., Montreal.

Toronto Office: 568 Manning Ave., Toronto.



PATENT NO. 318,400

PAT. NO.	700,899	PAT. NO.	829,116
" "	704,104	" "	830,530
" "	705,328	" "	866,103
" "	654,541	" "	878,238
" "	654,542	" "	894,537
" "	725,168	" "	895,791
" "	734,490	" "	898,066
" "	776,193	" "	905,103
" "	776,194	" "	934,629
" "	791,300	" "	979,208
" "	805,669	" "	1000,76

Why not Buy the Best, when in market for Packing?

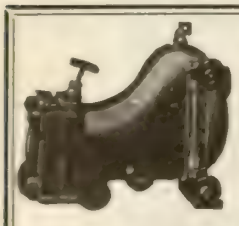
HOLMES' Metallic Packing

Is Guaranteed 3 Years

Lasts many times longer. 30 days' trial. Less oil. No cutting. Easily applied to any Steam Engine, Air Compressor or Gas Engine. Satisfaction or no pay. Write us.

HOLMES METALLIC PACKING CO., Wilkes-Barre, Pa.

Incorporated 1897



McDANIEL IMPROVED STEAM TRAP

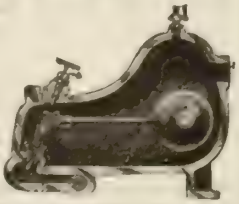
FOR HIGH OR LOW PRESSURE.

Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

MAY WE SEND ONE FOR TRIAL?

Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators.

SEND FOR CATALOGUE.



THE GARTH COMPANY

26 Craig Street MONTREAL, CAN.

WATSON & McDANIEL CO.

No. 146 N. 7th Street. PHILADELPHIA, Pa.

Water Turbines, Hydraulic Governors, Centrifugal Pumps

OUR LINDSAY WORKS

Boving Hydraulic & Engineering Co., Limited

Lindsay, Ontario

MILL SUPPLY DEPARTMENT

BEVERIDGE PAPER COMPANY LIMITED, MONTREAL

Plibrico — One-Piece Plastic Firebrick
For Boilers, Burners, Smelters.

Plibrico Bond — High Temperature Cements

SHELL BAR GRATES
Anti-Clinker—Revolving
Enables you to use cheaper fuel.

BOICO
Scientific Water Treatment

Stormtight — Cements Liquid and Plastic
For Roofs, Walls, Foundations.

Cemcoat
Washable, Enamellike Coating.

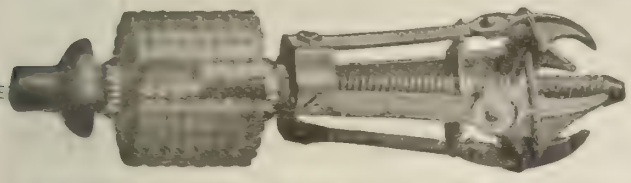
Hydrocide
Damp-proof for Acid Tanks, etc.

LapidoLith — "Makes Concrete Hard as Granite"
For Floors—Chests, etc.

VULCANIZED FIBRE
Everything in Hard and Flexible

Noiseless Trucks, Gears, Etc.

Why not use these guaranteed materials?



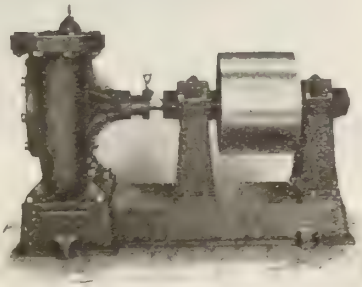
Looks like a good tool and it's just a little better than it looks. Adopted as standard by thousands of engineers who know from experience that it always gets results.

Pil eys Combination Flue Brush and Scraper

is adjustable to the tube—scrapes and brushes thoroughly in one operation. Guaranteed against defective materials and that wires will not pull out or lay over. For sale by leading Canadian jobbers.

Eastern Office: 71 Fulton St., New York.

PILLEY PACKING & FLUE BRUSH MFG. CO.
623 South Third Street ST. LOUIS, MO.

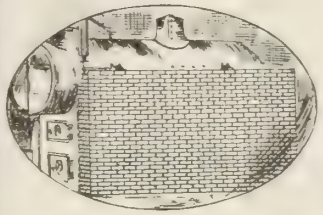


Send that PUMP inquiry to

The Smart-Turner Machine Co.
LIMITED
HAMILTON, CANADA

JAMISON COLD STORAGE DOOR CO.
JONES COLD STORE DOOR CO
OPEN RITE — And just a few of the facts in mind — CLOSE TITE
Manufacturers of the ORIGINAL "JONES" AND "NOEQUAL" TYPES
HAGERSTOWN, MD. P.O.BOX 93 U.S.A.

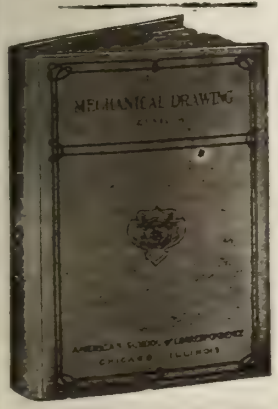
FIRE-BRICK WORK
in all its Branches



Your boilers need protection. Let me brick them up for you; this is my specialty. First-class, durable work—moderate cost.

Write for prices and particulars.

J. H. Wenting, Toronto, Ont.
Mason Contractor Phone Beach 1353 256 Lee Ave.



Mechanical Drawing
By Ervin Kenison, S.B.
Instructor in Mechanical Drawing, Massachusetts Institute of Technology

176 pp., 140 illus. Cloth binding. Gives a course of practical instruction in the art of Mechanical Drawing, based on methods that have stood the test of years of experience. Includes orthographic, isometric and oblique projections, shade lines, intersections and developments, lettering, etc., with abundant exercises and plates.

Price, $1.00

MacLean Publishing Co.
Technical Book Dept.
143-153 University Ave., Toronto

THE LADD VERTICAL WATER TUBE BOILER

The Goldie-McCulloch Co., Ltd.
Galt, Ontario

Canadian licencees under patents 162401 and 162402 dated May 4, 1915.

The George T. Ladd Company,
Pittsburgh, Pa.

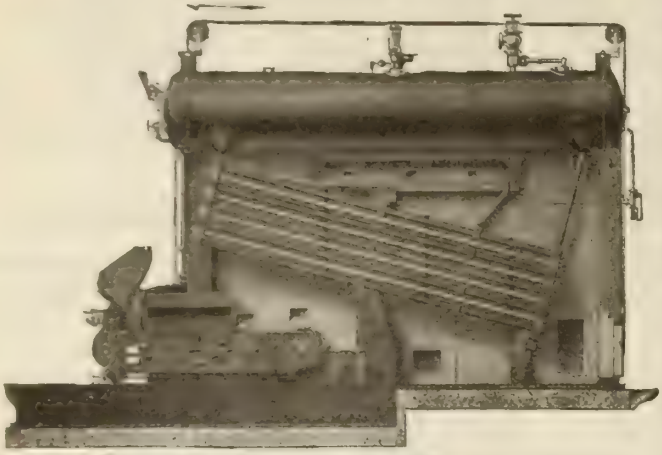
Owners and manufacturers for the United States.

Write for new Catalogue No. 17.

"ALL BRITISH"

"B.&W." PATENT WATER TUBE STEAM BOILERS

HIGHEST ECONOMY, SAFETY, DURABILITY. OVER 20,000,000 H.P. IN USE.



Babcock & Wilcox Patent Water Tube Steam Boiler, Superheater and Mechanical Stoker.

ALSO

Steam Superheaters
Mechanical Stokers
Coal-Handling Machinery
Piping, Feed Water Heaters
Water Softeners and Purifiers
and **ELECTRIC CRANES**

BABCOCK & WILCOX, Limited

HEAD OFFICE FOR CANADA - COLLEGE ST. (ST. HENRY), MONTREAL
TORONTO OFFICE, TRADERS BANK BUILDING

Starrett Speed Indicator

A GOOD SELLER

Every engineer needs a speed indicator and a tool bearing the name "Starrett" will be readily purchased by the man of experience.

Catalogue No. 21CD showing 2,100 fine tools sent on request.

THE L. S. STARRETT CO.
The World's Greatest Toolmakers
ATHOL, MASS.

The Wrench of 25% Greater Efficiency

TRIMO PIPE WRENCH

Two new features have been recently added to the Trimo Pipe Wrench, namely Nut-Guards, in all sizes, and unbreakable steel frames, in leading sizes.

The Nut-Guards prevent the accidental rotation of the nut while in use.

These improvements add 25% to the usefulness of the tool.

The Trimo Pipe Wrench is made with wood handles in 4 sizes, 6-in., 8-in., 10-in., 14-in. and in steel handles in all sizes, 6-in. to 48-in. inclusive.

All Trimo Pipe Wrench parts are interchangeable.

The inserted jaw in the handle can be readily replaced when worn, thus adding to the life of the tool.

Nut with Nut-Guards

Inquiries from Importers and Dealers Solicited. Send for Catalogue No. 55.

TRIMONT MANUFACTURING CO.

CableAddress: Triwrench
Code: Western Union

Roxbury (Boston) Mass., U.S.A.

POWER HOUSE BUYERS' DIRECTORY

If what you want is not listed here write us, and we will tell you where to get it. Let us suggest that you consult also the advertisers' index facing the inside back cover, after having secured advertisers' names from this directory. The information you desire may be found in the advertising pages This department is maintained for the benefit and convenience of our readers. The insertion of our advertisers names under proper headings is gladly undertaken, but does not become part of an advertising contract.

ACCUMULATORS, HYDRAULIC
Bawden Pump Co., Toronto.

AIR COCKS
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

AIR VALVES
Mueller Mfg. Co., H., Sarnia, Ont.

ALTERNATORS
Lancashire Dynamo & Motor Co., Toronto, Ont.

AMMETERS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. H. W. Johns-Manville Co., Toronto, Ont.

AMMONIA VALVES AND FITTINGS
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Frick Co., Waynesboro, Franklin Co., Pa.
Homestead Valve Mfg. Co., Pittsburgh, Pa.
York Mfg. Co., York, Pa.

AMMONIA PURIFIERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Mfg. Co., York, Pa.

AMMONIA TANKS
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford, Ont.

ANTIMONY
Dominion Metal Co., Sherbrooke, Que.

ARCHES, COMBUSTION CHAMBER
Canadian Fairbanks-Morse Co., Ltd. Montreal.

ASH CARRYING SYSTEMS
Babcock & Wilcox, Ltd. Montreal.
Waterous Engine Works Co., Brantford, Ont.

ASBESTOS SPECIALTIES
Durabla Mfg. Co., New York, N.Y.
Garlock Packing Co., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

AUTOMATIC ICE RECORDING DOORS AND CHUTES
Jamison Cold Storage Door Co., Hagerstown, Md.

BABBITT AND ANTI-FRICTION METAL
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Dominion Metal Co., Sherbrooke, Que.
Hoyt Metal Co., Toronto.
Magnolia Metal Co. Montreal.
Wm. C. Wilson & Co., Toronto.

BALL BEARINGS
Can. S K F Co., Toronto, Ont.

BALLCOCKS
D'Este Co., Julian, Boston, Mass.

BATTERIES AND ACCESSORIES
Can. H. W. Johns-Manville Co., Toronto, Ont.

BELT CEMENT
Graton & Knight Mfg. Co., Montreal.

BELT DRESSING
Cling Surface Co., Buffalo.
Jos. Dixon Crucible Co., Jersey City.
Dominion Belting Co., Hamilton, Ont.
Graton & Knight Mfg. Co., Montreal.

BELT LACING, LEATHER
Graton & Knight Mfg. Co., Montreal.

BELT TIGHTENERS
Waterous Engine Works Co., Brantford, Ont.

BELT PULLEYS
American Pulley Co., Philadelphia, Pa.
Waterous Engine Works Co., Brantford, Ont.

BELTING, BALATA
Federal Engineering Co., Toronto, Ont.

BELTING, LINK
Graton & Knight Mfg. Co., Montreal.
Waterous Engine Works Co., Brantford, Ont.

BELTING, STITCHED COTTON DUCK
Dominion Belting Co., Hamilton, Ont.

BELTING, LEATHER
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Garlock Packing Co., Hamilton, Ont.
Goodyear Tire & Rubber Co., Toronto.
Graton & Knight Mfg. Co., Montreal.
Main Belting Co., Montreal.
D. K. McLaren Ltd., Montreal.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

BELTING, RUBBER
Can. H. W. Johns-Manville Co., Toronto, Ont.
Goodyear Tire & Rubber Co., Toronto.
Jeffrey Manufacturing Co., Montreal.
Thomson-Gordon, Ltd., Hamilton, Ont.
United States Rubber Co., New York.

BELTING, WOVEN COTTON
Federal Engineering Co., Toronto, Ont.

BINS, COAL, COKE AND ORE
Jeffrey Manufacturing Co., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford, Ont.

BLOWERS
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Can. Sirocco Co., Windsor, Ont.
Coppus Eng. & Equip. Co., Worcester, Mass.
Green's Economiser, Ltd., Toronto.

BOILER COVERING
Beveridge Paper Co., Montreal, Que.

BOILER COMPOUNDS
Beveridge Paper Co., Montreal, Que.
Can. Economic Lubricant Co., Montreal, Que.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Metlskin Mfg. Co., Rochester, N.Y.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Wm. C. Wilson & Co., Toronto.

BOILER COMPOUND FEEDERS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Morehead Mfg. Co., Woodstock.
Lunkenheimer Co., Cincinnati, O.

BOILER FEED PUMPS
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Steam Boiler Equipment Co., Toronto, Ont.
Darling Bros., Ltd., Montreal, Que.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Laurie & Lamb, Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

BOILER FEED REGULATORS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Beveridge Paper Co., Montreal, Que.
Mason Regulator & Engineering Co., Montreal.
Northern Equipment Co., Erie, Pa.

BOILER GRAPHITE
Joseph Dixon Crucible Co., Jersey City, N.J.

BOILER MOUNTINGS
Babcock & Wilcox, Ltd. Montreal.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Ltd., Montreal, Que.
Inglis Co., The John, Toronto, Ont.
Lunkenheimer Co., Cincinnati, O.
Mason Regulator & Engineering Co., Montreal.

BOILER PRESERVATIVES
Johns-Pratt Co., The, Hartford, Conn.
Metlskin Co., Inc., Rochester, N.Y.

BOILER AND FURNACE BRICK WORK
Wenting, J. H., 256 Lee Ave., Toronto, Ont.

BOILER HOUSE ACCESSORIES
Babcock & Wilcox, Ltd. Montreal.
Canadian Griscom-Russell Co., Ltd., Montreal.
Cole, Ltd., Geo. W., Toronto.
Mason Regulator & Engineering Co., Montreal.

BOILER SEAM PROTECTOR
National Boiler Seam Protector Co., Montreal.

BOILER SETTINGS
Beveridge Paper Co., Montreal.
Gates, John W., St. James St., Montreal.

BOILERS, HORIZONTAL, RETURN, TUBULAR AND WATERTUBE
Babcock & Wilcox, Ltd. Montreal.
Cole, Ltd., Geo. W., Toronto.
Goldie & McCulloch Co., Galt.
Frick Co., Waynesboro, Franklin Co., Pa.
Inglis Co., The John, Toronto, Ont.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Jones Underfeed Stoker Co., Toronto.
Leonard & Sons, E., London, Can.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Ladd, The Geo. T., Co., Pittsburgh, Pa.
McAvity, T., & Sons, Ltd., St. John, N.B.
Waterous Engine Works Co., Brantford, Ont.

BOILERS, MARINE, LOCOMOTIVE AND VERTICAL
Babcock & Wilcox, Ltd. Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Goldie & McCulloch Co., Galt.
Inglis Co., The John, Toronto, Ont.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Leonard & Sons, E., London, Can.
John McDougall Caledonian Iron Works, Montreal.
Waterous Engine Works Co., Brantford, Ont.

BOOKS
Audel & Co., Theo, New York, N.Y.
MacLean Publishing Co., Toronto.

BOXES, FUSE AND METER
Johns-Pratt Co., The, Hartford, Conn.

BRASS FOUNDERS
McAvity, T., & Sons, Ltd., St. John, N.B.
D'Este Co., Julian, Boston, Mass.
Mueller Mfg. Co., H., Sarnia, Ont.

BRINE COOLERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

BRINE TANKS
Frick Co., Waynesboro, Franklin Co., Pa.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford, Ont.
York Manufacturing Co., York, Pa.

BUSHINGS
Steel Mill Packing Co., Windsor, Ont.

CABLE
Wm. C. Wilson & Co., Toronto.

CALORIMETERS
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Taylor Instrument Co., Rochester, N.Y.

CANS, OILY WASTE
Jas. Morrison Brass Mfg. Co., Toronto.

CAST IRON FITTINGS
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.

CASTINGS, BRASS AND IRON
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Hamilton Co., Wm., Peterboro, Ont.
Lunkenheimer Co., Cincinnati, O.
John McDougall Caledonian Iron Works Co., Ltd., Montreal.
McAvity, T., & Sons, Ltd., St. John, N.B.
Mueller Mfg. Co., H., Sarnia, Ont.
Victoria Foundry Co, Ottawa, Ont.
Waterous Engine Works Co., Brantford, Ont.
Wood & Co., R. D., Philadelphia, Pa.

CELLAR DRAINERS
Morrison Brass Mfg. Co., James, Toronto, Ont.
Mueller Mfg. Co., H., Sarnia, Ont.

CEMENT HARDNER & WATERPROOFER
Beveridge Paper Co., Montreal, Que.

CEMENT, HIGH TEMPERATURE
Beveridge Paper Co., Montreal.
Gates, John W., St. James St., Montreal.
Green's Economiser, Ltd., Toronto.

CEMENT, PIPE JOINT
Wm. C. Wilson & Co., Toronto.

CEMENT MACHINERY
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Waterous Engine Works Co., Brantford, Ont.

CEMENT, INSULATING, REFRACTORY
Green's Economiser, Ltd., Toronto.

CHAIN DRIVES
Coventry Chain Co., Coventry, England.
Morse Chain Co., Ithaca, N.Y.

CHAIN WHEELS
Babbitt Steam Specialty Co., New Bedford, Mass.

CHIMNEYS, STEEL
Babcock & Wilcox, Ltd. Montreal
MacKinnon, Holmes & Co., Sherbrooke, Que.

CHUTES, COAL
Can. Allis-Chalmers, Ltd., Toronto, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.

CLEANERS, BOILER TUBE
Babcock & Wilcox, Ltd., Montreal.
Can. H. W. Johns-Manville Co., Toronto.
Cole Ltd., Geo. W., Toronto.
Beveridge Paper Co., Montreal, Que.
Garlock Packing Co., Hamilton, Ont.
Green's Economiser, Ltd., Toronto.
Liberty Mfg. Co., Pittsburgh, Pa.
Laurie & Lamb, Montreal, Que.
Pilley Packing & Flue Brush Mfg. Co., St. Louis, Mo.
Roto Co., Hartford, Conn.

CLOCKS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Foxboro Co., The, Foxboro, Mass.

CLOSETS
Mueller Mfg. Co., H., Sarnia, Ont.

CLUTCHES
Waterous Engine Works Co., Brantford, Ont.

COAL
Dom. Coal Co., Montreal

COAL AND ASH CONVEYORS
Babcock & Wilcox, Ltd. Montreal.
Jeffrey Manufacturing Co., Montreal.
Waterous Engine Works Co., Brantford, Ont.

COAL HANDLING MACHINERY
Babcock & Wilcox, Ltd. Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Jeffrey Manufacturing Co., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford, Ont.

COAL HOLE COVERS
Can. Allis-Chalmers, Ltd., Toronto, Ont.

COILS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

COLD STORAGE INSULATION
Armstrong Cork & Insulation Co., Montreal, Que
Beveridge Paper Co., Ltd., Montreal, Que.

COMMUTATOR TRUING DEVICES
[illegible] Bros., Inc., New York, N.Y

CONDENSERS
Alberger Heater Co., Buffalo, N.Y.
[illegible] Steam Pump Co., Battle Creek, Mich
[illegible] Machine Co., Toronto.
[illegible] & Mitchell, Birmingham, Eng
[illegible] & Eng. Co., Ltd., Lindsay, Ont
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Darling Bros., Ltd., Montreal, Que.
[illegible] & Morrison Co., Galt.
Laurie & Lamb, Montreal.
[illegible] Can. Canadian Iron Wks., Montreal
[illegible] Engine Works Co., Brantford.

CONDENSERS, AMMONIA AND STEAM
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

COLLECTORS, PNEUMATIC
[illegible] Co. of Canada, B. F., Galt, Ont.

CONSULTING ENGINEERS
Walter J. Francis, Montreal.
Laurie & Lamb, Montreal

COLD STORAGE DOORS AND WINDOWS
Jamison Cold Storage Door Co., Hagerstown, Md

COMPRESSORS, AIR
American Steam Pump Co., Battle Creek, Mich
[illegible] & Mitchell, Birmingham, Eng.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd. Montreal
Darling Bros., Ltd., Montreal, Que.
Inglis Co., The John, Toronto, Ont.
Laurie & Lamb, Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Smart-Turner Machine Co., Ltd., Hamilton.
Taylor Instrument Co., Rochester, N.Y.

COMPRESSORS, GAS
Can. Allis-Chalmers, Ltd., Toronto, Ont.

CONDUITS
Can. H. W. Johns-Manville Co., Toronto, Ont.

CONDENSATION RECEIVER
Cole, Ltd., Geo. W., Toronto.
G. M. Davis Regulator Co., Chicago.

CONDENSER AND SMOKESTACK PAINTS
Beveridge Paper Co., Montreal, Que.

CONNECTIONS, FLANGED
Jefferson Union Co., Lexington, Mass.
Dart Union Co., Ltd., Toronto, Ont.

CONTRACTORS' STRUCTURAL STEEL
Canadian Fairbanks-Morse Co., Ltd. Montreal
MacKinnon, Holmes & Co., Sherbrooke, Que.

CONVEYOR MACHINERY
[illegible] & Wilcox, Ltd. Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Canadian Fairbanks-Morse Co., Ltd. Montreal
Jeffrey Manufacturing Co., Montreal.
Milton & Prentiss, Toronto, Ont.
[illegible] Engine Works Co., Brantford.
Victoria Foundry Co., Ottawa, Ont.

COOLER, DOORS
Jamison Cold Storage Door Co., Hagerstown, Md

CORK INSULATION
Armstrong Cork & Insulation Co., Montreal, Que
Can. H. W. Johns-Manville Co., Toronto, Ont.

COTTON HOSE
Garlock Packing Co., Hamilton, Ont.

COUNTERS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

COUNTERSHAFTS
Can. Bond Hanger & Coupling Co., Alexandria.
[illegible]
Victoria Foundry Co., Ottawa, Ont.

COUPLINGS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Beveridge Paper Co., Montreal, Que.
Jeffrey Manufacturing Co., Montreal.
McAvity & Sons, T., St. John, N.B.
Victoria Foundry Co., Ottawa, Ont.

COUPLINGS, BOILER, FLANGED PIPE, JOINT PIPE, UNION, STEAM PIPE
Jefferson Union Co., Lexington, Mass.
Dart Union Co., Ltd., Toronto, Ont.

COUPLINGS, SHAFT
Can. Bond Hanger & Coupling Co., Alexandria.
[illegible]

CRANES, ALL KINDS
[illegible] Ltd. Montreal
Smart-Turner Machine Co., Ltd., Hamilton.

CRANES, ELECTRIC
[illegible] Ltd. Montreal
Smart-Turner Machine Co., Ltd., Hamilton.

CRANES, HAND POWER
[illegible] Ltd. Montreal
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Frick Co., Waynesboro, Pa.
Smart-Turner Machine Co., Ltd., Hamilton.

CRANES, OVERHEAD TRAVELLING
Babcock & Wilcox, Ltd., Montreal.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
[illegible]

CRANES, POST JIB
Babcock & Wilcox, Ltd., Montreal.

CRANES, SWING JIB
Babcock & Wilcox, Ltd., Montreal

CRANES, WALL
Babcock & Wilcox, Ltd., Montreal.

CRANE MOTORS
Lancashire Dynamo & Motor Co., Toronto, Ont.

CRANK AND CROSSHEAD PIN OILERS
Lunkenheimer Co., Cincinnati, O.

CRIMPS, LEATHER
Graton & Knight Mfg. Co., Montreal.

CRUSHING MACHINERY
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Jeffrey Mfg. Co., Columbus, Ohio.

CYLINDER OIL
E. H. Kellogg & Co., New York.

DAMPER REGULATORS
Babcock & Wilcox, Ltd., Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng
Darling Bros., Ltd., Montreal, Que.
G. M. Davis Regulator Co., Chicago.
D'Este Co., Julian, Boston, Mass.
Elliott Co., Pittsburgh, Pa.
Mason Regulator Co., Boston, Mass.
Jas. Morrison Brass Mfg. Co., Toronto.

DISCS, FIBRE
Beveridge Paper Co., Ltd., Montreal, Que.
Johns-Pratt Co., The, Hartford, Conn.

DISCS, LEATHER
Graton & Knight Mfg. Co., Montreal.

DISTILLING APPARATUS
Canadian Griscom-Russell Co., Ltd., Montreal
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

DOORS, COLD STORAGE AND FREEZER
Jamison Cold Storage Door Co., Hagerstown, Md.

DOUBLE PIPE CONDENSERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

DRAFT APPARATUS SYSTEMS, MECHANICAL
Green's Economiser, Ltd., Toronto.

DRYING MACHINERY
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Sirocco Co., Windsor, Ont.

DUST SEPARATORS
Sturtevant Co. of Canada, B. F., Galt, Ont.

DYNAMOS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Sturtevant Co. of Canada, B. F., Galt, Ont.

ECONOMIZERS
Babcock & Wilcox, Ltd., Montreal.
[illegible] Economiser, Ltd., Toronto.
Green's Economiser, Ltd., Toronto.

EJECTORS
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.
Smart-Turner Machine Co., Ltd., Hamilton.

ELECTRICAL ACCESSORIES AND MACHINERY
Can. H. W. Johns-Manville Co., Toronto, Ont.
Beveridge Paper Co., Ltd., Montreal, Que.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Economy Fuse & Mfg. Co., Montreal, Que.
MacGovern & Co., Inc., New York.
Milton & Prentiss, Toronto, Ont.

ELECTRICAL SUPPLIES
Can. General Electric Co., Toronto, Ont.
Can. H. W. Johns-Manville Co., Toronto, Ont.

ELEVATORS
Beveridge Paper Co., Montreal, Que.
MacKinnon, Holmes & Co., Sherbrooke Ont
John MacDougall Caledonian Iron Works, Montreal.

ELEVATING MACHINERY
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Beveridge Paper Co., Montreal, Que.
Goldie & McCulloch Co., Galt.
Hamilton Mfg. Co., Wm., Peterboro, Ont.
Jeffrey Manufacturing Co., Montreal
Waterous Engine Works Co., Brantford.

ENAMELWARE
H. Mueller Mfg. Co., Sarnia, Ont.

ENGINEERS' SUPPLIES
Beveridge Paper Co., Ltd., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Ltd., Montreal, Que.
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.
Jas. Morrison Brass Mfg. Co., Toronto.

ENGINES, AUTOMATIC AND DROP VALVE
Frick Co., Waynesboro, Franklin Co., Pa.
Waterous Engine Works Co., Brantford.

ENGINES, CORLISS AND ROCKING VALVE
[illegible] Co., Toronto
[illegible] Co., Waynesboro, Pa.
[illegible] & McCulloch Co., Galt.
Green's Economiser, Ltd., Toronto
Engineering and Machine Works of Canada, Ltd., [illegible], Ont.
[illegible] Engine Works Co., Brantford

ENGINES, DIESEL
Can. Allis-Chalmers, Ltd., Toronto, Ont.

ENGINES, GAS AND GASOLINE
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Laurie & Lamb, Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

ENGINES, STEAM
Belliss & Morcom, Birmingham, Eng.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
[illegible] Co., Windsor, Ont.
Goldie & McCulloch Co., Galt.
[illegible] Co., Wm., Peterboro, Ont.
Inglis Co., The John, Toronto, Ont.
[illegible] Ltd. Montreal
Leonard & Sons, E., London, Can.
John MacDougall Caledonian Iron Works, Montreal.
Waterous Engine Works Co., Brantford.

ENGINES, HOISTING, LOGGING, CABLEWAY
Can. Allis-Chalmers, Ltd., Toronto, Ont.

ENGINES, MARINE
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.

ENGINES, SAW MILL
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Laurie & Lamb, Montreal.
Waterous Engine Works Co., Brantford.

ENGINES, SINGLE COMPOUND AND TRIPLE EXPANSION
Canadian Griscom-Russell Co., Ltd., Montreal.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Laurie & Lamb, Montreal.
John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Kerr Engine Co., Walkerville.
Waterous Engine Works Co., Brantford.

ENGINES, VERTICAL
Laurie & Lamb, Montreal.

ENGINEERING BOOKS
MacLean Publishing Co., Toronto

EXHAUSTERS
Green's Economiser, Ltd., Toronto.

EXHAUST HEADS
Can. Sirocco Co., Windsor, Ont.
Darling Bros., Ltd., Montreal, Que.
Direct Separator Co., Syracuse, N.Y.
Jas. Morrison Brass Mfg. Co., Toronto.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Franklin Williams Co., New York.
Watson & McDaniel Co., Philadelphia.

EXPANSION JOINTS
Alberger Heater Co., Buffalo, N.Y.
Direct Separator Co., Syracuse, N.Y.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.

FANS, VENTILATING
Can. Sirocco Co., Windsor, Ont.
C. T. Coe Co., 10 Johnson St., Newark, N.J.
Coppus Engr. & Equip. Co., Worcester, Mass.
Green's Economiser, Ltd., Toronto
Sturtevant Co. of Canada, B. F., Galt, Ont.

FEED WATER HEATERS
Alberger Heater Co., Buffalo, N.Y.
Babcock & Wilcox, Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Stewart Heater Co., Buffalo, N.Y.
Waterous Engine Works Co., Brantford.

FEED WATER PURIFIERS
Stewart Heater Co., Buffalo, N.Y.

FEED WATER REGULATORS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Chaplin, Fulton Mfg. Co., Pittsburg, Pa.
Beveridge Paper Co., Montreal, Que.
Elliott Co., Pittsburgh, Pa.
Laurie & Lamb, Montreal.

FIBRE, VULCANIZED
Beveridge Paper Co., Montreal, Que.

FILTERS
Bowser & Co., Inc., S. F., Toronto, Ont.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.

FILTERS, WATER
Canadian Griscom-Russell Co., Ltd., Montreal.
Darling Bros., Ltd., Montreal, Que.
Frick Co., Waynesboro, Franklin Co., Pa.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Scaife & Sons, Wm. B., Pittsburgh, Pa.
York Manufacturing Co., York, Pa.

FIREBRICK—JOINTLESS
Beveridge Paper Co., Montreal, Que.

FIRE BRICK, PLASTIC
Gates, John W., St. James St., Montreal.
Wenting, J. H., Toronto.

FIREPROOF COLD STORAGE DOORS AND WINDOWS
Jamison Cold Storage Door Co., Hagerstown, Md.

FITTINGS, AIR, AUTOMOBILE, GAS, HYDRAULIC, PIPE, PIPE FLANGED, SCREWED PIPE, STEAM
Jefferson Union Co., Lexington, Mass.
Dart Union Co., Ltd., Toronto, Ont.
H. Mueller Mfg. Co., Sarnia, Ont.

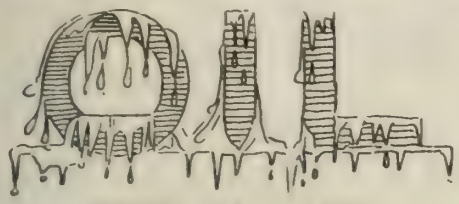
FLANGED STEAM FITTINGS
Direct Separator Co., Syracuse, N.Y.
McAvity, T., & Sons, Ltd., St. John, N.B.

FLANGES
Dart Union Co., Ltd., Toronto, Ont.
Jefferson Union Co., Lexington, Mass.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.

FLOORING COMPOSITION
Armstrong Cork & Insulation Co., Montreal, Que.

Anderson Pressure Filter

will save you one out of every two barrels of oil ordinarily used—and



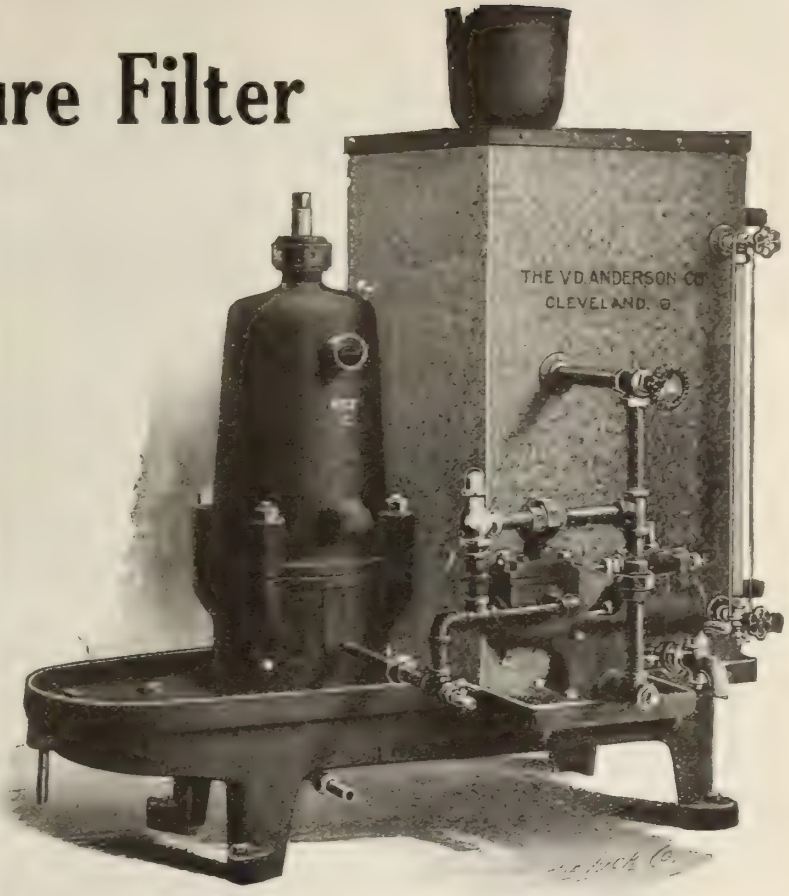
MUST BE SAVED

The Anderson Pressure Filter will make one barrel of oil do the work of two by cleansing and purifying the oil after use so that it can be used again and again on the finest bearings.

In wasted oil you pay the cost of an Anderson Oil Pressure Filter over and over—but you do not get it. Better pay for it once and thereafter experience what a really great economy it is.

Details in Booklet. Write.

The V. D. Anderson Co.
West 96th St., Cleveland, Ohio



In the big steel plants that are speeding up on war equipment for Uncle Sam.

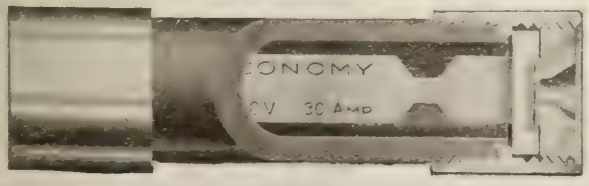
ECONOMY renewable FUSES

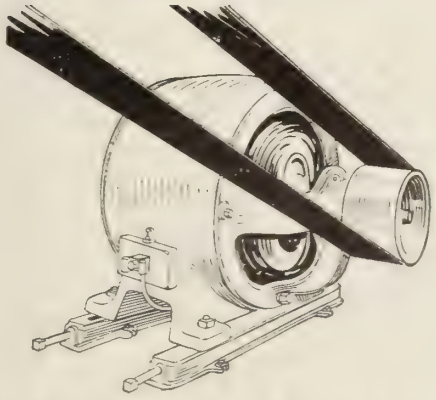
insure electrical safety and cut annual fuse maintenance costs 80%. An inexpensive little "Drop Out" Renewal Link restores a blown Economy Fuse to its original efficiency.

WRITE FOR CATALOG 24

Economy Fuse & Mfg. Co. of Canada, Limited
UNITY BLDG. - - MONTREAL

Manufacturers in Canada of S & B High Potential Fuses to 150,000 Volts.





LANCO BALATA BELTING

makes an

IDEAL BELT *for a* MOTOR DRIVE

On account of its very slight stretch it requires very little attention. As motor drive belts are frequently made endless to make silent running the small stretch is worth taking into consideration.

In addition to this it is a straight running belt; the tension is equally distributed over the whole width. Did you ever see a belt continually changing its position across the face of the pulley while running? This may be caused by not having the ends square but the chances are it is caused by unequal tension in different parts of the belt width.

This unequal tension does not occur in Lanco Balata.

FEDERAL ENGINEERING CO., LTD.
172 John Street, Toronto

If any advertisement interests you, tear it out now and place with letters to be answered.

FLUE CLEANERS
Babcock & Wilcox, Montreal
[illegible] Co., Pittsburg, Pa.
Pilley Packing and Flue Brush Mfg. Co., St. [illegible]
William R. Pierce Co., Buffalo, N.Y.
[illegible]
[illegible] & Co., Toronto

FLUE GAS ANALYSIS INSTRUMENTS
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y
[illegible] Co., New York.
Precision Instrument Co., Detroit, Mich.
[illegible] Co., Windsor, Ont.

FLUES, GAS AND SMOKE
Green's Economiser, Ltd., Toronto.

FLUMES, STEEL
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.

FREEZER DOORS
Jamison Cold Storage Door Co., Hagerstown, Md.

FRICTION LEATHERS
Graton & Knight Mfg. Co., Montreal.

FURNACES, BOILER
Gates, J. W., Montreal, P.Q.
Green's Economiser, Ltd., Toronto.

FURNACES, SMOKELESS
Babcock & Wilcox, Montreal.
[illegible] & Co., Little Hulton, Bolton, Eng.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Detroit, Mich.

FURNACE GRATE BARS
Beveridge Paper Co., Montreal, Que.

FUSES
Can. H. W. Johns-Manville Co., Toronto, Ont.
Economy Fuse & Mfg. Co. of Canada, Montreal.
Johns-Pratt Co., The, Hartford, Conn.

GAS ANALYSIS INSTRUMENTS, ETC.
Penberthy Injector Co., Windsor, Ont.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y
Uehling Instrument Co., New York, N.Y.

GASKETS, RUBBER, ASBESTOS
Can. H. W. Johns-Manville Co., Toronto, Ont.
Durabla Mfg. Co., New York, N.Y.
Frick Co., Waynesboro, Franklin Co., Pa.
Garlock Packing Co., Hamilton, Ont.
Johns-Pratt Co., The, Hartford, Conn.
Peerless Rubber Mfg. Co., New York, N.Y.
Sarco Co., Inc., New York, N.Y.
Thomson-Gordon, Ltd., Hamilton, Ont.

GASKETS, LEAD, COPPER AND LEATHER
Graton & Knight Mfg. Co., Montreal, Que.
Shell Bar Boico Supply Co., Toronto, Ont.
Sarco Co., Inc., New York, N.Y.
Wm. C. Wilson & Co., Toronto, Ont.

GAS COLLECTORS
Precision Instrument Co., Detroit, Mich.

GAS PRODUCER PLANTS
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal
Laurie & Lamb, Montreal.

GAUGE COCKS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Garlock Packing Co., Hamilton, Ont.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.
W. J. Wall, Montreal.

GAUGE GLASSES
Wm. C. Wilson & Co., Toronto.

GAUGES, AMMONIA, OIL, GAS, AIR
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y

GAUGES, PRESSURE, VACUUM, DRAFT AND RECORDING, AND MICROMETER
Babcock & Wilcox, Montreal.
Foxboro Company, Foxboro, Mass.
Green's Economiser, Ltd., Toronto.
Lunkenheimer Co., Cincinnati, O.
Milton & Prentiss, Toronto.
Precision Instrument Co., Detroit, Mich.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.

GAUGES, WATER
Babcock & Wilcox, Montreal.
Jenkins Bros., Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
[illegible] Windsor, Ont.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

GEARS, FIBRE CUT
Beveridge Paper Co., Ltd., Montreal, Que.

GEARS, CUT, WORM, MORTISE
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

GENERATORS, DIRECT CURRENT
Lancashire Dynamo & Motor Co., Toronto, Ont.

GENERATORS, STEAM TURBO
[illegible] Toronto, Ont.
[illegible] & Lamb, Montreal

GENERATORS AND CONVERTORS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
[illegible] Toronto, Ont.

GOVERNORS, ENGINE
Fisher Wyse & Co., Montreal, Que.
McAvity, T., & Sons, Ltd., St. John, N.B.
Waterous Engine Works Co., Brantford

GRAPHITE, BOILER
[illegible] Jersey City.
Wm. C. Wilson & Co., Toronto

GRATES, DUMPING, ROCKING, STATIONARY
Babcock & Wilcox, Montreal.
Boiler Repair & Grate Bar Co., Toronto, Ont.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
C. T. Coe Co., 10 Johnson St., Newark, N.J.
Can. Steam Boiler Equipment Co., Toronto, Ont.
Galt Foundry Co., Galt, Ont.
Mason Regulator & Engineering Co., Montreal.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Waterous Engine Works Co., Brantford.

GREASE CUPS
Albany Lubricating Co., New York City.
Detroit Lubricator Co., Walkerville.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

GREASE AND OIL EXTRACTORS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Canadian Griscom-Russell Co., Ltd., Montreal.
Elliott Co., Pittsburgh, Pa.
Laurie & Lamb, Montreal.

GREASES
Albany Lubricating Co., New York City.
Can. Economic Lubricant Co., Montreal, Que.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Jos. Dixon Crucible Co., Jersey City.
Wm. C. Wilson & Co., Toronto.

HAND LEATHERS OR PADS
Graton & Knight Mfg. Co., Montreal.

HANGERS
Can. General Electric Co., Toronto, Ont.
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Can. S K F Co., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Goldie & McCulloch Co., Galt.
Waterous Engine Works Co., Brantford.

HEATERS
Alberger Heater Co., Buffalo, N.Y.
Babcock & Wilcox, Ltd., Montreal.
Can. Sirocco Co., Windsor, Ont.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
Hamilton Mfg. Co., Wm., Peterboro, Ont.
Laurie & Lamb, Montreal.
McAvity & Sons, T., St. John, N.B.
Scaife & Sons, Wm. B., Pittsburgh, Pa.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Waterous Engine Works Co., Brantford.

HEATERS, EXHAUST STEAM
Can. Allis-Chalmers, Ltd., Toronto, Ont.

HEATERS, METERING
Can. Allis-Chalmers, Ltd., Toronto, Ont.

HEATING SYSTEMS, FANS
Can. Sirocco Co., Windsor, Ont.

HOISTS, GRIP
Jordan Bros., Inc., New York, N.Y.

HOISTING AND CONVEYING MACHINERY
Babcock & Wilcox, Ltd., Montreal.
Hamilton Mfg. Co., Wm., Peterboro, Ont.
Waterous Engine Works Co., Brantford.

HOSE, METALLIC
Pennsylvania Flexible Metallic Tubing Co., Boston, Mass.

HOSE, STEAM, SUCTION AND WATER
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Asbestos Co., Montreal.
Garlock Packing Co., Hamilton, Ont.
Goodyear Tire & Rubber Co., Toronto.
Peerless Rubber Mfg. Co., New York, N.Y.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

HYDRANTS
Wood & Co., R. D., Philadelphia, Pa.

HYDRAULIC ACCUMULATORS
Smart-Turner Machine Co., Ltd., Hamilton.

HYDRAULIC MACHINERY
Bawden Pump Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Hamilton Mfg. Co., Wm., Peterboro, Ont.
John McDougall Caledonian Iron Wks., Montreal.

HYDRAULIC PRESSES
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

ICE MAKING MACHINERY
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Griscom-Russell Co., Ltd., Montreal.
Frick Co., Waynesboro, Franklin Co.
Linde Canadian Refrigeration Co., Montreal.
York Mfg. Co., York, Pa.

INDICATORS, ELECTRIC—ALL TYPES
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Uehling Instrument Co., New York, N.Y.

INDICATORS, STEAM AND GAS ENGINE
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Canadian Fairbanks-Morse Co., Montreal.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Green's Economiser, Ltd., Toronto.
Uehling Instrument Co., New York, N.Y.

INDICATORS—AMMONIA, HYDRAULIC
Can. Detroit Lubricator Co., Walkerville, Ont.

INDICATORS, SPEED
L. S. Starrett Co., Athol, Mass.

INJECTORS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

INSTRUMENTS, RECORDING
Green's Economiser, Ltd., Toronto.
Taylor Instrument Companies, Rochester, N.Y.

INSULATING BRICK
Armstrong Cork & Insulation Co., Montreal, Que.
Beveridge Paper Co., Ltd., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.

INSULATING COMPOUNDS
Johns-Pratt Co., The, Hartford, Conn.

INSULATORS
Ed. Bennis & Co., Little Fulton, Bolton, Eng.
Beveridge Paper Co., Ltd., Montreal, Que.
Johns-Pratt Co., The, Hartford, Conn.

IRON FILLER
Can. H. W. Johns-Manville Co., Toronto, Ont.

KILNS
Green's Economiser, Ltd., Toronto.

LACE LEATHERS
Graton & Knight Mfg. Co., Montreal.
Wm. C. Wilson & Co., Toronto.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Can. B. K. Morton Co., Toronto, Montreal.
Canuck Supply Co., Ltd., Montreal, Que.
Crane Packing Co., Chicago, Ill.

LAMPS, ARC
Canadian Fairbanks-Morse Co., Montreal.
Can. General Electric Co., Toronto, Ont.
Can. H. W. Johns-Manville Co., Toronto, Ont.

LAMPS, ELECTRIC
Wm. C. Wilson & Co., Toronto.

LAMPS, INCANDESCENT
Canadian Fairbanks-Morse Co., Montreal.
Can. General Electric Co., Toronto, Ont.
Can. H. W. Johns-Manville Co., Toronto, Ont
Can. Laco-Philips Co., Ltd., Toronto, Ont.

LAMPS, NITRO
Can. Laco-Philips Co., Ltd., Toronto, Ont.

LAMPS, TUNGSTEN AND NITRO
Can. General Electric Co., Toronto, Ont.
Can. Laco-Philips Co., Ltd., Toronto, Ont.

LEAD
Dominion Metal Co., Sherbrooke, Que.

LEATHER STRAPPING
Graton & Knight Mfg. Co., Montreal.

LININGS, FIRE BRICK, STEEL STACK
Green's Economiser, Ltd., Toronto.

LUBRICANTS
Albany Lubricating Co., New York City.
Canadian Economic Lubricant Co., Montreal.
Jos. Dixon Crucible Co., Jersey City.

LUBRICATORS, CYLINDER
Albany Lubricating Co., New York City.
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

LUBRICATORS, FORCE FEED
Can. Detroit Lubricator Co., Walkerville, Ont.
Darling Bros., Montreal.
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

LUBRICATORS, PLAIN
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

MACHINERY INSULATION
Armstrong Cork & Insulation Co., Montreal, Que.
Beveridge Paper Co., Ltd., Montreal, Que.

MANGENESITE PASTE
Wm. C. Wilson & Co., Toronto.

MASON CONTRACTOR
Wenting, J. H., 256 Lee Ave., Toronto.

MECHANICAL STOKERS
Babcock & Wilcox, Ltd., Montreal.
Green's Economiser, Ltd., Toronto.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Dertoit, Mich.

METERS, ELECTRIC
Can. H. W. Johns-Manville Co., Toronto, Ont.

METERS, STEAM
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Green's Economiser, Ltd., Toronto.

METERS, WATER
Allen General Supplies, Toronto, Ont.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Foxboro Company, Foxboro, Mass.
McAvity & Sons, T., St. John, N.B.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Precision Instrument Co., Detroit, Mich.

MIXING VALVES
Mueller Mfg. Co., H., Sarnia, Ont.

MILL AND MINING MACHINERY
Canadian Fairbanks-Morse Co., Montreal.
Engineering and Machine Works of Canada, Ltd. St. Catharines, Ont.
Goldie & McCulloch Co., Galt.
Hamilton Co., Wm., Peterboro, Ont.
Waterous Engine Works Co., Brantford.

METER TESTERS
Mueller Mfg. Co., H., Sarnia, Ont.

MOTORS
Canadian Fairbanks-Morse Co., Montreal.
Can. General Electric Co., Toronto, Ont.
Green's Economiser, Ltd., Toronto.
Milton & Prentiss, Toronto.

MOTORS, DIRECT CURRENT
Lancashire Dynamo & Motor Co., Toronto, Ont.

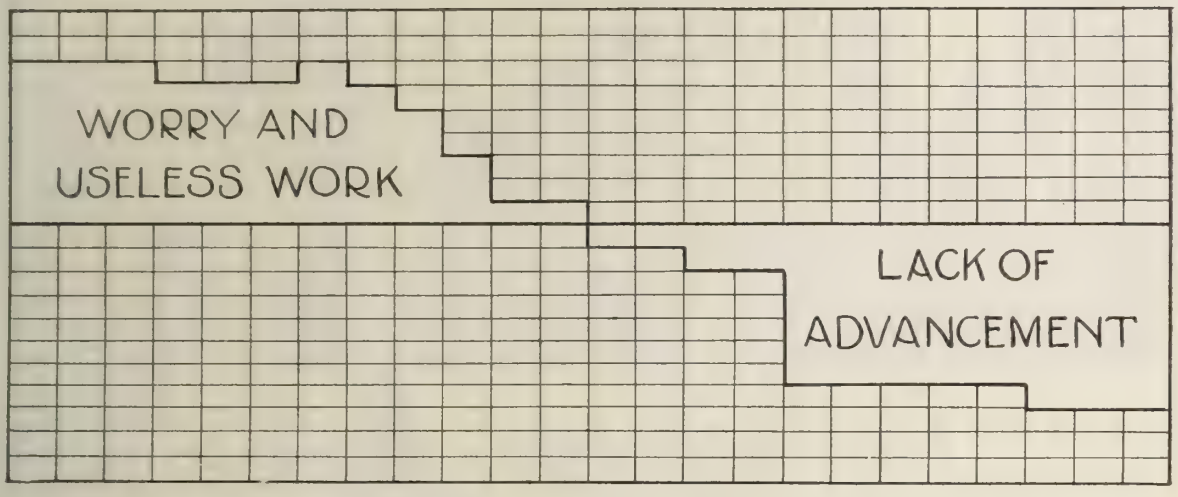
MOTORS, INDUCTION
Lancashire Dynamo & Motor Co., Toronto, Ont.

MOTORS, SYNCHRONOUS
Lancashire Dynamo & Motor Co., Toronto, Ont.

OAKUM
Wm. C. Wilson & Co., Toronto.

OFFICE RAILINGS
Jas. Morrison Brass Mfg. Co., Toronto.

Let the C.A.S.E. Smooth Out Your Load Curve



Remove The Peaks of Worry And Unproductive Labor And Build Up The Valleys By Working For Your Advancement

A man who is thoroughly grounded in the practice of his profession, who is free from personal worry and trouble, overcomes the many difficulties besetting the path of the operating engineer with little labor and in a manner ensuring his advancement.

The successful man owes his success to a wise appreciation of the advantages and mutual help offered by association with those in the same field of endeavor. To join an association having for its objectives the welfare of the engineer in things mental and material, his advancement in knowledge and skill, his protection by provision for sickness and distress is to take advantage of an opportunity indispensable to all who hope to better themselves.

If you are interested in such an organization and live where less than fifteen engineers are located, send for a copy of our constitution and application blanks for admission to nearest branch lodge. If there are more than fifteen engineers in your community, get together and send for particulars regarding formation of a branch lodge.

J. H. HALE, General Secretary,

Canadian Association of Stationary Engineers

230 Caroline Street Hamilton, Ont.

OIL CUPS
[illegible] New York City.
Lunkenheimer Co., Cincinnati, O.
[illegible] Toronto.
Penberthy Injector Co., Windsor, Ont.

OILER, COMPOUND FEEDERS
Lunkenheimer Co., Cincinnati, O.

OILERS, GAUGE
Lunkenheimer Co., Cincinnati, O.

OILERS, MULTIPLE
Can. Detroit Lubricator Co., Walkerville, Ont.
Lunkenheimer Co., Cincinnati, O.

OIL FILTERS AND CIRCULATING SYSTEMS
Bowser & Co., Inc., S. F., Toronto, Ont.
[illegible]
Elliott Co., Pittsburgh, Pa.
Jas. Morrison Brass Mfg. Co., Toronto.

OIL SEPARATORS
[illegible] & Wilson Ltd., Montreal.
Can. Allis Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
Direct Separator Co., Syracuse, N.Y.
Elliott Co., Pittsburgh, Pa.
Leitch Co., Arthur S., Toronto, Ont.
Liberty Mfg. Co., Pittsburgh.
Jas. Morrison Brass Mfg. Co., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.

OILING SYSTEMS
Albany Lubricating Co., New York City.
Bowser & Co., Inc., S. F., Toronto, Ont.
Lunkenheimer Co., Cincinnati, O.

OILS, LUBRICATING
Albany Lubricating Co., New York City.
Can. Economic Lubricant Co., Montreal, Que.
Kellogg & Co., E. H., New York, N.Y.
Wm. C. Wilson & Co., Toronto.

PACKING, ASBESTOS
Johns-Pratt Co., The, Hartford, Conn.

PACKING, ENGINE
Can. Asbestos Co., Montreal, Que.
Garlock Packing Co., Hamilton, Ont.
Johns-Pratt Co., The, Hartford, Conn.
Peerless Rubber Mfg. Co., New York, N.Y.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Thomson Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, FIBRE
Beveridge Paper Co., Ltd., Montreal, Que.
Can. B. K. Morton Co., Montreal, Que.
Johns-Pratt Co., The, Hartford, Conn.
Wm. C. Wilson & Co., Toronto.

PACKING, HYDRAULIC
Can. Asbestos Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Can. B. K. Morton Co., Toronto, Montreal.
Crane Packing Co., Chicago, Ill.
Durabla Manufacturing Co., New York.
Garlock Packing Co., Hamilton, Ont.
Goodyear Tire & Rubber Co., Toronto.
Shell Bar, Boico Supply, Ltd., Toronto, Ont.
Thomson Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, METALLIC
Can. B. K. Morton Co., Montreal, Que.
[illegible] Toronto, Ont.
[illegible] New York.
[illegible] Wilkesbarre, Pa.
[illegible]
Steel Mill Packing Co., Windsor, Ont.
Thomson Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, ROD
Can. Asbestos Co., Montreal, Que.
Can. B. K. Morton Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Crane Packing Co., Chicago, Ill.
Garlock Packing Co., Hamilton, Ont.
Canuck Supply Co., Ltd., Montreal, Que.
Steel Mill Packing Co., Windsor, Ont.
Peerless Rubber Mfg. Co., New York, N.Y.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, SHEET
Can. Asbestos Co., Montreal, Que.
Can. B. K. Morton Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Canuck Supply Co., Ltd., Montreal, Que.
Durabla Manufacturing Co., New York.
Garlock Packing Co., Hamilton, Ont.
Jenkins Bros., Ltd., Montreal.
Johns-Pratt Co., The, Hartford, Conn.
Peerless Rubber Mfg. Co., New York, N.Y.
[illegible]
Wm. C. Wilson & Co., Toronto.

PACKING, AMMONIA, STEAM AND WATER
Can. Asbestos Co., Montreal, Que.
Can. B. K. Morton Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
[illegible] Que.
[illegible] Ont.
[illegible]
Johns-Pratt Co., The, Hartford, Conn.
[illegible] Ont.
Thomson Gordon, Ltd., Hamilton, Ont.

PACKING, LEATHER
Can. B. K. Morton Co., Toronto, Montreal.
Canuck Supply Co., Ltd., Montreal, Que.
Garlock Packing Co., Hamilton, Ont.
Graton & Knight Mfg. Co., Montreal.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
[illegible] Ont.
Wm. C. Wilson & Co., Toronto.

PACKING PISTON
Crane Packing Co., Chicago, Ill.

PACKING, VALVE STEM
Crane Packing Co., Chicago, Ill.
Johns-Pratt Co., The, Hartford, Conn.

PAINTS
Wm. C. Wilson & Co., Toronto.

PAINT, DAMP RESISTING
Toch Bros., Toronto, Ont.

PAPER, INSULATING, ETC.
Beveridge Paper Co., Montreal, Que.

PATTERNS
Victoria Foundry Co., Ottawa, Ont.

PENSTOCKS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
MacKinnon, Holmes & Co., Sherbrooke, Que.

PILLOW BLOCKS
Can. Bond Hanger & Coupling Co., Alexandria Ont.
Waterous Engine Works Co., Brantford.

PIPE COILS
[illegible] Pa.
York Mfg. Co., York, Pa.

PIPE COVERINGS, STEAM, BRINE, AMMONIA AND ICE WATER
Armstrong Cork & Insulation Co., Montreal, Que

PIPE, CAST IRON
Wood & Co., R. D., Philadelphia, Pa.

PIPE STEEL
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont

PIPE VISES AND CUTTERS
Armstrong Mfg. Co., Bridgeport, Conn.

PIPE, GAS
Can. Allis-Chalmers, Ltd., Toronto, Ont.

PIPES, WATER
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont

PIPING AND FITTINGS
Frick Co., Waynesboro, Franklin Co., Pa.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
York Mfg. Co., York, Pa.

PIPING, STEAM
Babcock & Wilcox, Ltd., Montreal.

PLATE WORK
Goldie & McCulloch Co., Galt.
[illegible] and Machine Works of Canada, Ltd. St. Catharines, Ont.
Hamilton Co., Wm., Peterboro, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

PLUG COCKS
Homestead Valve Mfg. Co., Pittsburgh, Pa

PLUMBING SUPPLIES
Mueller Mfg. Co., H., Sarnia, Ont.
Wm. C. Wilson & Co., Toronto.

POWER PUMPS
American Steam Pump Co., Battle Creek, Mich
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
The John McDougall Caledonian Iron Works Co. Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
Waterous Engine Works Co., Brantford.
Garlock Packing Co., Hamilton, Ont.
Laurie & Lamb, Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.

POWER, TRANSMISSION MACHINERY
American Pulley Co., Philadelphia, Pa.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Goldie & McCulloch Co., Galt.
Hamilton Co., Wm., Peterboro, Ont.
Jeffrey Manufacturing Co., Montreal.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
MacGovern & Co., New York.
The John McDougall Caledonian Iron Works Co. Ltd., Montreal.
Morse Chain Co., Ithaca, N.Y.
Waterous Engine Works Co., Brantford.

PRESSES
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont

PRESSURE, BLOWERS, CENTRIFUGAL
Can. Sirocco Co., Windsor, Ont.

PULLEYS
American Pulley Co., Philadelphia, Pa.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Wm. Hamilton Co., Ltd., Peterboro.
Jeffrey Manufacturing Co., Montreal.
Victoria Foundry Co., Ottawa, Ont.
Waterous Engine Works Co., Brantford.

PULP MILL MACHINERY
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Hamilton Co., Wm., Peterboro, Ont.
Jeffrey Manufacturing Co., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

PUMPING MACHINERY
American Steam Pump Co., Battle Creek, Mich
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Bawden Machine Co., Toronto.
[illegible] Montreal, Que.
Laurie & Lamb, Montreal.
McAvity & Sons, T., St. John, N.B.
The John McDougall Caledonian Iron Works Co. Ltd., Montreal.
Storey Pump & Equipment Co., Ltd., Toronto
Smart-Turner Machine Co., Ltd., Hamilton.
Waterous Engine Works Co., Brantford.

PUMPING MACHINERY, ELECTRICAL
Bawden Machine Co., Toronto.
Beveridge Paper Co., Montreal, Que.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Jeffrey Manufacturing Co., Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.

PUMPS, AIR
American Steam Pump Co., Battle Creek, Mich
Bawden Machine Co., Ltd., Toronto.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Montreal.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co. Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
Storey Pump & Equipment Co., Ltd., Toronto

PUMPS, ACID
Bawden Pump Co, Toronto.
Beveridge Paper Co., Montreal, Que.

PUMPS, CONTRACTORS'
Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Beveridge Paper Co., Montreal, Que.
McAvity & Sons, T., St. John, N.B.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, ELECTRICAL
American Steam Pump Co., Battle Creek, Mich
Beveridge Paper Co., Montreal, Que.

PUMPS, FEED WATER
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Beveridge Paper Co., Montreal, Que.

PUMP GOVERNORS AND REGULATORS
Bawden Machine Co., Ltd., Toronto.
Darling Bros., Montreal.
G. M. Davis Regulator Co., Chicago.
D'Este Co., Julian, Boston, Mass.
Elliott Co., Pittsburgh, Pa.
Mason Regulator Co., Boston, Mass.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.
Watson & McDaniel Co., Philadelphia.

PUMP STRAINERS
Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Darling Bros., Ltd., Montreal.
Liberty Mfg. Co., Pittsburgh, Pa.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, HAND AND POWER
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Darling Bros., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, BOILER FEED
Bawden Pump Co, Toronto.

PUMPS, CENTRIFUGAL
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Darling Bros., Montreal
Hamilton Co., Wm., Peterboro, Ont.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Pulsometer Engineering Co., Ltd., London, Eng.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Victoria Foundry Co., Ottawa, Ont.
Waterous Engine Works Co., Brantford.

PUMPS, DUPLEX
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Beveridge Paper Co., Montreal, Que.

PUMPS, GEARED, COMPOUND
American Steam Pump Co., Battle Creek, Mich
Bawden Machine Co., Ltd., Toronto.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Montreal.
Inglis Co., The John, Toronto, Ont.
The John McDougall Caledonian Iron Works Co. Ltd., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

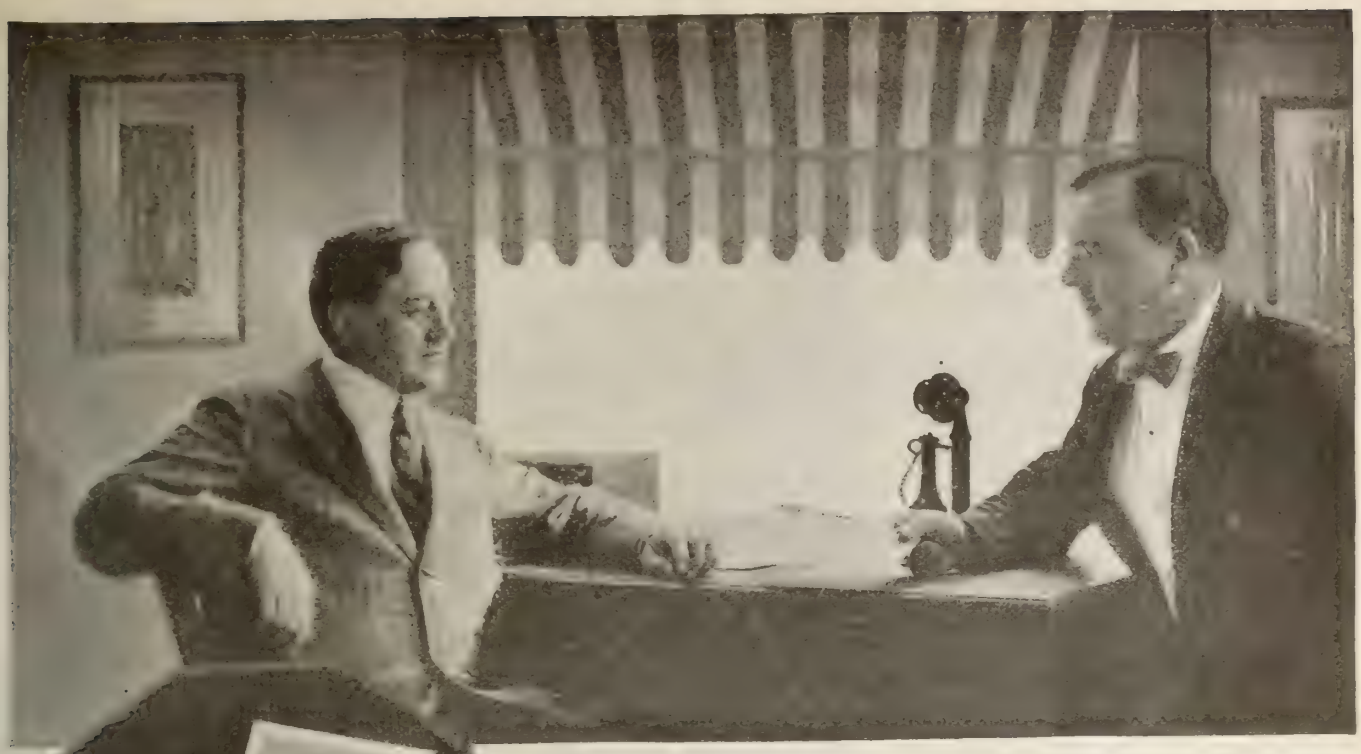
PUMPS, ELECTRICAL
Bawden Pump Co, Toronto.

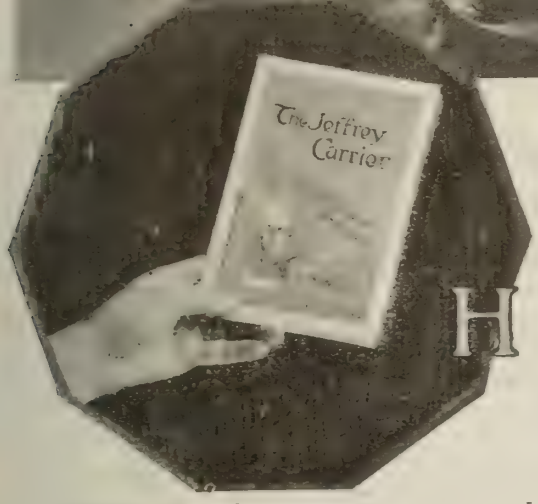
PUMPS, HYDRAULIC, PRESSURE
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Darling Bros., Montreal.
Inglis Co., The John, Toronto, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.

PUMP LEATHERS
Beveridge Paper Co., Ltd., Montreal, Que.
Can. B. K. Morton Co., Toronto, Montreal.
Graton & Knight Mfg. Co., Montreal.

PUMPS, OIL
American Steam Pump Co., Battle Creek, Mich
Bawden Machine Co., Ltd., Toronto.
Bowser & Co., Inc., S. F., Toronto, Ont.
Can. Detroit Lubricator Co., Walkerville, Ont.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, STEAM TURBO
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Darling Bros., Montreal.
Escher Wyss & Co., Montreal, Que.
Pulsometer Engineering Co., Ltd., London, Eng.





Before ordering that new conveyer, look over the advantages of this Improved Carrier, showing HOW OTHERS are safeguarding their Coal and Ashes Handling Machinery against carelessness.

There is only one way to wreck the Jeffrey Improved Carrier and that is by deliberate action. Each part and movement is constructed to safeguard your equipment against the carelessness of the operator. Unskilled labor can operate the Jeffrey Carrier.

Each bucket empties its material before receiving another load. There is no chance for material piling up on the floor and causing a serious wreck. There are many other devices for increasing the life of the chain joints, for reversing the buckets to obtain double service, etc.

Our New Bulletin, concisely describing the Jeffrey Carrier, has many clear views showing the carrier in action, while shop views of its parts give proof of its enduring qualities.

SEND FOR YOUR COPY—TO-DAY.

The Jeffrey Manufacturing Co.

Canadian Branch and Warerooms, Montreal

Handle it Mechanically

If any advertisement interests you, tear it out now and place with letters to be answered.

PUMP TANK, RECEIVER
American Steam Pump Co., Battle Creek, Mich.
Beveridge Paper Co., Montreal, Que.
Smart-Turner Machine Co., Hamilton, Ont.

PUMPS, STEAM
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Ltd., Toronto.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
Inglis Co., The John, Toronto, Ont.
Laurie & Lamb, Montreal.
Leitch Co., Arthur S., Toronto, Ont.
McAvity & Sons, T., St. John, N.B.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, TRIPLEX
Smart-Turner Machine Co., Hamilton, Ont.

PUMPS, VACUUM
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Ltd., Toronto.
Beveridge Paper Co., Montreal, Que.
Laurie & Lamb, Montreal.
Leitch Co., Arthur S., Toronto, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PYROMETERS
Foxboro Co., The, Foxboro, Mass.
Green's Economiser, Ltd., Toronto.
Jas. Morrison Brass Mfg. Co., Toronto.
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.

RADIATOR TRAPS
Beveridge Paper Co., Montreal, Que.
Sarco Co., Inc., New York, N.Y.

RADIATOR AIR VENTS
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

RAGS
Wm. C. Wilson & Co., Toronto.

REBOILERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

RECEIVERS, AIR
Can. Allis-Chalmers, Ltd., Toronto, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.

RECORDING INSTRUMENTS
Can. H. W. Johns-Manville Co., Toronto, Ont
Foxboro Co., The, Foxboro, Mass.
Green's Economiser, Ltd., Toronto.
Precision Instrument Co., Detroit, Mich.
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.

REFRIGERATOR DOORS, WINDOWS, ETC.
Jamison Cold Storage Door Co., Hagerstown, Md.

REFRIGERATING MACHINERY
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Griscom-Russell Co., Ltd., Montreal.
Frick Co., Waynesboro, Franklin Co., Pa.
Linde Canadian Refrigeration Co., Montreal.
Vilter Mfg. Co., Milwaukee, Wis.
York Mfg. Co., York, Pa.

REFUSE DESTRUCTOR
Canadian Griscom-Russell Co., Ltd., Montreal.
Laurie & Lamb, Montreal.

REGULATORS, PRESSURE
Chaplin-Fulton Mfg. Co., Pittsburgh, Pa.
D'Este Co., Julian, Boston, Mass.
Jas. Morrison Brass Mfg. Co., Toronto.
Taylor Instrument Co., Rochester, N.Y.

REGULATORS, TEMPERATURE
Sarco Co., Inc., New York, N.Y.
Taylor Instrument Co., Rochester, N.Y.

RETORTS
MacKinnon, Holmes & Co., Sherbrooke, Que.

REVOVLING DOORS FOR HARDENING ROOMS
Jamison Cold Storage Door Co., Hagerstown, Md.

ROOFING
Wm. C. Wilson & Co., Toronto.

ROOFINGS—RUBBER, PLASTIC, LIQUID
Beveridge Paper Co., Montreal, Que.

ROPE
Wm. C. Wilson & Co., Toronto.

ROPE PRESERVATIVE
Cling Surface Co., Buffalo.

ROTARY CONVERTERS
Canadian Fairbanks-Morse Co., Montreal.

RUBBER HOSE
Can. H. W. Johns-Manville Co., Toronto, Ont.
Garlock Packing Co., Hamilton, Ont.
Liberty Mfg. Co., Pittsburg, Pa.
Thomson-Gordon, Ltd., Hamilton, Ont.

RUBBER MOLDS
Bawden Machine Co., Ltd., Toronto.

SAFES
Canadian Fairbanks-Morse Co., Montreal.
Goldie & McCulloch Co., Galt.

SCALE REMOVERS
Babcock & Wilcox, Ltd., Montreal.
Beveridge Paper Co., Ltd., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Roto Co., Hartford, Conn.
William B. Pierce Co., Buffalo, N.Y.
Snowdon, C. C., Calgary, Alta.

SEAM PROTECTORS, GIRTH
National Boiler Protector Co. of Canada, Montreal, Que.

SHAFTING
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Hamilton Co., Wm., Peterboro, Ont.
Waterous Engine Works Co., Brantford.

SHAKING AND DUMPING GRATES
Babcock & Wilcox, Ltd., Montreal.
Galt Foundry Co., Galt, Ont.
Waterous Engine Works Co., Brantford.

SMELTER LININGS
Beveridge Paper Co., Montreal, Que.

SMOKE BOXES, STACKS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Green's Economiser, Ltd., Toronto.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

SMOOTH-ON
Wm. C. Wilson & Co., Toronto.

SPECIAL MACHINERY
Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Hamilton Co., Wm., Peterboro, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Waterous Engine Works Co., Brantford.

SPEED INDICATORS
Foxboro Co., The, Foxboro, Mass.
Schaeffer & Budenburg Mfg. Co., Brooklyn, N.Y.
L. S. Starrett Co., Athol, Mass.

SPLICE PROTECTORS
Jordan Bros., Inc., New York, N.Y.

SPROCKET CHAIN ATTACHMENTS
Waterous Engine Works Co., Brantford.

SPROCKET RIMS
Babbitt Steam Specialty Co., New Bedford, Mass.

SPUR WHEELS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Hamilton Co., Wm., Peterboro, Ont.
Waterous Engine Works Co., Brantford.

STACKS, STEEL
Babcock & Wilcox, Ltd., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.

STAND PIPES, STEEL
MacKinnon, Holmes & Co., Sherbrooke, Que.

STAYBOLTS, FLEXIBLE
Can. Allis-Chalmers, Ltd., Toronto, Ont.

STEAM SEPARATORS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Darling Bros., Montreal.
Direct Separator Co., Syracuse, N.Y.
D'Este Co., Julian, Boston, Mass.
Elliott Co., Pittsburgh, Pa.
Leitch Co., Arthur S., Toronto, Ont.
Penberthy Injector Co., Windsor, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Watson & McDaniel Co., Philadelphia.

STEAM SPECIALTIES
Alberger Heater Co., Buffalo, N.Y.
Canadian Fairbanks-Morse Co., Montreal.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
D'Este Co., Julian, Boston, Mass.
Liberty Mfg. Co., Pittsburg, Pa.
Lunkenheimer Co., Cincinnati, O.
Mason Regulator & Engineering Co., Montreal.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor.
Watson & McDaniel Co., Philadelphia.

STEAM TRAPS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Anderson Co., Y. D., Cleveland, O.
Canadian Fairbanks-Morse Co., Montreal.
Can. Sirocco Co., Windsor, Ont.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
Davis Regulator Co., G. M., Chicago.
D'Este Co., Julian, Boston, Mass.
Dunham Co., Ltd., C. A., Toronto, Ont.
Elliott Co., Pittsburgh, Pa.
J. T. Long, 84 Adam St., Montreal, Que.
Can. Morehead Mfg. Co., Woodstock.
Mason Regulator & Engineering Co., Montreal.
Nashua Mach. Co., Boston, Mass.
Sarco Co., Inc., New York, N.Y.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Watson & McDaniel Co., Philadelphia.

STEEL BARRELS
Smart-Turner Machine Co., Hamilton, Ont.

STEEL DRUMS
Smart-Turner Machine Co., Hamilton, Ont.

STEEL TANKS
Babcock & Wilcox, Ltd., Montreal.
Hamilton Co., Wm., Peterboro, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works, Brantford, Ont.

STOKERS
Babcock & Wilcox, Ltd., Montreal.
Ed. Bennis & Co., Little Fulton, Bolton, Eng.
Detroit Stoker Co., Detroit, Mich.
Galt Foundry Co., Galt, Ont.
Green's Economiser, Ltd., Toronto.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Dertoit, Mich.

STRAINERS
Babcock & Wilcox, Ltd., Montreal.
Bawden Machine Co., Ltd., Toronto.
Beveridge Paper Co., Montreal, Que.
Elliott Co., Pittsburgh, Pa.
Self-Cleansing Strainer Co., Chicago.

STRUCTURAL STEEL WORK
Babcock & Wilcox, Ltd., Montreal.
Hamilton Co., Wm., Peterboro, Ont.
MacKinnon, Holmes & Co., Ltd., Sherbrooke, Que.

SUPERHEATERS, STEAM
Babcock & Wilcox, Ltd., Montreal.
Green's Economiser, Ltd., Toronto.

SWING JOINTS
Franklin Williams Co., New York.

SWITCHBOARDS
Can. General Electric Co., Toronto, Ont.

SWITCHES AND SWITCH BOXES
Can. H. W. Johns-Manville Co., Toronto, Ont.

TACHOMETERS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Foxboro Co., The, Foxboro, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

TANKS, BLOW-OFF
Darling Bros., Montreal.
John McDougall Caledonian Iron Works, Montreal
Waterous Engine Works Co., Brantford.

TANKS, FREEZING, STORAGE AND WATER COOLING
Frick Co., Waynesboro, Franklin Co., Pa.

TANKS, OIL
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Bowser & Co., Inc., S. F., Toronto, Ont.
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Hamilton Co., Wm., Peterboro, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

TANKS, WATER
Inglis Co., The John, Toronto, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

TAPPING MACHINES
Mueller Mfg. Co., H., Sarnia, Ont.

TECHNICAL BOOKS
MacLean Publishing Co., Toronto.

THERMOMETERS
Foxboro Co., The, Foxboro, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Milton & Prentiss, Toronto.
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.

THERMOSTATS
Sarco Co., Inc., New York, N.Y.

TIN
Dominion Metal Co., Sherbrooke, Que.

TOOLS
Mueller Mfg. Co., H., Sarnia, Ont.

TRANSFORMERS
Can. General Electric Co., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.

TRANSMISSION MACHINERY
American Pulley Co., Philadelphia, Pa.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Goldie & McCulloch Co., Galt, Ont.
Hamilton Co., Wm., Peterboro, Ont.
Jeffrey Manufacturing Co., Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Waterous Engine Works Co., Brantford.

TRAPS, STEAM AND WATER-LINE
Beveridge Paper Co., Montreal, Que.
D'Este Co., Julian, Boston, Mass.

TRUCKS, FACTORY
Beveridge Paper Co., Ltd., Montreal, Que.
Canadian Fairbanks-Morse Co., Montreal.

TUBE CLEANERS
Babcock & Wilcox, Ltd., Montreal.

WATER
WE-FU-GO AND SCAIFE
PURIFICATION SYSTEMS
SOFTENING & FILTRATION
FOR BOILER FEED AND
ALL INDUSTRIAL USES
WM. B. SCAIFE & SONS CO. PITTSBURGH, PA.

Don't buy that New Electrical Apparatus Just Yet

WE can supply you with high-grade apparatus that has been slightly used and discarded through no fault of its own, at an **immense saving in cost.** For instance, in many cases we take over entire plants simply because of changed conditions such as increased capacity, change of system, etc.

EVERYTHING IS OVERHAULED AND REFINISHED BY US AND **GUARANTEED** AS GOOD AS NEW, BOTH ELECTRICALLY AND MECHANICALLY.

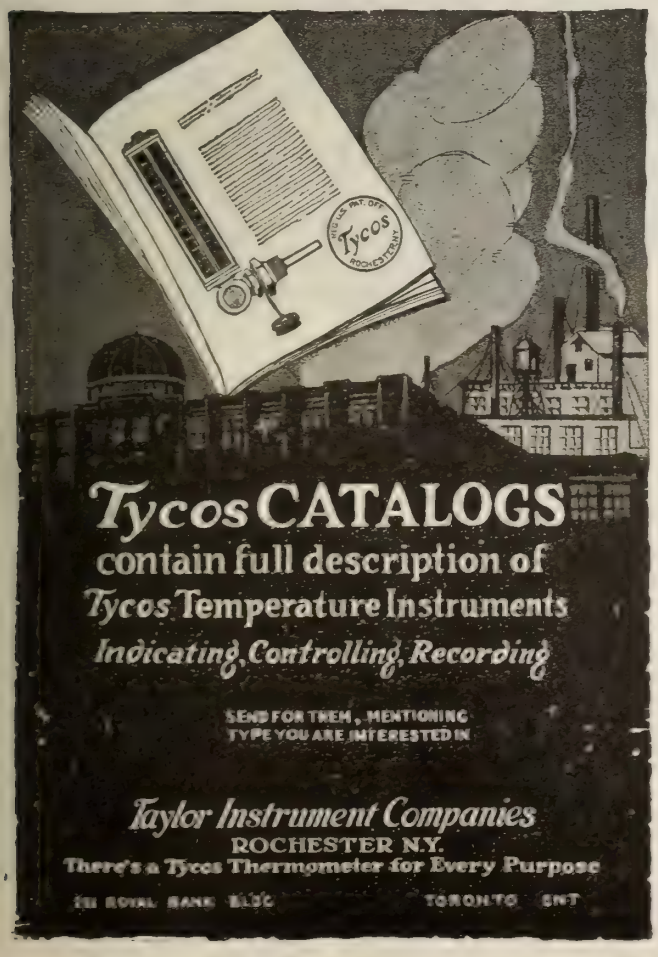
Our catalogs of offerings should be in the hands of every power plant superintendent each time they are gotten out, and it will be worth while for anyone interested in this class of power plant equipment to be on our mailing list to receive all offerings.

Nearly all of the principal power, lighting and street railway plants in the United States are our customers.

WRITE FOR OUR LATEST CATALOG of **Power House Equipment, Street Cars, Motors, Hoists, Compressors, etc.**

MACGOVERN & COMPANY, Inc.

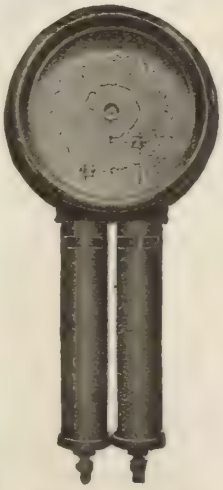
114 Liberty St., New York City



UEHLING WASTE METER

COMBINED

CO_2 AND TEMPERATURE RECORDER



Record of CO2 and stack temperature on one chart.

Does your fireman know how much fuel he is wasting? Do you know?

The Uehling CO_2 Recorder makes a complete 24 hr. record of your combustion efficiency and the CO2 indicator at the Boiler Front holds the fireman responsible.

Get more **Steam** per pound of **Coal** and reduce your annual fuel consumption.

CO2 Indicator for Boiler Front

Let us know the number and size of your boilers and coal consumed per year, upon receipt of which information we will be glad to send you full particulars.

Let us hear from you. We are pioneers in the manufacture of Indicators and Recorders for Power Plant purposes.

Send for our Bulletin No. 110.

Uehling Instrument Company

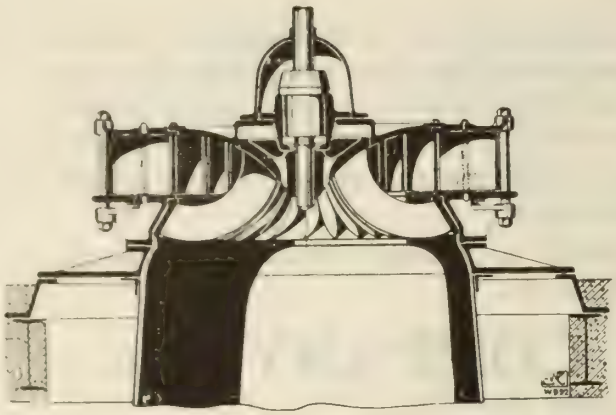
2008 Empire Building **New York City**

If any advertisement interests you, tear it out now and place with letters to be answered.

Escher Wyss & Co. S.A. Zurich (Switzerland)

Montreal Office: 112 Coristine Building

Water Turbines



Governors

Pipelines

Turbopumps

15/18

ADVERTISING INDEX

A

Albany Lubricating Co. 61
Alberger Heater Co. 54
American Steam Gauge & Valve Mfg. Co. 52
American Steam Pump Co. ... 57
Anderson Co., V. D. 81
Armstrong Cork & Insulation Co. 72

B

[illegible] 58
Babcock & Wilcox 78
Beveridge Paper Co. 77
[illegible] 70
Boving Hydraulic & Eng. Co. 76
Bowser, S. F., & Co., Inc. ... 72

[illegible] 57
[illegible] 64
Can. Detroit Lubricator Co... 4
Can. Fairbanks-Morse 64
Can. General Electric Co. 74
H. W. Johns-Manville Co. ... 61
Lane-Phillips Co., Ltd.... 62

[illegible] 3
[illegible] Ltd. 80
[illegible] 64
[illegible] 47
[illegible] Co. 66

D

Darling Bros. 8
Dart Union Co., Inside [illegible] 4
Davis Regulator Co. 12

D'Este Co., Julian 62
Direct Separator Co. 50
Dixon Crucible Co., Jos..... 45
Dominion Belting Co. 74
Dominion Coal Co. 78
Dunham & Co., C. A. 47
Durabla Mfg. Co. 52

E

Economy Fuse & Mfg. Co. of Canada 81
Elliott Co. 43
Engineering & Mach. Works of Canada, Ltd. 2
Escher Wyss & Co. 88

F

Federal Engineering Co. ... 81
Francis & Co., Walter J. 45
Frick Co. 11

G

Galt Foundry Co. 5
Garlock Packing Co. 69
Garth Co. 76
Gates, John W. 45
Goldie & McCulloch Co. 16
Goodyear Tire & Rubber Co... [illegible]
Graton & Knight Mfg. Co. . 54
Greene, Tweed & Co. 58
Green's Economizer, Ltd. 68

H

[illegible] Mfg. Co. 76
Homestead Valve Mfg. Co.... 69
[illegible] Co. 2

I

Inglis Co., John...Inside back cover

J

Jamison Cold Storage Door Co. 77
[illegible] 74
Jeffrey Mfg. Co. 85
Jenkins Bros. 67
Johns-Pratt Co., The 58
Jones Underfeed Stoker Co. . 4
Jordan Bros., Inc. 6

K

Kellogg & Co., E. H..... 45
Kerr Engine Co. 66

L

Ladd Co., The Geo. T. 77
Laurie & Lamb 13
Leitch Co., The Arthur S. 6
Liberty Mfg. Co. 43
Linde Canadian Refrigeration Works Co. 10
Long & Co., J. T. 45
Lunkenheimer Co. 62

M

MacGovern & Co. 87
MacKinnon, Holmes & Co. .. 45
MacLean's Magazine 56
Magnolia Metal Co. 74
Mason Regulator Co. 6
Mason Regulator & Equipment [illegible] 7
McAvity & Sons, T. 65
McDougall Caledonian Iron Works Co. 14
McGhie, W. C. 71
McLaren Ltd., D. K. 65
Metlskin Co., Inc. 50
Morrison Brass Mfg. Co., Jas. Outside back cover
Morse Chain Co. 71
Mueller Mfg. Co. 63
Murphy Iron Works 3

N

National Boiler Seam Protector Co. 76

O

Ogilvie Flour Mills Co. 46

P

Penberthy Injector Co..Front cover
Pennsylvania Flexible Metallic Tubing Co. 50
Pilley Packing & Rue Brush Mfg. Co. 77
Power Plant Equipment Co.... 57
Pratt & Cady Co., Inc..... 52

R

Roto Co. 47

S

Sarco Co., Inc. 44
Scaife & Sons Co., Wm. B. .. 86
Schaffer & Budenberg Mfg. Co. 6
Shell-Bar, Boico Supply, Ltd.. 3
Smart-Turner Mach. Co. 57
Snowdon, C. C. 70
Starrett, L. S., Co..... 78
Steel Mill Packing Co..... 72

T

Taylor Instrument Co. 87
Thomson-Gordon, Ltd. 70
Trimont Manufacturing Co. ... 78

U

Uehling Instrument Co. 87

V

Vilter Mfg. Co. 10

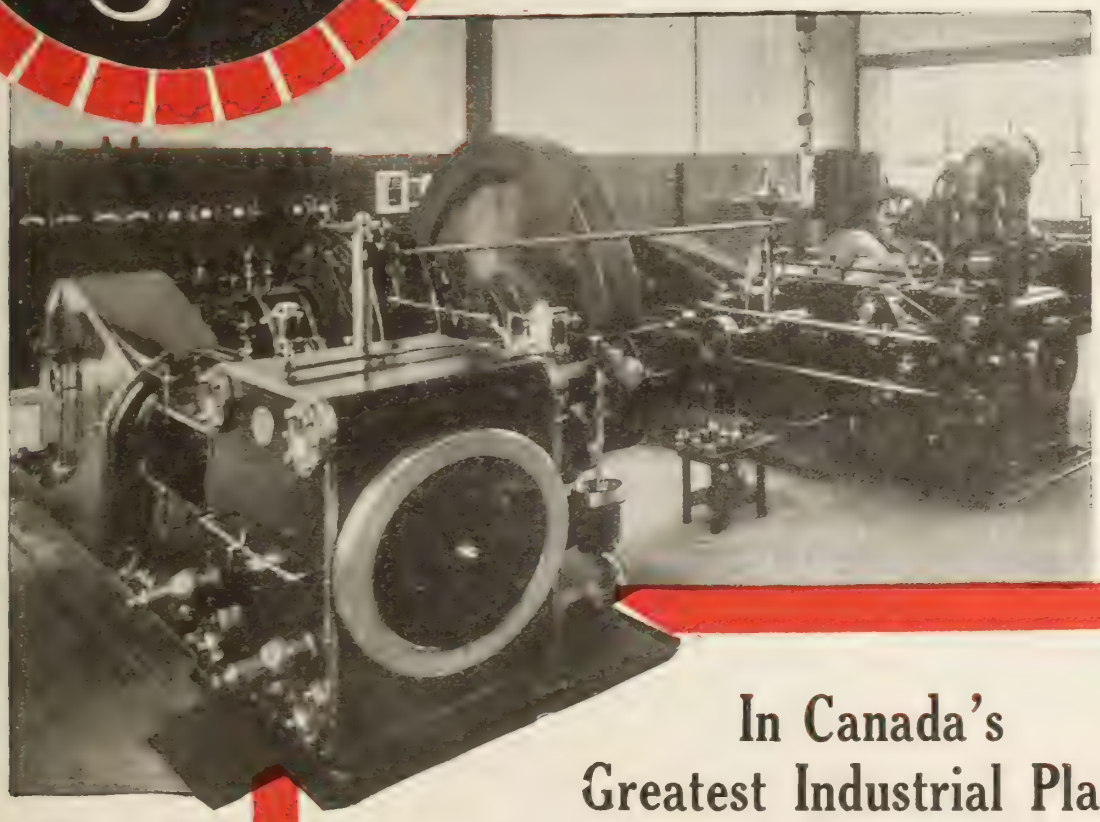
W

Wall, W. J. 45
Waterous Engine Works Co.. 1
Watson & McDaniel Co. 76
Wenting, J. H. 77
Williams & Co., J. H..... 60
Williams Co., Franklin..... 68
Wood & Co., R. D. 47

Y

Yarnall-Waring Co. 58
York Mfg. Co. 12

INGLIS Engines and Boilers



In Canada's Greatest Industrial Plants

The larger the plant, the easier the sale—or so we have found it. For in the personnel of almost all great plants there is at least one mechanical expert who invariably holds out for the highest type of power equipment. In the judgment of such men certain features exclusively possessed by Inglis Engines and Boilers are vastly more important than price or favor.

Without charge, without placing you under any obligation whatever, Inglis Experts will answer your questions, consider your special requirements, and recommend the equipment best suited to your needs.

The John Inglis Company, Limited

ENGINEERS AND BOILER MAKERS

14 Strachan Ave., Toronto, Canada

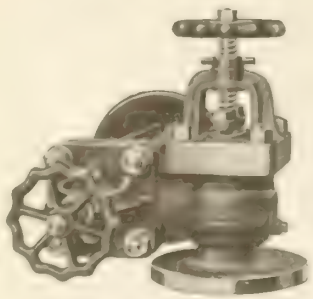
Good for 40 Years

MORRISON'S

Steam Goods & Specialties

J.M.T. Reducing Valve.

Gem Ejector

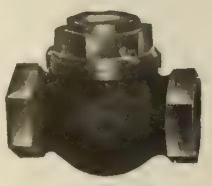


Beaver Combined Stop and Check Valve

Every Article Factory Tested and Guaranteed

Every article bearing the quality mark —J.M.T.—is warranted perfect. We set a high standard well on to half a century ago. Would we to-day break faith with the thousands using Morrison's Steam Goods? A thousand times no. It is their right to expect long, wholly satisfying service, just as it is our privilege to make Steam Goods and Specialties that so serve.

J.M.T. Injector



J.M.T. Check Valve

SOME OF OUR LINES

We'd like to tell you in detail about these:

- Stop Valves
- Check Valves
- Gate Valves
- Safety Valves
- Relief Valves
- Reducing Valves
- Steam Traps
- Injectors
- Ejectors
- Insperators
- Jet Pumps
- Steam Gauges
- Vacuum Gauges
- Ammonia Gauges
- General Boiler Mountings
- Gauge Board Outfits
- Lubricators
- Pipe Fittings
- Steam Whistles
- Engine Indicators
- Pipes, Tools, etc.

Pressure Gauges and Recording Instruments

The J.M.T. Line includes everything for the engine and boiler room—all approved by Provincial Government Inspection.

Let the quality mark—J.M.T.—guide you to the best.

The James Morrison Brass Manufacturing Company, Limited

93-97 Adelaide Street West, Toronto, Ontario, Canada

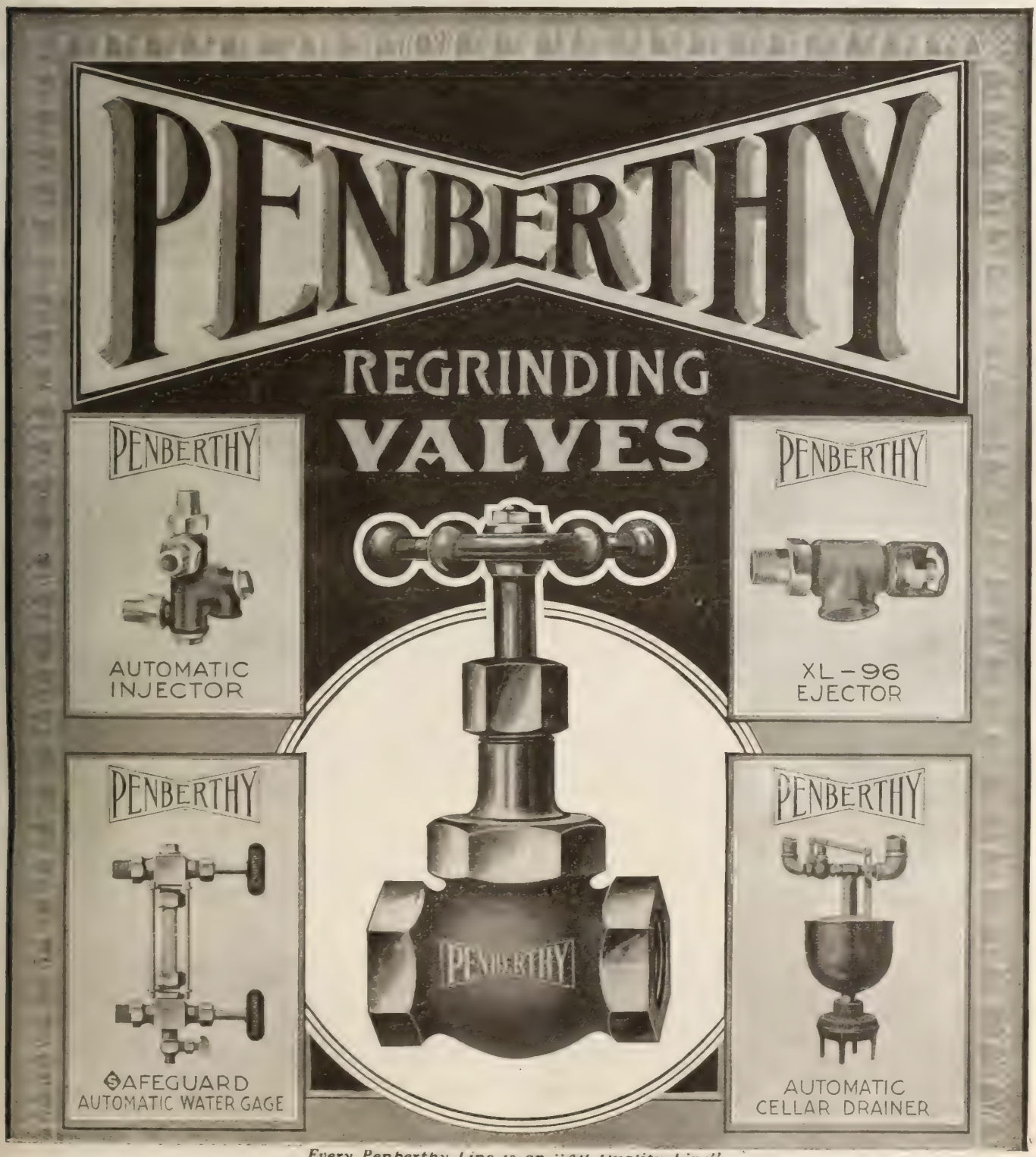
POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power; and to the operation of Refrigerating Machinery.

Published by The MacLean Publishing Company, Limited, 143-153 University Ave., Toronto

MONTREAL: Southam Bldg. LONDON, ENG.: 88 Fleet St., E.C. WINNIPEG: 1207 Union Trust Bldg

Vol. XI—No. 9 Publication Office, Toronto—September, 1918 Published Monthly $1.00 per Year.



Every Penberthy Line is an "All Quality Line"

MANUFACTURED BY

PENBERTHY INJECTOR COMPANY, LIMITED, Windsor, Ontario

Photo taken at Matthews-Blackwell Ltd., Pork Packers and Provisioners, Toronto, Ont.

Prepare Now

for the coming Winter

Everything points to an acute shortage of coal this winter. Take steps now to make your supply go as far as possible.

The Chief Engineer of Matthews-Blackwell Ltd., Toronto, says:

"I have been at the business twenty years and I've had at least **50% LESS TROUBLE WITH MY BOILERS** this year than ever before, and besides have effected a **GOOD SAVING OF COAL.** I say it's the Dean."

MR. ENGINEER, MAKE THIS TEST

Pick out the boilers in your shop which you believe perfectly clean and try the Dean Boiler Tube Cleaner on them.
This is what the chief engineer of the Matthews-Blackwell, Ltd., did and he was surprised at the amount of scale removed.

KEEP YOUR BOILERS SCALE-FREE AND REDUCE COAL BILLS

The Dean reduces coal bills from 9% to 35% depending upon the amount of scale in your boiler tubes.
The Dean cleans boiler tubes clean. It gets all the scale.
The Dean, because of its few and simple parts, takes out scale **faster** and **more thoroughly** than any other known methods; and its sturdy simplicity means long life, low upkeep cost and ease of operation

TRY THE DEAN CLEANER FREE OF CHARGE

Write a letter, "Send us a Dean on free trial, with the understanding that we are under no obligation to purchase it," and state type of boilers and exact outside diameter of tubes.

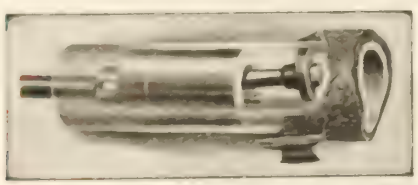
Dean

REG. U.S. PAT. OFF.

Boiler Tube Cleaner

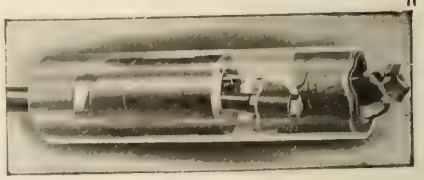
The Wm. B. Pierce Company

153 Ellicott Street, Buffalo, N. Y.



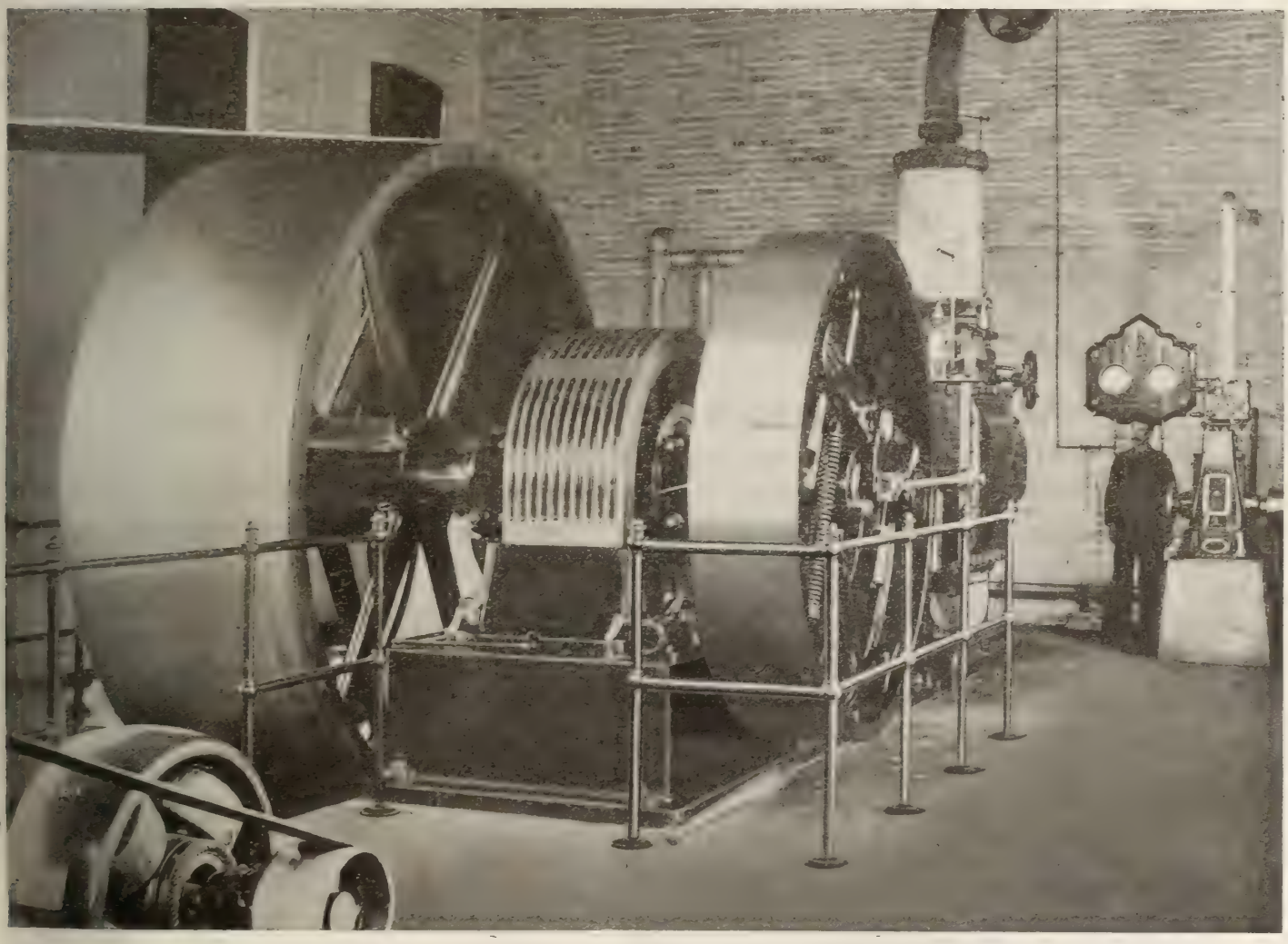
The Dean removing scale from the tube of a return tubular boiler.

The Dean operating in a Stirling Tube.



The Dean removing scale from the tube of a water tube boiler.

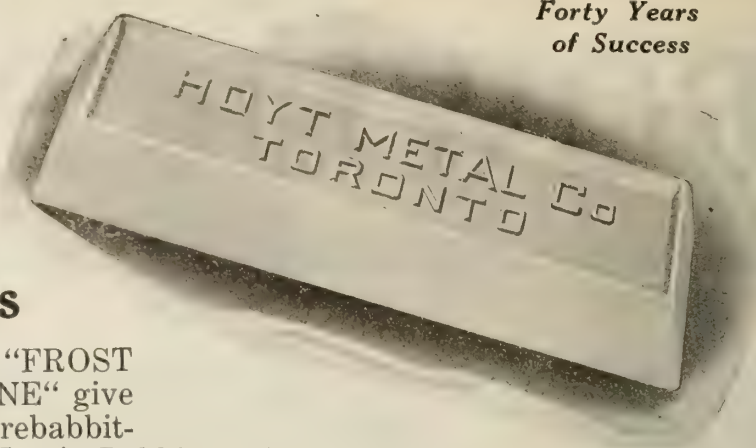
POWER PLANTS



Waterous
BRANTFORD, ONTARIO, CANADA

Hoyt Babbitts

Forty Years of Success



Will Cut Your Costs

Bearings babbitted with Hoyt's "FROST KING" or Hoyt's "NICKEL GENUINE" give extra long service before they need rebabbitting. Don't use common alloys. Hoyt's Babbitts will give you better satisfaction and cut your babbitting costs.

HOYT'S FROST KING—This general purpose babbitt has won its way into many of the foremost power plants of the world. It represents 40 years of success and has won the favor of Canadian engineers from coast to coast.

HOYT'S NICKEL GENUINE—This famous babbitt is recommended for use in gas engines, gasoline engines and all classes of marine engines. Especially adapted for automobiles. There is no better babbitt made for high-speed work.

Specify HOYT in Your Next Order for Babbitts

Hoyt Metal Company Eastern Avenue and Lewis St. **Toronto**

London, Eng., New York, U.S.A., St. Louis, Mo., U.S.A.

View Showing Interior of Boiler Department.

Stationary Boilers

Horizontal Tubular
Vertical Tubular
Locomotive Types

To conform with various Provincial codes.

Catalogs gladly furnished to members of the C.A.S.E.

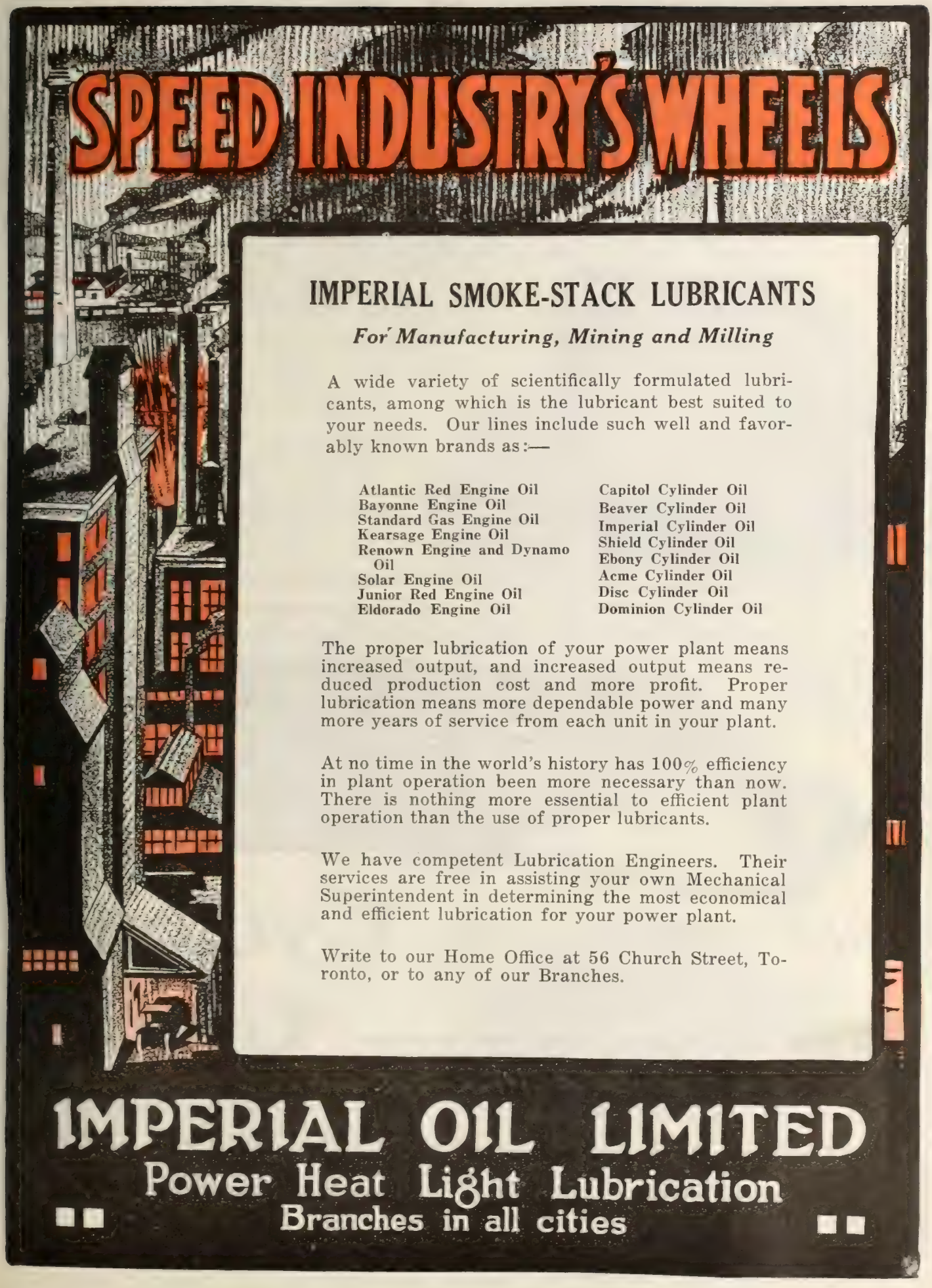
Kindly address nearest office

Engineering & Machine Works of Canada, Limited

Formerly
St. Catharines Works of
The Jenckes Machine Co., Ltd.

Head Office and Works
St. Catharines, Ont.

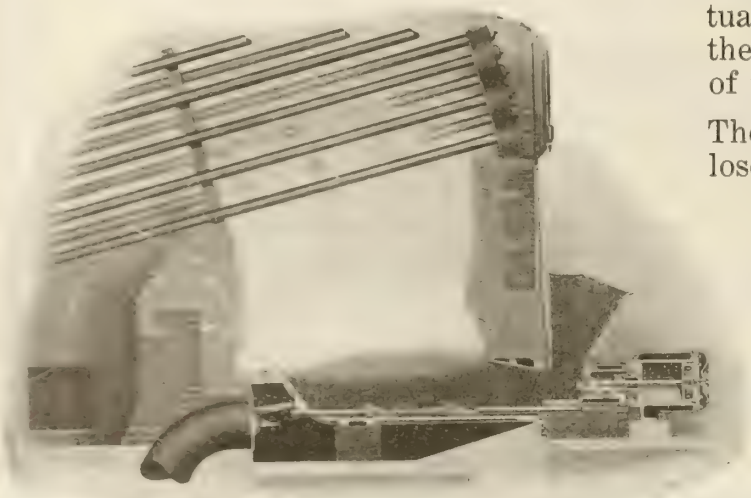
Sales Offices
710 C.P.R. Building, Toronto
344 St. James Street, Montreal
Hall Machinery Co., Sherbrooke, Que.


SPEED INDUSTRY'S WHEELS
IMPERIAL SMOKE-STACK LUBRICANTS
For Manufacturing, Mining and Milling
A wide variety of scientifically formulated lubricants, among which is the lubricant best suited to your needs. Our lines include such well and favorably known brands as:—
Atlantic Red Engine Oil
Bayonne Engine Oil
Standard Gas Engine Oil
Kearsage Engine Oil
Renown Engine and Dynamo Oil
Solar Engine Oil
Junior Red Engine Oil
Eldorado Engine Oil
Capitol Cylinder Oil
Beaver Cylinder Oil
Imperial Cylinder Oil
Shield Cylinder Oil
Ebony Cylinder Oil
Acme Cylinder Oil
Disc Cylinder Oil
Dominion Cylinder Oil
The proper lubrication of your power plant means increased output, and increased output means reduced production cost and more profit. Proper lubrication means more dependable power and many more years of service from each unit in your plant.
At no time in the world's history has 100% efficiency in plant operation been more necessary than now. There is nothing more essential to efficient plant operation than the use of proper lubricants.
We have competent Lubrication Engineers. Their services are free in assisting your own Mechanical Superintendent in determining the most economical and efficient lubrication for your power plant.
Write to our Home Office at 56 Church Street, Toronto, or to any of our Branches.
IMPERIAL OIL LIMITED
Power Heat Light Lubrication
Branches in all cities

NO NEED TO WORRY *about fuel shortage*

You can do with 1/8 to 1/4 less fuel, and also save much labor and wages by installing the

JONES UNDERFEED STOKER



It is entirely automatic. Gives you a steady steam pressure, regardless of fluctuating loads, and scientifically gets **all** the energy out of coal by definite control of fuel and draught.

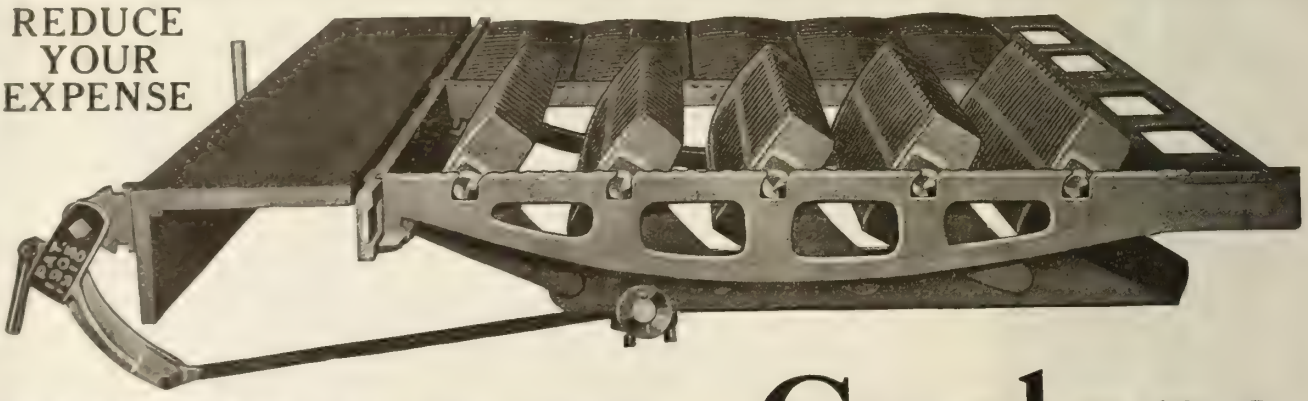
The simplest stoker built—no grates to lose fuel through—not a working part that moves in contact with the fire—no complicated mechanism.

Ask the users. We'll gladly put you in touch with a number of them.

Jones Underfeed Stoker Company, Limited

37-41 Britain St. - - TORONTO

REDUCE YOUR EXPENSE



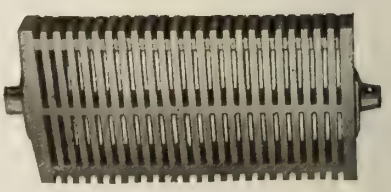
SAVE COAL by using— Cyclone Grates

The design of Cyclone Shaking and Dumping Grate Bars ensures perfect combustion when using the lowest price fuel, such as screenings or low-grade soft coal.

60% Air Space and 90% Underdraught means no clinkers and no waste.

The new jarring, shaking movement sifts the worthless ashes through—but not a particle of good fuel.

Write for our 30 Days' Free Trial Offer now.



The Canadian Steam Boiler Equipment Co., Ltd.

Sole Makers for Canada

20 McGee Street Phone G. 3660 Toronto, Ontario

AGENTS:

ST. JOHN, N.B.: F. W. Blizard, 329 Charlotte St. MONTREAL: Mason Regulator Co., Ltd., St. James St. HAMILTON: Robt. Fitzsimmons, 8 Grove St. WINNIPEG, Vulcan Iron Works.

Murphy AUTOMATIC Furnace

Murphy Stokers

A few longtime constant users, and there are others!

Lockport Paper Co.,	Lockport, N.Y.	33 years constant use
Hartje Paper Co.,	Steubenville, Ohio	24 years constant use
Sherwin-Williams Co. 12 contracts 20 Stokers	Montreal, P.Q. Cleveland, Ohio Kensington, Ill.	16 years constant use
Laurentide Co., Ltd.,	Grand Mere, P.Q.	13 years constant use
Ford Motor Co.,	Detroit, Mich.	
" " "	Des Moines, Iowa	18 years constant use
" " "	New York, N.Y.	
Ohio Traction Co., 16 Repeat Orders	Cincinnati, Ohio	28 years constant use
		74 Murphy Stokers

For printed matter address

MURPHY IRON WORKS

DETROIT, MICH. BUFFALO, N.Y.

Every Barrel of **BOICO** The Quick Remover and Positive Preventive of Boiler Scale

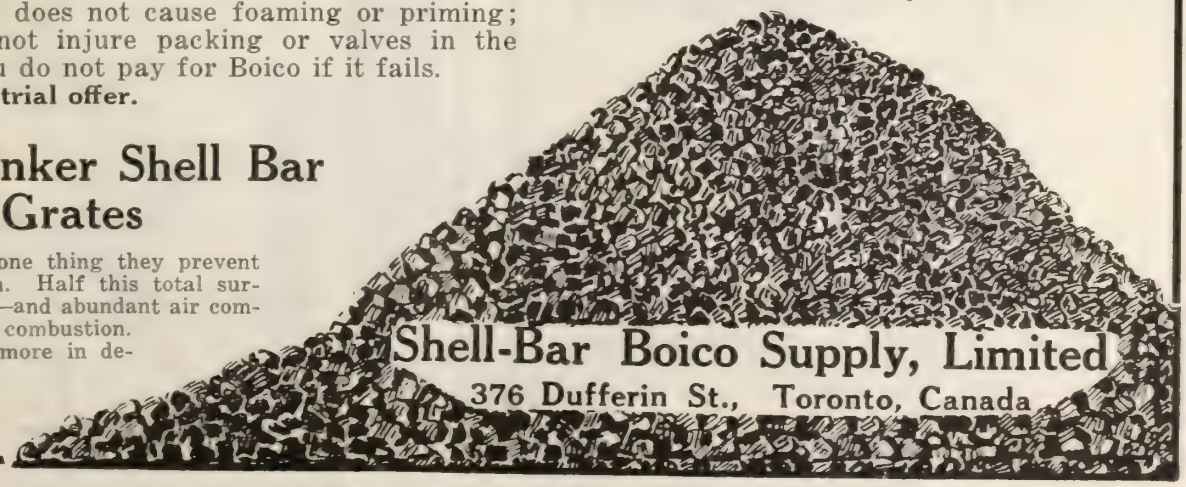
SAVES A PILE OF COAL

It's such a heartless job trying to keep a boiler clean with ordinary compounds that comparatively few are always wholly clean. Consequently a good deal more fuel than need be is burned up on the grates. We claim for Boico that it removes absolutely all scale; that it positively prevents further formation of scale; that it does not carry over in the steam; that it does not cause foaming or priming; that it does not injure packing or valves in the slightest. You do not pay for Boico if it fails.

Write for our trial offer.

Anti-Clinker Shell Bar Grates

save coal. For one thing they prevent clinker formation. Half this total surface is air space—and abundant air commands perfect combustion. Let us tell you more in detail.



Shell-Bar Boico Supply, Limited

376 Dufferin St., Toronto, Canada

If any advertisement interests you, tear it out now and place with letters to be answered.

Having Commutator Troubles?

The Jordan Commutator Truing Device will true your commutators without a shut-down.

Jordan Bros., Inc.

82 Beekman St. New York City, N.Y.

Canadian Representative :

CANADA SALES CO., 183 Church Street, Toronto, Canada

MASON

Reducing Valves

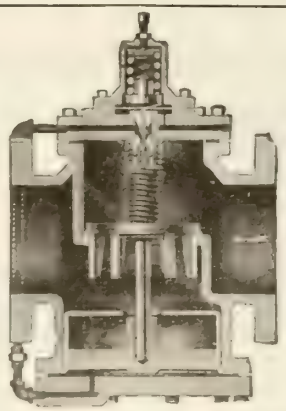
Pump Regulator
Balanced Valves
Damper Regulators

If you order a Mason you will get absolute satisfaction. This we guarantee you. You simply cannot make a mistake.
Dependable regulation under every possible condition.

Our complete catalog tells you WHY. Let us mail you a copy.

Mason Regulator Company
BOSTON, MASS.

TORONTO REPRESENTATIVES:
The Arthur S. Leitch Co.,
506 Kent Bldg., Toronto.



Kieley & Mueller Specialties

Regulating Valves
Back Pressure Valves
Pump Governors
Separators
Traps

FOR EVERY SERVICE

SALES ENGINEERS

THE ARTHUR S. LEITCH CO.
TORONTO

When Buying Thermometers

There's Just Three Things to Remember—

First, you must have accuracy and sensitiveness—

Second, durability is absolutely essential—

Third, the thermometer must be suitably constructed for the intended application.

Accuracy, sensitiveness and durability are absolutely guaranteed in

"Crescent" Thermometers

And with nearly seventy years of experience to our credit, we are qualified to properly interpret your needs.

Our Catalog P.H. 200 illustrates and describes "Crescent" Thermometers for every application. Also test thermometers, glass thermometers, etc.

Get a copy of Catalog P.H.-200 to-day.

The Schaeffer & Budenberg Mfg. Co.

Canadian Agents:

Brooklyn, New York

Chicago
Pittsburg
St. Louis
Philadelphia
Los Angeles

Milton and Prentiss, Toronto

Power Plant thermometers for all temperatures not exceeding 1000° F

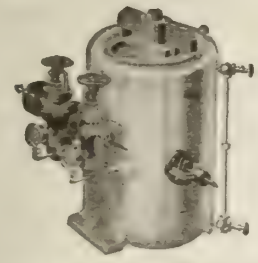
Also—"Columbia" Recording Gauges and Thermometers, Gauges, Gauge Testers, Tachometers, Steam Calorimeters, Counters, etc.

If any advertisement interests you, tear it out now and place with letters to be answered.

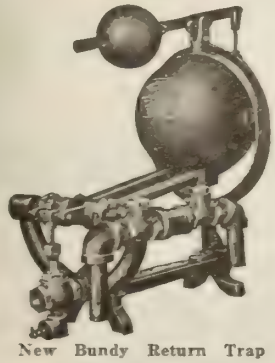
We are at Your Service

Mason Standard Bronze Reducing Valve

Mason No. 55 Pump Pressure Regulator



Reilly Multi-Screen Feed Water Filter

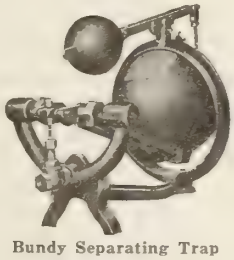


New Bundy Return Trap

THE practical knowledge of experts who are continuously coming into contact with difficult engineering problems should be of considerable assistance to you. Let us demonstrate the "Mason Service" on your next problem.

"Mason" line of steam specialties means quality and reliability in service.

Mason Reducing Valves (Genuine)
Mason Pump Governors
Mason Pressure Controllers
Bundy Steam Traps for every service
Coppus Turbine-driven Blowers
Sims Hot Water Generators
Sims Storage Heaters
Sims Open Feed Water Heaters
Bundy Oil Separators
Ashton Gauges and Safety Valves
Everlasting Blow-Off Valves
Babbitt Sprocket Rims
Stratton Steam Separators
Reilly Multi-coil Feed Water Heaters
Reilly Evaporators and Distillers
Reilly Multi-screen Feed Water Filters



Bundy Separating Trap

The
Mason Regulator & Engineering Co.
Limited

Successors to H. L. PEILER & COMPANY

Montreal Office and Factory: 135-153 Dagenais Street

Toronto Representative:
The Arthur S. Leitch Co., 506 Kent Building

Are your heating problems for the coming winter a source of worry to you?

THEY don't need to be, for the reason that given proper treatment they don't amount to problems.

We are the people who know how to administer the treatment, and we do it through the medium of THE WEBSTER VACUUM SYSTEM OF HEATING PLUS EXHAUST STEAM.

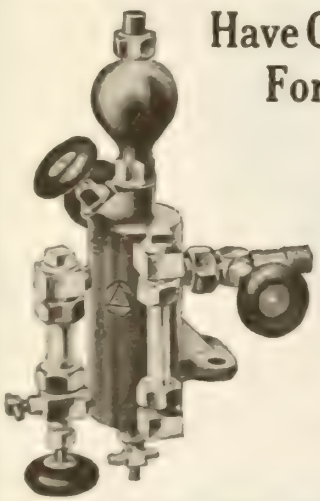
DARLING BROTHERS, LIMITED

120 PRINCE STREET - MONTREAL

VANCOUVER CALGARY WINNIPEG TORONTO HALIFAX

Detroit Lubricators

Have Given Satisfaction For Forty Years.



Built in a sufficient variety of styles to lubricate properly every type of steam engine, pump, gas engine, air compressor, etc.

Send to-day for catalog L 1. The information on lubricating devices contained in it will be valuable to you.

THEIR efficiency holds over half the world's trade.

Makers of Stewart Carburetors.

CANADIAN DETROIT LUBRICATOR COMPANY, LTD.

WALKERVILLE, ONT.

LUBRICATION Around Machinery is An Important Function

It gives longer life, more perfect running, and distributes the energy to all parts and in perfect harmony and proportion.

All this can be done by using

THE

ROCHESTER LUBRICATOR

Manufactured by

Greene, Tweed & Co., New York

Sole Agents for Canada

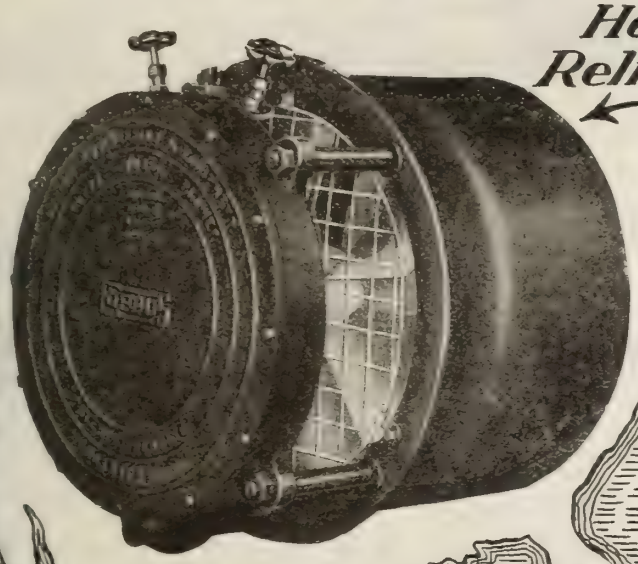
Darling Brothers, Limited

120 Prince Street, Montreal

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

50 Million-ton Coal Shortage

Here's Relief



Coppus Turbo Blower

EVERY power plant in North America should be deeply concerned with the coal supply of the country. The situation is serious in the States, and what is true of the States is true of Canada. Here's what a recent bulletin issued by the United States Fuel Administration has to say:

"When it is popularly said that Munitions will win the war, or that finances will win the war, these are merely other ways of saying that the production of coal, and its application to the war in armaments, war ships, merchant ships, shells, rifles, tanks, submarines, airplanes or locomotives, will win the war. The war has created a demand upon this country for 100 million more tons of coal this year than is normally produced. Because of the car-shortage and the congested condition of the railroads, it will be impossible to increase the supply more than 50 million tons. The remaining gap of 50 million tons will have to be filled in by conservation in the industrial plants of America."

THE COPPUS TURBO BLOWER

places within the grasp of the power plants of Canada an opportunity to save their country thousands of tons of Coal.

Some of the best power plants in America have found it safe, sound and economical to make their boilers "come through" with maximum results, by the use of Coppus Turbo Blowers. There's no reason why you can't do the same.

There never was a time like the present when it behooved you to strive for big production, and economy in the fuel you use. And there's no better means to this end than through the use of Coppus Turbo Blowers.

You can easily run your boilers at 200 per cent. of rating, increase their efficiency, reduce your fuel expense, help your country solve the fuel problem and put money in your pocket. *Coppus Turbo Blowers* give you any amount of draft you want, where you want it and when you want it, and they do it with from 25 to 75 per cent. less steam for driving than any other blower on the market. Hurry and investigate it — time is precious these days.

Canada is dependent upon the United States for the greatest portion of her fuel supply. United States can't supply her own demands—and a shortage of coal in the States means a shortage of coal in Canada.

Thus it behooves all users of fuel to adopt every available means to help make good this shortage to avoid a menacing situation.

Every power house in Canada should have their boilers equipped with Coppus Turbo Blowers.

Coppus Engineering and Equipment Co.

351 Park Avenue, Worcester, Mass.

CANADIAN AGENTS—Montreal, Mason Regulator & Engineering Co., 135 Dagenais Street. Toronto, The Arthur S. Leitch Co., 506 Kent Bldg. Winnipeg, Wm. Carter, 817 Union Bank Bldg.

Every phase of Refrigeration specialized in—

Linde Ice Machines

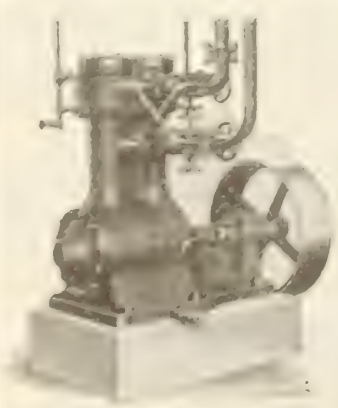
Linde Ice Machines represent years of mechanical perfection work by skilled and practical engineers—working for a machine that not only runs smoothly without annoying breakdowns, but one simple in design with a long life and economic operation.

These fundamental principles are back of every Linde Machine, and we have one for every purpose and size of business.

The Linde Canadian Refrigeration Company, Limited

37 St. Peter Street, Montreal

Established and Manufacturing in Canada since 1896



Ice-making and Refrigerating Machinery

Built in any capacity that you desire. HORIZONTAL OR VERTICAL

Our SMALL MACHINES have the same "regularity of Operation," "Reliability" and "Efficiency" as our large ones.

AMMONIA FITTINGS, CONDENSERS, BRINE COOLERS, ETC.

Our Machines are in daily operation in Canada

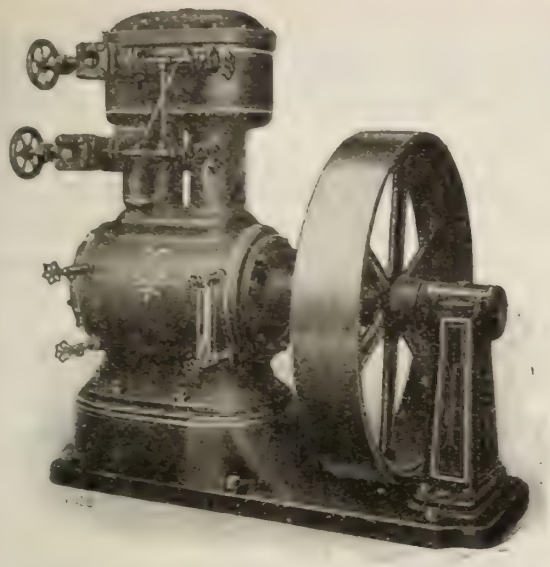
CORLISS and POPPET VALVE ENGINES

The Vilter Manufacturing Company

242 Beecher St. - - - Milwaukee, Wisconsin

If any advertisement interests you, tear it out now and place with letters to be answered.

"Install the FRICK Machine"



Recommendations frequently made by Engineers and Owners who have installed and operated various makes of Refrigerating Machines and Equipment, plainly state, "Install the FRICK Machine."

Why?—Because they exceed the guarantees made for them. In the Refrigerating field the FRICK Machine is like a Yankee on the battlefield—prepared and ready for extra duty.

Ask for Ice and Frost No. 5—— It explains details.

36½ YEARS OF SUCCESSFUL REGRIGERATING ENGINEERING EXPERIENCE.

Ask for a copy of our list of users covering 48 pages of satisfied customers—also your copy of "Ice and Frost."

Frick Company
WAYNESBORO, PA. U.S.A.
ICE MACHINERY SUPERIOR SINCE 1862

Canadian Representatives:
FRICK ICE & REFRIGERATING COMPANY
Montreal, Canada

There is a FRICK Machine for every refrigerating purpose—all types—Vertical — Horizontal — Absorption.

Insulation Most Important Point

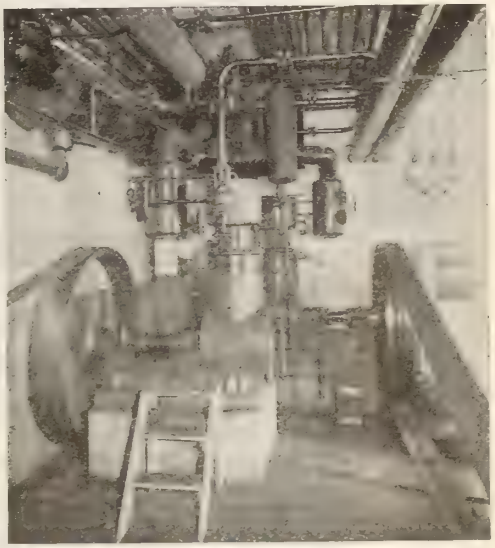
U. S. Dairy Expert Says

"In the economical operation of a refrigerating plant, the insulation is the most important point, and great care should be exercised in its selection and installation. All exposed piping between the expansion valve and the suction side of the machine should be carefully insulated."—John T. Bowen, Technologist, Dairy Division, U.S. Department of Agriculture.

Nonpareil Cork Covering

For Cold Pipes and Tanks

has thoroughly proved its superiority during the twenty years it has been on the market. It consists of pure granulated cork, compressed and baked in metal molds. The result is a covering which will save approximately 80% of the loss from bare pipes. Nonpareil Cork Covering is durable in service, too, because it will not suck in moisture by capillary attraction. Furthermore, the price is reasonable.



Brine lines insulated with Nonpareil Cork Covering, Peerless Creamery Company, Chattanooga, Tenn.

Armstrong Cork & Insulation Co.
504 McGill Building, Montreal, Que., Canada

Why not find out how much Nonpareil Cork Covering will save for you? Our 64-page book will tell. A sample of the covering, too, if you wish it.

Also manufacturers of Nonpareil Corkboard Insulation for all cold storage rooms; Nonpareil High Pressure Covering for steam lines; Nonpareil Insulating Brick for furnaces, boiler settings, etc.; Nonpareil Cork Machinery Isolation for deadening the noise of machine; and Linotile for floors in offices, residences, etc.

York Ammonia Valves and Fittings

assist materially in the conservation of ammonia.

Dependable Ammonia Valves and Fittings are of vital importance in every Refrigerating and Ice-Making Plant to-day.

YORK Ammonia Valves and Fittings are correctly designed, made under ideal conditions, subjected to an air test under water, and guaranteed tight under all usual working pressures.

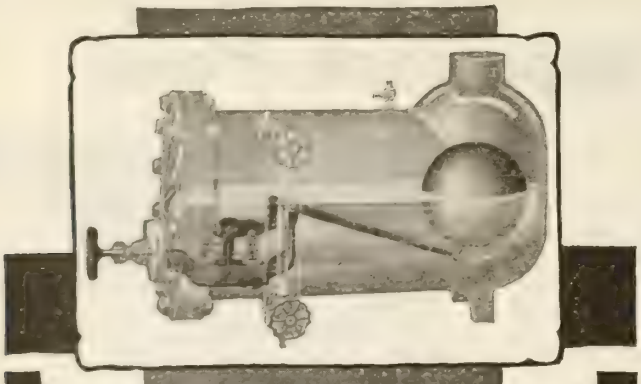
A trial order will convince you of the superiority of YORK Valves and Fittings.

Stocks are carried by our Canadian Representatives at all times. For prices and any other information pertaining to YORK Quality Products, write

CANADIAN ICE MACHINE COMPANY

TORONTO, 82 Chestnut St. MONTREAL, 626 Coristine Bldg.
WINNIPEG, 85 Lombard St.

YORK MANUFACTURING CO., YORK, PA., U.S.A.
Ice-Making and Refrigerating Machinery Exclusively



DAVIS STEAM TRAPS

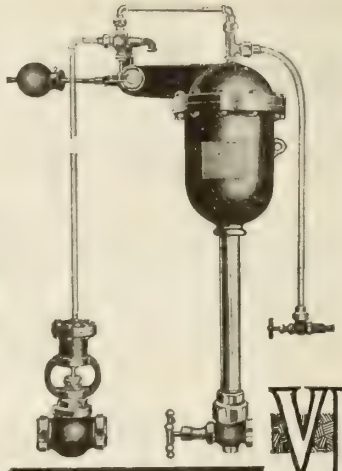
protect equipment and save steam, by keeping the steam lines free of condensation.

Davis Steam Traps discharge continuously against any lower pressure—have renewable double cone-shaped balanced valves which give large capacity—are water sealed to prevent steam leakage—have valves and seats made of a special long-wearing bronze—have all working parts attached to the cover, which can be removed without breaking pipe connections. Especially valuable where large capacity and balanced cone-shaped valves are needed.

For your free copy of the new Davis catalogue showing this and all the other Davis Steam Savers, write the G. M. Davis Regulator Co., 431 Milwaukee Ave., Chicago. Branches in principal cities.

DAVIS VALVE SPECIALTIES

STEAM SAVERS SINCE 1875



Keeps the Water Within ¼" of Middle Gauge

This VIGILANT

Automatic Feed-Water Regulator

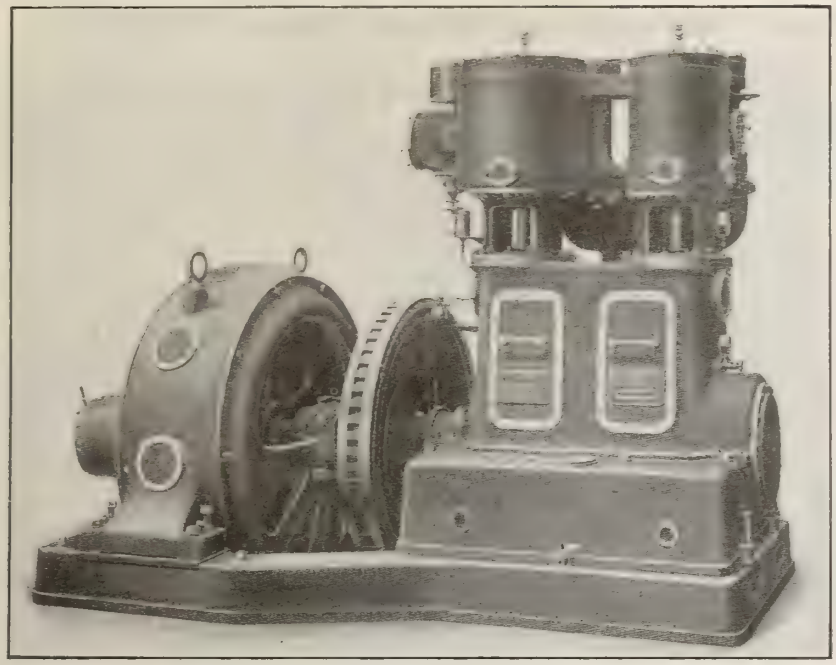
It does precisely that, automatically, perfectly, regardless of the load or firing. Therefore it is a positive protection from all high and low water accidents.

Incidentally—and this we can also prove—the Vigilant Feed-water Regulator saves 3 to 17 per cent. on fuel costs.

Ask us to send you catalog.

The Chaplin-Fulton Manufacturing Company
28 Penn Avenue : : Pittsburgh, Pa.

BELLISS & MORCOM, LTD.
Engines and Air Compressors



Belliss & Morcom Motor-Driven Air Compressor.

Belliss Steam Engines, Steam Turbines, Diesel Engines,
Air Compressors, Condensing Plants

Heenan Refuse Destructors, Air Coolers, Water Coolers,
Oil Coolers, Dynamometers

Paterson Water Softening Plants and Filters

Centrifugal Pumps

We can make good delivery for War Service.

LAURIE & LAMB

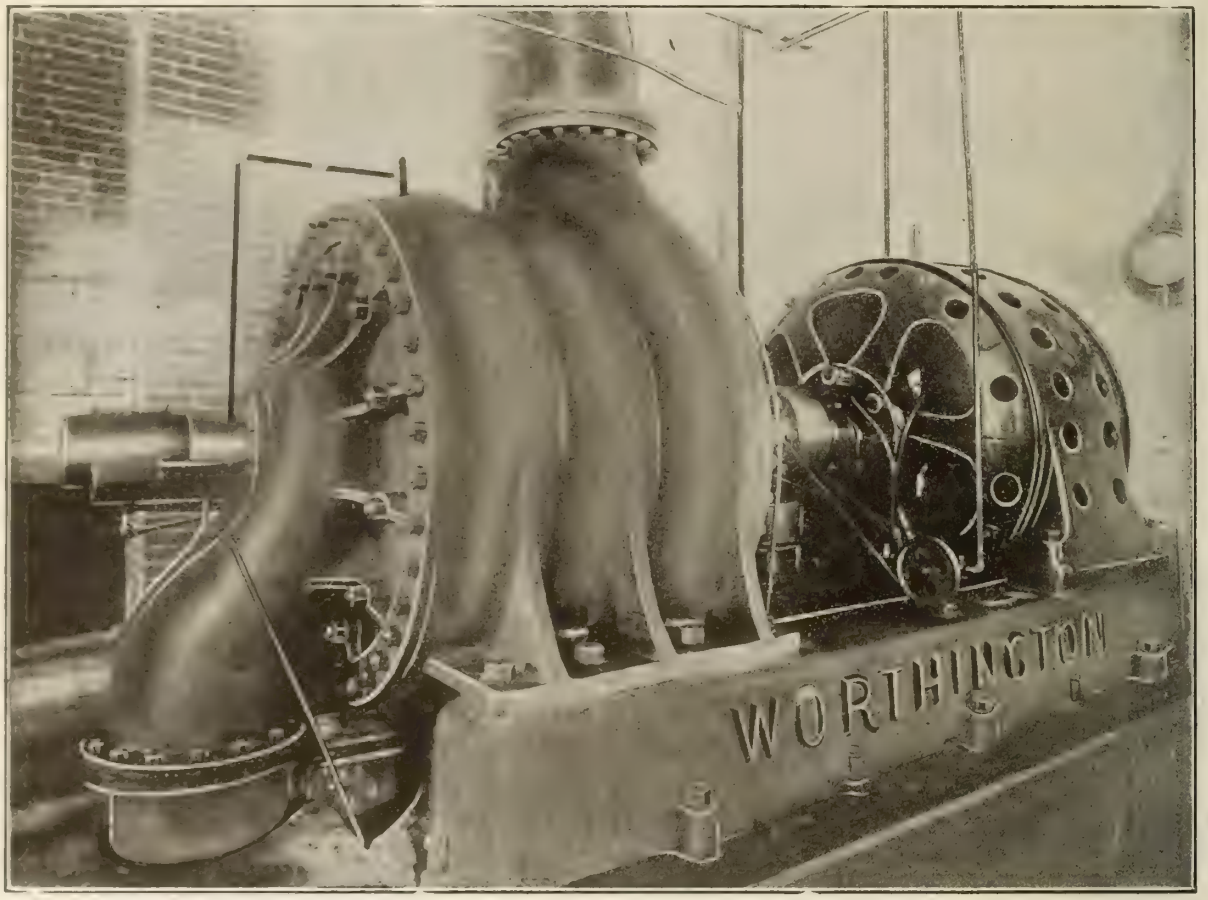
Engineers

211 Board of Trade Bldg. - - **MONTREAL**

THE JOHN McDOUGALL CALEDONIAN IRON WORKS CO., Limited

Manufacturers of Boilers, Castings, Condensers, Elevators, Engines, Filters, Forgings, Hydraulic Machinery, Pumps — centrifugal and reciprocating, Steam Turbines, Tanks, Water Wheels, Water Works Plants

Works : Seigneurs and William Streets, MONTREAL



5,000,000 gallons daily—Montreal Water Works—Driven by 400 H.P. Induction Motor.

Our Engineers have spent many years developing Centrifugal Pumps and we are now able to offer you perfected designs in any size pump from inch and a half and up for any service you may desire, and to be driven either with motor, engine or belt.

Write us for Engineering information, or prices, any time.

Sole Canadian Agents for H. R. Worthington Co.

Keeping in Stock at Montreal a large assortment of their Boiler, Feed and General Service Pumps

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

The Publisher's Page

TORONTO SEPTEMBER, 1918

The Wisdom of Advertising When Oversold

ASK the "man in the street" to call the roll of talking-machine manufacturers, and he will name three almost certainly, four probably, and perhaps will go as far as five or six before his knowledge of the subject is exhausted. But ask him for the name of the leading concern in the industry and ninety-nine times out of one hundred you will get the same answer. The wisdom of the Victor Talking Machine Company's policy of continued advertising when the factory is oversold can be demonstrated by so simple a test as that.

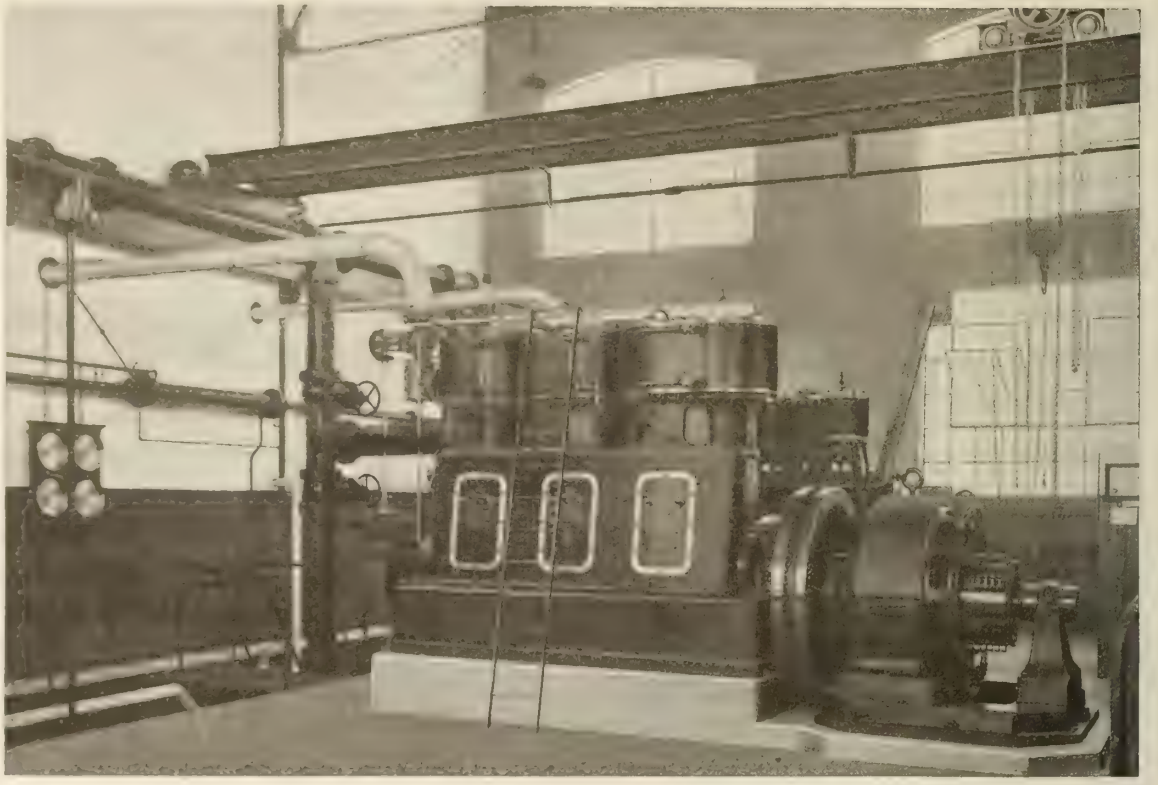
Our neighbor, the *Dry Goods Economist*, points out that the talking-machine business is no longer a specialty proposition, requiring expert handling. The public at large is so thoroughly familiar with the idea of owning a machine and operating it that the department store can profitably enter the field and sell the line on a merchandise basis. And certainly there are plenty of available sources of supply. We counted the ads. of twenty-six different manufacturers in a single issue of a trade-paper, and that is by no means the complete roster. Some of them are also advertising to the consumer, others are not, yet the fact remains that the immense prosperity of the industry is attracting a multitude of concerns which intend to share it if they can. The leaders have done the pioneer work of educating the public to the talking-machine idea, and now let them look to their laurels!

The same thing has happened before in many other lines of business. We can name concerns which once were leaders, but which have gone down under the pressure of just such competition as is now threatening the talking-machine industry. Prestige meant little to them so long as they got the business; they felt that their standing was secure because the factory could not keep ahead of its orders. They regarded advertising as a useful means of getting more business, but why advertise when we don't need business?

There is little likelihood that leaders in the talking-machine industry will be deposed, for they have not advertised merely to "get business." Their advertising has represented in large part an investment in good-will—the laying up of a fund of public confidence which could be drawn upon whenever it became necessary. The wisdom of that policy will become more and more apparent as time goes on.—Printer's Ink.

POWER EQUIPMENT

Built to Meet Your Own Requirements



A corner in the Engine Room of our New Power Plant recently erected at our Main South Works. Equipped with G. & McC. Co. Three-Cylinder Compound and Two-Cylinder Compound Vertical Forced Lubrication Steam Engines.

G. & McC. CO. ENGINES and BOILERS

will provide your plant with

A Continuous and Economical Service

WE BUILD

Horizontal and Vertical Steam Engines; Steam Turbines; Return Tubular and Water Tube Boilers; Heaters; Tanks; Pumps and Condensers; Transmission Machinery; Safes, Vaults and Vault Doors.

The advice of our Engineering Experts, our Catalogues, Specifications, Photographs, etc., will be cheerfully supplied to interested parties.

The GOLDIE & McCULLOCH CO., Limited

Head Office and Works: GALT, Ontario, Canada

TORONTO OFFICE: Suite 1101-2, Traders Bank Bldg.

WESTERN BRANCH: 248 McDermott Ave., Winnipeg, Man.

QUEBEC AGENTS: Ross & Greig, 412 St. James St. Montreal, Que.

BRITISH COLUMBIA AGENTS: Robt. Hamilton & Co., Vancouver, B.C.

POWER HOUSE

Refrigeration in the Packing House Industry

Trade Expansion Necessitates Increased Capacity—New Equipment Added Aids in Economical Handling of Packing-house Products

By W. F. SUTHERLAND, Associate Editor

CHANGES and advances consequent upon the demands of the war have taken place in almost every line of activity. This is true of the packing house industry no less than of those industries which one usually associates with the need for munitions.

Armour and Company have recently completed extensive alterations to their Hamilton plant, alterations which have added much to its effectiveness and efficiency in operation. Not only have these two desirable ends been achieved but a city wholesale market has been housed in a new building of attractive appearance, offering every facility for the transacting of city business. The improvements as completed involved reconstruction of part of the existing plant in addition to new buildings and increased refrigerating and power plant capacity. Engineering work in connection with the alterations was done by the Armour Company through their engineer, Mr. J. W. Carnegie.

Plant Description

The entire plant comprises four main buildings consisting of the new wholesale market and general offices, a building for general purposes, and a reconstructed block in which is incorporated a new loading platform or dock which not only provides a means of keeping all meats cool while being loaded into the cars, but which at the same time provides excellent facilities for icing the refrigerator cars used. In addition to the above a new cold storage building has been built which also contains the artificial ice making plant and ice storage.

Wholesale Market

The wholesale market, exterior and interior views of which are shown, contains the general and private offices necessary for the management of the plant, the cooling rooms for the wholesale meat storage, lunch rooms for the office staff and kitchen.

On the ground floor leading from the entrance hall are the general offices, while at the rear are the cooling rooms and at the side a shipping and loading dock. The cooling rooms include a pork cooler, beef cooler, packing rooms and smoked meat room.

The cooling rooms in the market are cooled on the brine system, two lines of 3-inch feed and return pipes being run from the power house. The coolers are held at 35 deg. Fahr. The pork cooler has 6538 cu. ft. capacity and 684 ft. of 2 in. piping, while the beef cooler has 11,170 cu. ft. capacity and 1,188 ft. of 2 in. piping. On the same floor is a general packing room 15 by 60 ft., another packing room 10 by 25 ft., and a storage for smoked meats 15 ft. wide by 25 ft. The packing and smoke rooms are at atmospheric temperature. The shipping dock at the wholesale market is equipped with overhead runways for handling the meat for shipping. The second floor is utilized entirely for general offices, while the third floor contains the lunchroom, smoking room and kitchen for the office staffs and departmental heads.

The wholesale market is connected to the main building by a long overhead viaduct, covered in. This serves as a passageway and is furnished with an overhead runway system for transporting meats to the market. The brine pipes to the wholesale market from the power plant are also carried in this viaduct.

ARMOUR & CO., GENERAL OFFICES AND WHOLESALE MARKET.

New Cold Storage Building

The new cold storage building recently completed is three storeys high with basement. Provision has been made in the strength of the footings, columns and bearing walls for two additional storeys at some future date. In the construction of this building a seven foot brick sewer was encountered in excavating for the footings and several footing had to be built so as to bridge this sewer and carry the load down on each side of it to the soil below and relieving it of all weight.

The basement is used for cooling export products, the first floor is a general storage, the second floor is a cooperage, while the egg storage is on the third floor.

NTERIOR OF COMPRESSOR ROOM, SHOWING WESTINGHOUSE MOTORS BELTED TO COMPRESSORS.

The ice storage and ice making plants are also located on the third floor. The ice storage adjoins the freezing tank and has a capacity of 13,700 cu. ft. This is sufficient to contain 150 tons of artificial ice. Four inch cork insulation supplied by the Armstrong Cork Company and placed by the Union Insulating Company of Chicago insulates the walls, while the floor is provided with 1½ in. mastic flooring and three layers of felt laid by the Johns Manville Co.

The freezing tank, which is operated under the flooded system, is 45 ft. 3 in. by 23 ft. 9 in. by 4 ft. deep. It contains 7,500 ft. of 1¼ in. piping and will hold 360 ice cans, each 11½ in. by 22½ in. by 44 in. deep, each cake of ice weighing 300 lbs. The capacity of the tank is 25 tons of ice daily. A hand operated Euclid travelling crane serves the tank, an electric hoist being provided for handling the cans. Two 20 in. agitators are provided for the tank, these being driven by a 5 H.P. C. G. E. induction motor belt connected.

The cans of ice are conveyed to a shipping tank where they are freed from the containers by hot water and are dropped onto a runway which passes through the ice storage. From this runway the ice may be placed in storage or sent through directly to the chute which carries it to the car icing plant.

The basement has a capacity of 73,675 cu. ft. and contains 3,070 ft. of 2 in. expansion piping. It is maintained at a temperature of about 36 deg. fahr. The egg storage has a capacity of 40,410 cu. ft. and contains 3,367 ft. of 2 in. expansion piping. Fans are installed in the egg storage for the circulation of air, a very necessary feature. All piping in this building was installed by the Vilter Mfg. Company, Milwaukee.

Car Icing and Loading Arrangements

In line with the work done in the building of that portion of the plant just described a loading dock has been built for the loading of all the products under sanitary and efficient conditions. This loading dock at the same time makes provision for the icing of the refrigerator cars used and as the loading platform is shut off from the tracks by heavy doors except when loading a moderate temperature can be maintained, a feature found advantageous in the handling of meats and other cold storage products.

The icing plant is connected to the ice storage by an overhead skid or runway. This enters the dock at the third floor level and the ice entering the dock goes into a Mechanical Manufacturing Company's ice crusher driven by a 20 h.p. the floor to the second floor level where it is received in ice buckets carried on an overhead runway and travelling out over the cars to be iced.

The rock salt used with the ice is unloaded from cars into a hopper and is conveyed to a salt room, adjacent to the crusher, and from which it is spouted into the ice buckets and mixed as required. The arrangement as installed is unusually complete and little manual labor is required for its operation. Five cars can be iced at one time.

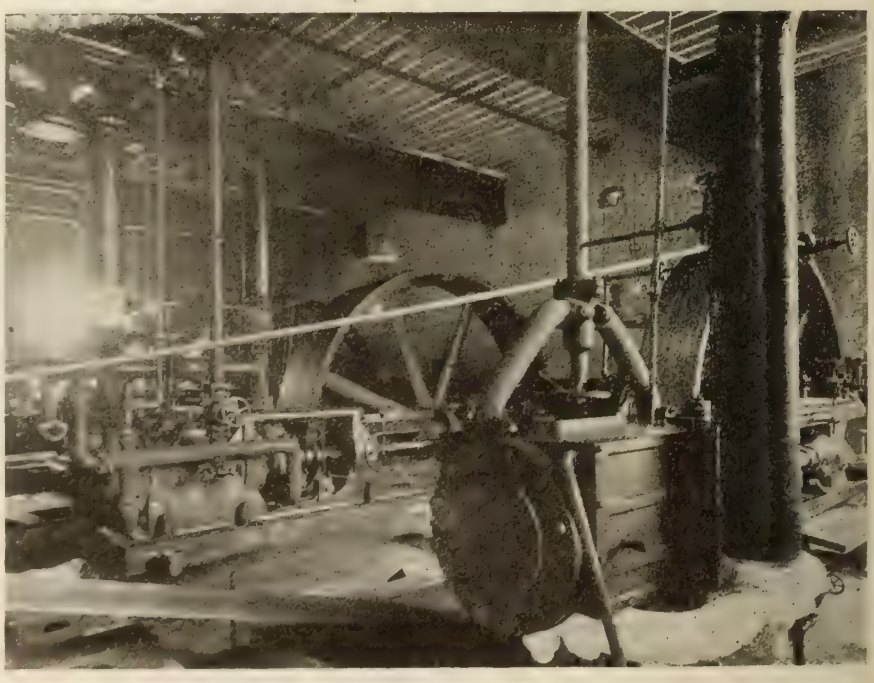
In a plant of this nature unusual attention must be paid to cleanliness and conveniences for the changing of clothing, etc., and the space over the icing platform and adjoining the crusher and salt rooms is given over to toilet and dressing rooms, lockers, showers and other conveniences for the accommodation of 300 men and 100 women.

Reconstructed Cold Storage Building

The reconstructed cold storage building contains three storage freezers and a sharp freezer. No. 1 freezer has a capacity of 13,734 cu. ft. with 2,013 ft. of 2 in. direct expansion piping. No. 2 freezer has a capacity of 12,653 ft. with 1,865 ft. of 2 in. expansion piping. No. 3 has a capacity of 9,826 cu. ft. with 1,580 ft. of 2 in. piping. The sharp freezer has a capacity of 12,373 cu. ft. with 4,179 ft. of 2 in. expansion piping. All the cold storage rooms are fitted with Jamieson doors and are insulated with 4 in. and 2 in. of nonpareil cork covered with plaster. The Union Insulating Co. of Chicago installed the insulation, while the expansion piping was installed by the Canadian Ice Machine Company, Toronto.

Refrigerating Plant

The ammonia compressers necessary for the operation of the refrigerating



COMPRESSAR ROOM, ARMOUR & COMPANY.

INTERIOR OF LOCKER ROOM.

system are installed in a separate building. These machines comprise the following units; one 50-ton Ball machine driven by a 100 h.p. Westinghouse motor; this motor is variable speed and speeds of 72, 64. 56 and 45 revs. per minute can be obtained; one 125-ton Vilter machine, driven by a 225 h.p. Westinghouse motor, having variable speeds similar to the one on the Ball machine; one 75-ton Huterman and Gaemer machine, driven by a 125 h.p. Westinghouse constant speed induction motor.

The resistance necessary for controlling the speeds of the variable speed motors are mounted on a covered platform supported between the power plant and the new refrigerating and ice storage building. This platform being open at the bottom and provided with a ventilator at the top provides a constant circulation of air for the carrying off of the heat generated.

Boiler Plant

As may be gathered from the description of the compressor room the power requirements of the plant are all met by purchased power. This does not do away with the necessity of using steam for many of the packing house processes, cooking, rendering, scalding, etc., and a boiler plant is installed, furnishing steam for these purposes.

The 100 horsepower Robb Engineering boilers are installed in a double setting with hand-fired grates; the boilers are horizontal return tubular and have grate areas of 52.5 sq. ft. A third unit is being installed, steel work, foundations and breeching being provided for an additional unit at a later date.

This third unit is of 125 h.p. capacity and is manufactured by the Casey Hedges Co. of Chattanooga, Tenn.

The feed water pumps are of Deane horizontal duplex type, 6x4x6 in. The pumping installation also includes a brine circulating pump, a booster pump and a centrifugal pump for the condenser. The feed water is heated to an approximate temperature of 210 deg. Fahr by a No. 7 Stillwell heater. A steam pressure of 100 lbs. is carried.

Perhaps the most interesting feature of the boiler plant is the periodical tests which are run at intervals of two months. These tests are quite painstaking and serve as an excellent check on plant performance, a feature which not only is of benefit to the company but is also of value to the country at large in view of the widespread interest and necessity for fuel conservation. The tests are conducted by the engineer in charge, Mr. Eustice, and results are tabulated in the Chicago office and returned together with the results of similar tests in the other plants of Armo and Company. This feature, needless to say, lends considerable interest to the test and furnishes the engineer with an incentive to keep plant performance up to a very high mark.

While the boiler capacity of the Hamilton plant is limited, excellent results are obtained, comparing very favorably with those obtained in the larger plant at Chicago and elsewhere.

The following data obtained from the report of the last test is of interest, being indicative of the general boiler performance.

Bituminous coal of a heat value of 12,375 B.T.U. as weighed was used carrying 14.87 per cent. ash; 644 lbs. coal were used per hour evaporating 5,732 lbs. of water from and at 212 deg. per hour.

The evaporation reduced to a tabulated basis is as follows:

Table No. 1—Evaporation

	Lbs.
Water evaporated actual per lb. fuel as fired	8.13
Water evaporated actual per lb. dry fuel.	8.13
Water evaporated F and A 212 deg. per lb. fuel as fired	8.90
Water evaporated F and A 212 deg. per lb. dry fuel	8.90
Water evaporated F and A 212 deg. per lb. combustible	10.4

In table number 2, given below, the most noticeable feature is the up-take temperature, that of 402 deg. Fahr being maintained as an average during the test.

Table No. 2—Temperatures

Average outside temperature	62
Average inside temperature in boiler room	70
Average temperature up take	402
Average temperature feed water	125
Average temperature steam	336.6
Average temperature of throttling calorimeter	223
Quality of steam	96.6

ARTIFICIAL ICE TANK. STRIPPING ICE TANKS.

CAR ICINB PLANT. VIEW SHOWS ICE CANS RECEIVING ICE FROM CRUSHER.

During each test gas analyses are taken periodically. The samples are drawn from the combustion chambers and the up-take and, as will be noticed, no variation between these samples was obtained, a CO_2 percentage of 13.4 resulting in each case and indicating a tight boiler setting.

Table No. 3—Gas Analysis

1st pass	CO^2	13.4
	O	3.2
	CO	0
Flue	CO^2	13.4
	O	3.2
	CO	0

The heat balance figured from the data obtained during the test showed a boiler efficiency of 69.78 per cent. and a furnace and grate efficiency of 87.90.

ELECTRIC AUTOMATIC ELEVATOR DISPATCHER

By Frank C. Perkins.

THE accompanying illustration shows an automatic novel electric elevator dispatcher, the basic principle of this device being such that it can be used for any duty to be performed at exact and recurring intervals.

In order to keep the elevators moving this machine was designed to aid the elevator starter in his job. The single tap of the bell gives the elevator man his cue to start both from the first floor and from the top on the return trip. It is pointed out that machines always eliminate that human element, which causes railroad wrecks, minimizes efficiency and adds to the petty annoyances of daily business life-fallibility. Nothing distracts the machine from taking care of its job—many things make the human "forget."

The electrical elevator starting machine speeds up the cars, keeps them continuously on the move, and makes possible regular service to all the floors, things every building manager has done his best to accomplish, but which he has never been able to achieve to his complete satisfaction.

It is held that hitherto there has been no known device for the purpose of marking time intervals other than the clock. By this is meant that no device for the performances of a certain duty at stated intervals has been invented except with a clock as the actuating mechanism and even such devices have been limited to individual units. The multiple unit system is primarily a device that has as its purpose the doing away with the uncertainties of the operation of elevators, or rather the starting them by means of human agency, and the substitution therefore of a system entirely automatic in its work.

The prime force of this device is the small motor having an extension shaft with a worm gear at its extremity, which actuates through a train of gears within the square box a large disc. This disc in turn moves the lesser discs, which being on shafts move together. At the end of each lateral shaft is a small commutator contact-piece on which a sliding brush contact plays. At each revolution of this commutator the circuit is broken and a single stroke bell in the elevator shaft, both top and bottom, is sounded.

It is stated that spacing by turning a thumb nut so that the smaller discs are brought either in or out from the periphery of the large disc, with the result that the time elapsing for the run of the elevator from top to bottom of the elevator shaft, or vice versa, may be extended or curtailed as desired. Each of these small discs are independent of the others and may be on different time spacings; but the essential point is that the small discs have been set and the time intervals established, the respective times are absolutely maintained, no variation being possible.

It will be noted that the lower portion of the cabinet contains a motor generator for the lowering of a regular line voltage to voltage required to ring the bells. Bull's eye lights on the front or face of the cabinet light in unison with the ringing of the bells. The advantage of this is that the engineer, in whose room the cabinet is placed, sees the operation of the elevator in effect and can keep a check on the work of the elevator drivers.

It is claimed that the gains of the building managers by the use of this device are many. It provided increased car mileage and acceleration of the movement of the cars by reason of the immutable signaling system established. There is a reduction of the peak load by reason of the fact that cars cannot bunch. No two cars may be at a given point at one time and hence it will be seen that the passengers must be more evenly distributed between the cars. Inasmuch as all charges for electricity and the cost of steam power are based on the maximum demand, it will readily be seen how important this is.

It is maintained that in one building in Chicago in which the device is used, it was found possible almost from its installation to cut the use of pumps

AUTOMATIC ELEVATOR DISPATCHER.

down from two to one, with a consequent saving of coal from $8 to $12 per day. This is a system in which a number of units may be controlled by one centralized moving device in absolute har

Port Colborne, Ont.—The International Nickel Co. of Canada began to treat matte at the new refinery at Port Colborne recently. A large quantity of matte from the Copper Cliff smelter has been shipped to the refinery, and supplies of all kinds are now on hand, and one furnace is in operation.

Genius is the art of taking infinite pains.—Carlyle.

PULVERIZED FUEL COMBUSTION

By Frank C. Perkins.

THE use of pulverized coal is said to make practicable the highest efficiency obtainable in boiler operation. It makes coal burn like a gas, with a flame, the physical and chemical character of which is regulable—a flame that may be elongated or shortened, thus placing the zone of highest temperature where needed; a flame that may be made oxidizing, reducing or neutral, as occasion may require.

The coal is burned as pulverized, thus there is no storage of the powder with its attendant hazard. Artificial drying of the coal is not necessary if the supply be sheltered from rain and snow. Where the pulverizer is used, it is wholly a furnace question whether a dryer should be installed. It is not at all a pulverizing or storage question. The labor is reduced to a minimum and slack coal at low cost yields it last b.t.u.

The pulverizer described herewith approaches the subject of coal burning from the theoretical side, and, therefore, pulverizes the coal to an impalpable powder, and surrounds each of its minute particles with the amount of air which will furnish just the required oxygen. The fineness of the pulverization may be regulated by attention to the dampers which control the movement axially of the air within the machine. If that movement is slow, the centrifugal force keeps all coarse particles at the periphery, and they are drawn from one chamber to the next only as they become reduced to such fineness as to permit the axial current to overcome the centrifugal force, but if the movement axially is rapid, it in part overcomes centrifugal force and draws through the machine a coarser grade of material. The pulverizer utilizes air separation on thoroughly scientific lines. Powdered coal and air in regulable proportions are intimately mixed in the pulverizer, and the mixture reaches the furnace instantly it leaves the pulverizer.

The mixing operation commences at the feed end of the pulverizer, where coal and air enter together and the pulverizing and the mixing go on together until the mixture leaves the pulverizer having the appearance of a cloud of smoke. This impalpable powder, with its theoretical requirement of air, is conducted through a suitable pipe directly from the pulveriser to the furnace. There is no coal pulverized except for instant use. Every minute particle of coal is in the furnace and ablaze within one second from the time it leaves the pulverizer, and within one additional second is completely consumed. In a majority of cases the time is less than one-half a second in each case.

A condition is, therefore, created and maintained, in which each particle of coal is separated from every other particle when it enters the furnace, and no opportunity is offered for the powder to pack or for the particles to adhere one to another, but each particle is enveloped in air and, therefore, in contact with the oxygen necessary for combustion. Thus, this system is emancipated from not only the dryer, but the powdered coal conveyer apparatus, the storage bins, the mixing chambers and the feeding mechanisms with the power units required for the several operations. There is nothing between the coal bunker and the furnace except the pulverizer, its motor, and a plain pipe connection. When the mixture of coal and air reaches the furnace combustion proceeds with great rapidity, with no smoke, no carbon in the ash, no CO in the flue gases, and only a trace of O, and no appreciable excess air is admitted to reduce the temperature of the products of combustion.

There is no opening of doors, no intermittent firing, no banked fires, no delay in meeting a sudden overload. The pulverizer consists of three or more interiorly communicating chamber of successively increasing diameters, in which revolve paddles on arms of correspondingly increasing lengths. The separate chambers are, in fact, separate pulverizers on a single shaft, each succeeding pulverizer having greater diameter and, therefore, greater speed at its periphery and greater power for fine grinding, each receiving and treating the product of the preceding chamber and passing it on to the succeeding chamber for still further reduction.

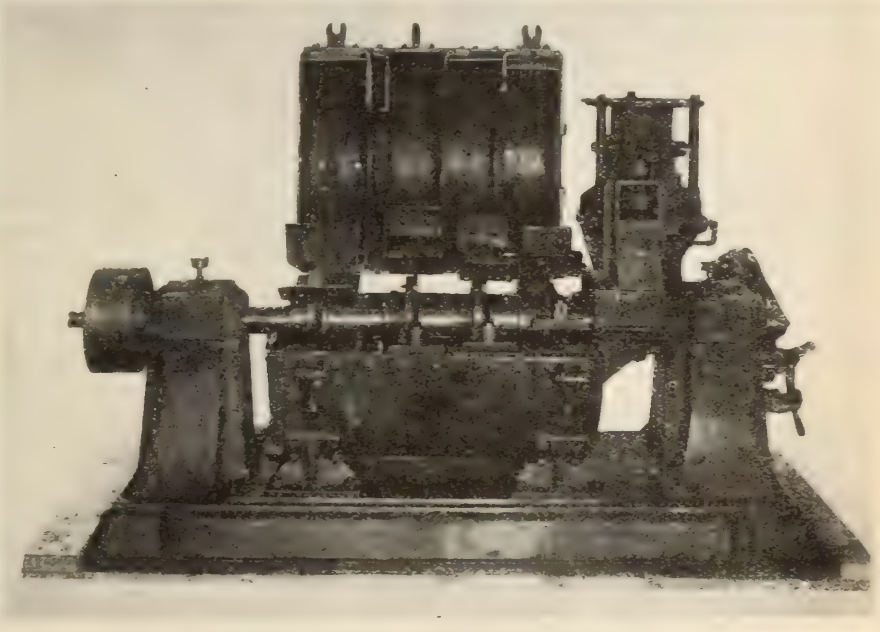
An additional chamber contains a fan, the function of which is to draw the finely pulverized material successively from one chamber to the next, and finally, to deliver it through a pipe connection to the furnace under the impetus of a forced draft. The separate pulverizers and fan are enclosed in one steel cylinder. A regulable feed mechanism accurately controls, and at the will of the operator varies the quantity of coal admitted to and delivered by the machine.

The feed mechanism is exact and uniform in its operation, and is easily adjusted to meet even minute variations in the fuel requirement. Two inlets in the feed mechanism admit the air required for fine grinding. An auxiliary inlet between the last work chamber and the fan, controlled by a damper, admits such additional air as is required for combustion. The air dampers with the feed mechanism give perfect regulation of the flame within a wide range.

Construction

The pulverizer runs at constant speed and the operator's attention and work is limited to observation of his fire and regulation of the feed mechanism. One operator can attend to a number of installations. The pulverizer is dustproof, and is arranged for easy repair to the parts susceptible to wear, the cost of which is small. The paddles, which are subject to the greatest wear, are of cast manganese steel, heat-treated for ductility and to resist abrasion and are reversible. The shaft is of 40 carbon open hearth steel.

The spiders are in one piece, cut from ½-inch steel plate, and are bolted to cast iron hubs with shearing bolts of a size to withstand ordinary strain, but to shear with extraordinary and unusual strains. The linings are of steel plate, and there is a relief opening in the bottom of the first chamber for the automatic removal of any iron or other metal that may accidentally enter the machine.



COAL CRUSHER AND PULVERIZER.

This equipment may be located either in front of the furnace or at either side, or above or below, and may be set with the discharge opening toward the furnace or away from it, or in any intermediate position as convenience may dictate, and the drive may be by belt or by direct connected electric motor. The connection between the pulverizer and the furnace is usually a galvanized iron pipe from the pulverizer discharge to the furnace. No additional feeding or mixing apparatus could serve any useful purpose, for the powdered coal and air are intimately mixed in the pulverizer. The furnace end of the discharge pipe is made of such size and shape as the furnace condition requires

Power Plant Management; Control of Combustion Losses

Economical Use of Coal as Essential to the Winning of the War as is Greater Production at the Mines—Both Tend to Minimize the Coal Shortage

By ROBERT JUNE

IN our prosecution of the war the biggest and most important factor is the coal problem. Some may disagree and claim that it is ships and munitions, but the production of these depends upon coal, and like it or not, we are faced by a very real coal shortage that is bound to limit our output of supplies to a greater or less extent.

I say greater or less extent, because we have an opportunity to overcome much, if not all, of the shortage through the elimination of waste by the institution of better methods of combustion. In order to get at a thorough understanding of our problem let us see what happens when we throw a shovel of coal into the boiler furnace.

The raw materials of combustion, coal and air, are composed of a number of elements which must be taken into consideration in arriving at an understanding of the cause of waste. Coal consists largely of carbon, hydrogen, oxygen, sulphur and earthy material or ash. Air is made up principally of oxygen, nitrogen and water vapor. In the furnace these elements behave in the manner shown in Table I.

TABLE I.

1 Name of Element	2 Chemical Symbol	3 What happens in the furnace.	4 Combines with Oxygen to form	5 Amt. of Oxygen required to burn	6 Amt. of air in lb. required to burn 1 lb.	7 Heat developed by complete burning of 1 lb. in B.T.U.
[illegible]	C	burns	CO-2	2.66	11.57	14,000
[illegible]	H	burns	H-2O	8.0	34.80	62,000
[illegible]	O	doesn't burn	....	....	.....	.....
[illegible]	N	doesn't burn	.....	....	.....	.....
Sulphur	S	burns	SO-2	1.0	4.35	4,050

If carbon and oxygen are brought together at a high temperature, 12 parts of carbon will unite with 32 parts of oxygen to form 44 parts of carbon dioxide, which means that 2 2-3 pounds of oxygen are required to burn 1 pound of carbon dioxide.

Our only source of oxygen is the air, which is composed of 23 per cent. of oxygen and 77 per cent. nitrogen by weight, so that to supply one pound of oxygen to the coal we must use

$$\frac{100}{23} = 4.35 \text{ lbs. of air}$$

$$\frac{77}{23}$$

which includes = 3.35 lbs. of nitrogen.

In order to burn completely one pound of carbon, 2 2-3 pounds of oxygen are required and 3 2-3 pounds of carbon dioxide are formed.

As 3.35 pounds of nitrogen are introduced with every pound of oxygen, it follows that for 2 2-3 pounds of oxygen, 8.92 pounds of nitrogen are used.

The result of burning one pound of pure carbon in air is therefore

3.67 pounds of CO_2
8.92 " " N

12.59 " " flue gases.

As the ash in coal requires no air, and hydrogen is present in but minor quantities, the theoretical amount of air required to burn carbon is approximately that required for the complete combustion of coal—that is 12 pounds of air in a perfect furnace.

In the actual furnace it is necessary to supply more than the theoretical amount of oxygen. The percentage of excess air depends upon the size and character of the coal, kind of furnace and grates, depth of fuel bed, method of firing, draft and other variables. But it may be set down as an axiom that where much over 40 per cent. of air is used for combustion there is something radically wrong.

The cooling effects of various percentages of excess air are indicated in Table II.

TABLE II.

Percentage Excess Air.	Theoretical Temperature of Combustion.	Loss of Temperature due to excess of Air.	Loss expressed in terms of Percentage.	Relative boiler capacity, assuming 40% excess air as normal attainable practice or 100%.
0	5132° F	0	0	....
10	4710	422° F	8.2	....
20	4352	780	15.2	....
30	4044	1088	21.2	....
40	3777	1355	26.4	100%
50	3543	1589	31.00	93.5%
60	3333	1796	35.0	88.2%
70	3152	1979	38.6	83.0%
80	2988	2144	41.4	78.5%
90	2840	2292	46.7	74.5%
100	2705	2927	47.3	70.0%
125	2419	2713	52.9	63.0%
150	2188	2944	57.4	56.6%
175	1997	3133	61.1	51.5%
200	1837	3295	64.2	47.0%

So far as concerns the efficiency of steam production it would make no difference what the temperature of the fire was, or whether 12 pounds or 120 pounds of air were used for each pound of coal, so long as the fuel were completely burned and the boiler surface large enough to absorb all the heat in the gases. If we had an ideally perfect boiler that could absorb heat from gases until they were cooled down to air temperature we would not care how much air had been used to burn the coal, nor what the temperature of the gases was, because all their heat would be absorbed. Unfortunately it is not only impossible but impracticable to build boilers of this kind. Heat cannot be absorbed effectively by a boiler from flue gases which are much cooler than 500 to 600 deg. Fahr. Furthermore, this temperature is usually required to produce the necessary draft, and unless the quantity of gas is kept down to a small volume the draft will be impaired because of the friction loss due to the resistance of fuel, boiler and chimney.

With the actual boiler then, it makes a great deal of difference whether 12 pounds or 120 pounds of air are used to burn one pound of coal. In one case 13 pounds of hot gas are going up the chimney, and in the other case 121 pounds. These hot gases are the chief "waste product" of the boiler plant or steam factory and they constitute the largest item in the total waste of 40 per cent. occurring in the average plant. Evidently the loss due to heat carried away by this waste product is reduced by taking only the minimum amount of air. But just as the factory manager must keep tab on his waste in order to eliminate it, so must the engineer measure the amount of his waste product in order to take steps towards its reduction. The amount of chimney gases per pound of coal is obtained by measuring CO_2 or carbon dioxide; the heat in each pound of these gases is measured by their temperature. We will consider briefly all of the important causes of loss in a boiler plant and point out their extent and, if possible, how each loss may be reduced.

[illegible] This is the third in a series of articles on Mr. June's Power Plant Management [illegible] problems, use of instruments, mechanical stokers, etc. [illegible] and [illegible] management of

Heat Losses in Burning Coal

A boiler, in order to utilize entirely the heat of combustion of the fuel must be free from radiation and leakage losses, the fuel must be completely oxidized and the products of combustion must be discharged at atmospheric temperatures. Commercially such conditions are unobtainable, hence complete utilization of the heat generated is im-

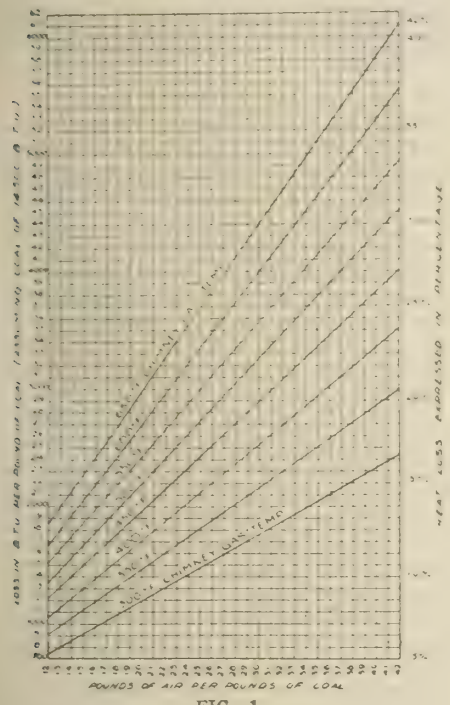


FIG. 1

possible. A boiler which utilizes 83 per cent. of the heat value of the fuel is exceptional and an average figure for very good practice is not far from 77 per cent. The various losses including the heat utilized by the boiler constitute the commercial "heat balance." The losses considered are:

1. Loss in the dry chimney gases.
2. Loss due to incomplete combustion.
3. Loss of fuel through the grate.
4. Superheating the hygroscopic moisture in the air.
5. Moisture in the fuel.
6. Loss due to the presence of hydrogen in the fuel.
7. Unburned fuel carried beyond the combustion chamber in the form of soot or smoke.
8. Radiation and minor losses.

Some of these losses are preventable, others are inherent and cannot be avoided.

Loss in the Dry Chimney Gases

This loss depends upon the type and proportion of the boiler and setting and upon the rate of driving. It is usually the greatest of all losses. The amount of heat carried away under varying conditions is shown graphically in Fig. 1.

It will be noted that the magnitude of this loss depends upon the air dilution and the temperature at which gases are discharged. Flue temperatures less than 450 deg. Fahr. are seldom experienced except in connection with economizers, and as the air dilution is ordinarily well over 40 per cent., the loss from this cause may range from 8 to 40 per cent. of the total heat generated.

The amount of this loss can be cut down by reducing the weight of the heat-bearing gases, by only admitting to the furnace the minimum practical amount of air, by preventing leaks in the furnace setting, and by reducing the temperature of the gases by keeping the fire surfaces of the boiler clean through the use of mechanical soot blowers.

CO_2 analysis apparatus is invaluable in determining this loss and furnishing a basis on which to lessen it.

Loss Due to Incomplete Combustion

If the volatile gases are not completely oxidized as when the air supply is insufficient or the mixture of air and gases is not thorough, some of the carbon may escape as CO_2. Some of the hydrocarbons may also pass through the furnace without being burned. The presence of even a small amount of CO_2 in the flue gas is indicative of appreciable loss, as will be seen from Fig. II.

If the furnace is properly designed these losses may be reduced to an almost negligible quantity by careful operation. With a good and even fire bed having a thickness suited to the effective draft, only traces of CO, hydrogen, etc., should be found. If the losses exceed 2 per cent. there is something wrong and pains should be taken to find out whether the trouble is due to poor design or careless firing, so that it can be eliminated.

Loss of Fuel Through Grate

In average practice the unconsumed carbon found in the ash pit ranges from 15 to 50 per cent. of the total weight of dry refuse, depending upon the size and quality of coal, type of grate and rate of driving. This loss of fuel runs from 1.5 to 10 per cent. or more of the total heating value. Although various attempts have been made to assign an average percentage to this loss they have been without result or value. Numerous tests of recent mechanical stoker installations have indicated losses ranging from 1.5 to 5 per cent. of the heat value of the coal at normal driving rates.

This loss can and should be reduced by proportioning the grate openings to suit the size of coal burned, careful handling of the fire, and, when practicable, the substitution of free burning for caking coals.

Less Due to Superheating Moisture in Air

This loss is in the main a minor one, ranging from 0.2 to 0.4 per cent., except on hot, humid days or at plants located at points of excessive rainfall or near the seacoast. As it cannot be controlled, except as excess of air is controlled, it is not discussed further.

Loss Due to Moisture in Fuel

Moisture in the fuel represents an appreciable loss in economy if present in large quantities, since the heat necessary to evaporate it into superheated steam at chimney temperature is lost. Firemen occasionally wet coal to assist coking or reduce dust, but moisture thus added necessarily reduces the theoretical furnace efficiency.

Under certain conditions wet coal may give a higher evaporation than dry coal, that is through a purely mechanical action the moisture may assist in packing the coal, thus reducing the loss through the grate, or in cases of thin fires, reduce air excess. The occasions when the application of the hose to the coal pile is warranted are of limited frequency, however, and firemen should be under strict instructions never to apply water without the specific consent of the boiler-room foreman.

It follows from what has been said, that coal known to be high in moisture content should not be purchased without adjustment of price to compensate for lowered efficiency.

Losses Due to Presence of Hydrogen in the Fuel

That part of the hydrogen in fuel, which is in a free state burns to water, and in so doing liberates 62,000 B.T.U. per pound. Unfortunately all of this heat does not become available for producing steam since the water formed by combustion is discharged by the flue gases as superheated steam at chimney temperature. This loss is inherent. With anthracite it approximates 2.5 per cent. of the heating value, and with bituminous, 4.5 per cent.

Loss Due to Visible Smoke

The loss due to smoke is very visible, but it cannot be weighed or measured and is generally over-estimated. Smoke consists of carbon in a flocculent state and ash mixed with the products of combustion.

The losses due to visible smoke seldom exceed one per cent. It must be remem-

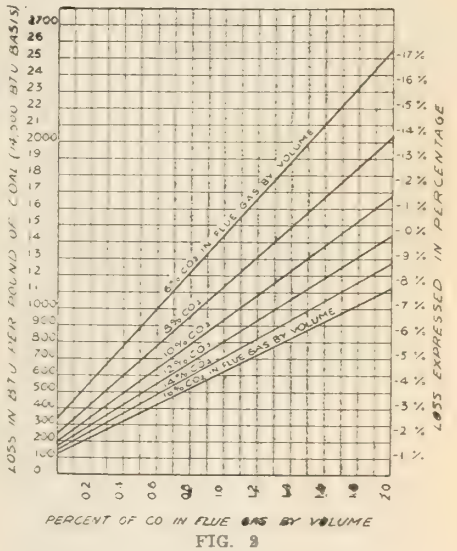


FIG. 2

bered in considering this loss that a smoky chimney does not necessarily indicate an inefficient furnace. Paradoxical as it seems, a smoky chimney may be much more efficient than one which is smokeless. That is, a furnace operating with minimum air supply may cause dense clouds of smoke and still give a higher evaporation than one made smokeless by a large excess of air.

There will, of course, be some loss due to carbon monoxide, unburned hydrocarbons, and combustible in soot in the former case, but this may be more than offset by the excessive losses caused by the heat carried away in the chimney gases in the latter. The amount of combustible in the soot and cinders deposited upon the tubes and in various parts of the setting seldom exceeds one per cent. of the calorific value of the fuel.

Radiation and Unaccounted-For Losses

These losses are determined by simple arithmetic, being the difference between the sum of the heat represented in the steam and the losses previously mentioned, subtracted from the 100 per cent. total heating value in the fuel. Consequently, unless careful attention is given to accuracy of determination of other losses the figures arrived at for this loss will be in error.

Radiation losses should not, and as a matter of fact do not, exceed 2 per cent. with well designed, well insulated boiler furnaces. On the contrary, with poorly installed settings where insulation is not properly attended to radiation losses may amount to as much as 6 to 8 per cent.

It is undoubtedly true that this loss equals a full 4 to 6 per cent. in the average plant and that it could be cut squarely in two with a comparatively small expenditure for insulating materials.

Heat Balance

The sum of all the losses and the heat absorbed by the boiler when distributed in a table or on a graph gives us the best balance. As the operating engineer, when searching out means for the elimination of losses is concerned with "coal as fired," any general representative heat balance, such as is shown in Table III. is of value for purposes of relative but not absolute comparison.

TABLE III.

Heat absorbed and losses itemized	Highest attain. efficiency Per cent.	Excellent Practice of calorific value	Good Practice	Average Practice of coal	Poor Practice as fired
Heat absorbed by boiler	89.86	80.0	75.0	65.0	60.0
Loss due to free moisture on coal	0.50	0.5	0.6	0.6	0.7
Loss due to hydrogen in coal (evaporated by H_2O)	4.20	4.2	4.3	4.3	4.4
Loss due to heat in dry flue gases	5.33	10.0	13.0	17.5	20.0
Loss due to carbon monoxide	0.00	0.2	0.3	0.5	1.0
Loss due to combustible in ash and refuse	0.00	1.5	2.4	4.5	5.5
Loss due to heating moisture in air	0.11	0.2	0.2	0.3	0.4
Loss due to unconsumed hydrogen, hydrocarbons, radiation and unaccounted for	0.00	3.4	4.2	7.3	8.0
Calorific value of coal	100%	100%	100%	100%	100%

The losses which we have been considering cover operation of the boiler at normal or high rating. In addition there are other important sources of loss in operation, such as standby losses, blow-off losses, losses due to leaky traps, valves, etc. These will all be discussed later. In our next paper we will take up in greater detail the determination and control of operating losses through the use of instruments.

Nothing is impossible to the man who can will.—Mirabeau.

RELATION OF EFFICIENCY TO BOILER ROOM CAPACITY

IN a recent paper before the American Society of Mechanical Engineers, by Victor B. Phillips, of the Cleveland Railway Co., steam boiler units were considered in relation to each of their two elements—the furnace or heat liberator, and the boiler or heat absorber, the former being the means whereby the chemical energy of coal or other fuel is transformed into sensible heat energy. The function of the furnace is chemical reaction between the combustible fuel and the oxygen of the air. As such it is governed by three factors:—1—Amount of air. 2—Degree of air mixture. 3—time. These three factors together govern the rate of combustion, the completeness of combustion and the resultant temperature of the latter; in a word, they completely determine the nature of combustion.

The boiler is a means whereby the heat liberated in the furnace is absorbed and transferred to the water. Its function is heat transmission, and it is governed by the laws expressing the several modes of heat transmission—conduction, convection and radiation. It is evident that the factors which govern combustion likewise govern very largely the heat transmission of the boiler, by the regulation of temperature and amounts of gas. Hence it follows that in the end the performance of the entire boiler unit may be expressed in terms of a number of factors over which the fireman either does or should be able to exercise proper control.

It is desirable so to define furnace furnace efficiency and boiler efficiency that their product will be the overall efficiency of the unit. To this end boiler efficiency is taken as the ratio of heat absorbed to the heat available for absorption, i.e.,

$$Eb = \frac{\text{heat in steam}}{\text{heat in steam and sensible heat in flue gas}}$$

Furnace efficiency is defined as the ratio of heat available for absorption by the boiler to the heat in the coal, i.e.,

$$Ef = \frac{\text{heat in steam and sensible heat in flue gas}}{\text{heat in coal}}$$

and

$$E \text{ (overall efficiency)} = Ef \times Eb$$

This method arbitrarily charges against the furnace all losses through the setting, such as radiation and leakage. Most of these losses do occur in the setting around the furnace, and so this arbitrary classification is reasonable. It also charges against the furnace the loss in latent heat in the vapor of the discharged flue gases.

The Furnace

The ideal furnace for any form of fuel is one in which the three factors of combustion already mentioned—amount and admixture of air, and time for completion of combustion, may be regulated independently. This furnace would have wide limits of efficient operation wherein it would be possible to attain at once both efficiency and capacity. Unfortunately the present status of the art, particularly with regard to coal burning furnaces, falls far below this ideal.

The most important methods of firing coal employ the chain grate and the underfeed and overfeed gravity stokers. In each of these cases the time of transit of coal decreases with increase of load, and is not subject to independent regulation, and also it is impossible to regulate independently the amount and admixture of air. The factors of air supply are controlled together by the amount of draft or pressure and by the condition of the fuel bed. These several inflexibilities are inherent in the present status of the art. They are serious disadvantages which may be reduced, however, by introducing in other ways a large degree of flexibility.

Since regulation of the time element by regulation of grate surface seems to be impracticable, the problem of furnace operation becomes simply the problem of the air supply, not merely over the fuel bed as a whole, but in its several parts separately. That flexibility of air supply will to some extent compensate for inflexibility in time of transit, may be illustrated by any of the underfeed gravity stokers. The grate areas of these stokers have been proportioned to give the proper time element for rated capacity.

For example, take the case of the Taylor stoker used in the equipment of the Cleveland Railway Co. plant which the writer tested. When the capacity is increased, the air supply on the lower or coking grates cannot be increased enough to burn the coal as fast as it is received from the upper grates. The result is a piling up of coke and ash on the dump and extension grates, causing not only a large loss from carbon monoxide and coke to the ash pit, but perhaps serious clinker difficulties. A variable grate surface would eliminate this trouble. It could, however, be largely mitigated by flexible and independent air control for this section of the fuel bed.

Fundamental Factors of Furnace Operation

The operating variables of the furnace

are simply the variables governing air supply. They are: (1)—Thickness of fuel bed; (2)—condition of fuel bed; and (3)—pressure drop through fuel bed. These variables may be regulated differently in different parts of the furnace, but they are in all events the fundamental factors involved. They determine efficiency and capacity. In order to operate a furnace properly, the inter-relations between efficiency and capacity and the foregoing variables must be established.

The validity of this principle has not been generally realized. Instruments for the indication of certain variables have been extensively used; yet, either the number of instruments or the amount of rational interpretation has been insufficeint. It is only in very special and limited cases that efficiency or capacity is indicated by a single variable factor such as carbon dioxide or flue temperature.

Having defined the fundamental factors of operation, it now remains to select means of indicating these quantities to the fireman. The means of indication necessarily vary for different types of stokers and furnaces. With a chain grate the thickness of fuel bed may be readily measured and adjusted, and its condition is for the most part uniform. The draft in the combustion chamber constitutes the pressure drop through the fuel bed. Thus the chain grate readily lends itself to this system, and it is a simple matter to determine by tests the relation of furnace efficiency and capacity to the operating variables. In fact, the limits of expedient and efficient operation with the chain grate are not only narrow, but readily apparent. This is a salient feature of this type of stoker. On the other hand, the forced-draft underfeed stoker is not by any means so simple, and here intelligent control is not only effective, but essential. In this case the thickness of fuel bed cannot be directly measured, nor is its uniformity so much a matter of course.

The point of primary importance is the amount of air pushed through the fuel bed and the intimacy with which it is mixed with the volatile matter forming in the lower layers of green coal and the coke of the upper layers. Roughly speaking, this intimacy increases with the resistance to air flow. It is the condition and thickness of the fuel bed that determines both the amount and admixture of air. The pressure necessary to force up a certain quantity of air is both a simple and an effective indication of the mean condition and thickness of the fuel bed; in other words, an air-pressure gauge and an air meter indicate the thickness of bed. In stokers of sufficient size to warrant the use of two air ducts, it is necessary to duplicate the air-measuring apparatus. By proper arrangement of the means of indication it now becomes possible to gauge the uniformity of the fuel bed by comparing the air indications to the two halves. Thus all the conditions governing air supply may be readily measured, and indicated to the fireman. In order, of course, that he may make proper use of these indications they must be related to the objects sought—efficiency and capacity.

The Boiler

The furnace produces heat which is available for absorption in the form of radiant energy and of hot gases—that is, the heat generated in the incandescent fuel bed is transmitted to the boiler surfaces by radiation and by convestion. It is then transmitted from the outer to the inner surfaces and to the water by conduction. The boiler employs, therefore, all three modes of heat transmission, and the variables of operation are those determining the effectiveness of each of these three modes. These variables are: (1)—Temperature; (2)—condition of surfaces; and (3)—gas velocity. Temperature is the predominant variable; it affects all three modes of transfer, in each case a temperature gradient being necessary. The condition of surfaces affects principally two modes of transmission — convection and conduction; while gas velocity affects simply convection.

It is evident that the factors governing furnace operation also determine the variables of boiler operation. The gas passing through the boiler is simply the air of combustion plus the weight of gasified coal (corrected, if necessary, for infiltration). The temperatures in the boiler are governed by the combustion conditions in the furnace. Hence, overall boiler efficiency and capacity are to be expressed simply in terms of the furnace variables—thickness of fuel bed and pressure drop through fuel bed. The function of flue temperature is simply a check upon the condition of the heating surfaces. A combined boiler-unit-operation chart brings out the essential importance of the variable factors which have been selected as determining performance. It supplies the information whereby the firemen may operate with maximum efficiency for each different load. It establishes the relation between efficiency and economy wherewith the economic policy of the boiler room may rationally be planned. Lastly, a study of such a chart and of the reasons for its characteristics becomes a sound basis for improvement in design.

EFFICIENCY IN REFRIGERATION

By M. M.

Real efficiency, about which we hear so much nowadays, consists merely in attaining a certain predetermined result by the easiest, quickest and best method. For many years aboard ship the commissary was somewhat of a secondary consideration; in fact, on some vessels the scale dropped even lower, but in any event it was never considered a serious problem. Careful investigation has, however, proved that men do better work, stick by the ship better, and are generally more useful in every respect if they are given plain, nourishing food that has been kept in first-class shape under ideal or, at least, sanitary conditions. In order to maintain such in the food compartments a refrigerating machine or, as it is most generally spoken of, an "ice machine" is essential.

To prove this to your satisfaction, it is only necessary to visit a ship immediately upon her return from an extended trip and look at the interior of the ice box. You will find on the floor racks about one-half ton of ice or less mixed up with various meats of various kinds in different stages of health—some of them comparatively healthy and some of them rather under the weather. You will also probably find a few very much dilapidated fowls that are away off color and very soggy. This is not first-class grub, and the commissary departments are beginning to realize it, so that gradually the various boats of all kinds—freighters, tankers, passenger ships, tugs, etc., are being equipped with ice machines.

When you enter the freezing compartment of a mechanically-cooled box you will find a temperature of two to ten points below freezing point, the air crisp and clear; there are no disagreeable odors, the meat and the poultry are firmly frozen, and thereby immune to deterioration for a long period. This is the theoretical side of the question. Now to come right down to earth and talk about the most important phase of the whole subject, which is the "dollar and cents" side. On one line of steamers, where a very careful record is kept of the "per meal" cost, the actual saving per meal by mechanical refrigeration with a well known system over the old style of ice method of cooling was 3½ cents.

This freighter had thirty men aboard, which at 3½ cents showed a saving of $1.05 per meal, $3.15 per day, or $1,149.75 a year. The plant on their boat cost in the neighborhood of $2,000, so that the outfit was paid for in two years. This is an actual saving when all costs of operation against cost of ice, etc., are taken into consideration. In some cases the saving might be less; in some it might very well be more. The above is cited as an instance to show that in addition to the improved sanitary conditions that are obtained by mechanical refrigeration there is an actual saving in money. Another point in favor of mechanical refrigeration is that whatever you buy in the way of supplies is fully used. Meat with a system installed in a vessel can be carried to the Orient and back in first-class shape, but a ship is lucky that can carry meat half-way across the Red Sea where ice is used as a refrigerant.

THE SCOTCH OF IT

Two old Scotsmen sat by the roadside, talking and puffing away merrily at their pipes.

'There's no muckle pleasure in smokin', Sandy," said Donald.

"Ho dae ye mak' that oot?" questioned Sandy.

"Weel," said Donald, "ye see, if ye're smokin' yer ain bacca ye're thinkin' o' the awfu' expense, an' if ye're smokin' some ither body's, yer pipe's ramm't sae tight it winna draw."—Tit-Bits.

Electricity and Hydraulics

PRINCIPLES AND OPERATION OF MODERN ELECTRICAL EQUIPMENT. VII

By A. M. PERE

THE field magnets of a generator serve to generate the magnetic flux and to properly distribute it through the armature core. Three types or varieties of windings for the field magnets of direct current machines are in common use; shunt, series and compound, the latter being a combination of the other two.

The shunt winding, as one will notice if a field magnet of this type be examined, is composed of a large number of turns of fine wire, the end terminals of the series of coils being connected to brushes of opposite polarity. In consequence the whole voltage generated by the machine is available for sending current through the field magnets. Fig. 1 shows the shunt wound dynamo connections.

Shunt wound dynamos find considerable use in storage battery charging, being the only suitable form for the purpose, and also for many other uses for large machines generating power for industrial or lighting purposes the compound wound machine is used, as will be explained later.

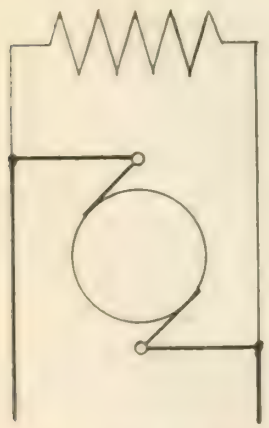


FIG. 1—DIAGRAM OF SHUNT WOUND MACHINE

As in all dynamo-electric machinery the generation of current is first started by the action of a certain amount of residual magnetism present in the field magnets, no matter how soft the iron. This generates extremely weak currents which, however small, are available for use in the shunt fields and thus strengthen the magnetism. The increased magnetism generates a greater voltage and renders available in consequence a still larger current and the voltage builds up to a value fixed by the characteristics of the machine. Fig. 2 shows the voltage characteristic curve for a shunt wound dynamo. If the field rheostat of the dynamo is not adjusted as the current supplied by the dynamo is increased the voltage falls only a little at first, but afterwards more rapidly until the point c along the curve is reached. For the dynamo considered the terminal volts are 120 at no load and only 100 when 50 amperes flow. The remaining part of the curve to d is of no practical interest beyond showing the fact that it is impossible to overload a shunt wound dynamo by short-circuiting the leads. No more current will flow on a dead short circuit than is indicated by od, in this case about 12 amperes. This is explained since the armature is short-circuited no current flows in the fields and the only current generated is that due to the residual magnetism present in the fields.

A dynamo designed so that the drop along the line a b c is slight would be nearly a constant potential machine. If the load changes gradually the voltage can be maintained at a constant value by hand manipulation of the field rheostat, the man in charge cutting out resistance and allowing more current to flow and thereby raising the voltage sufficiently.

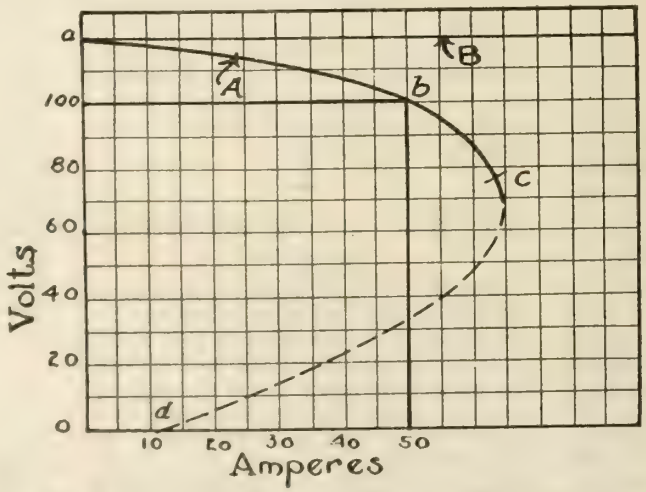


FIG. 2 CHARACTERISTIC CURVES FOR SHUNT WOUND MACHINE.

Series Generator

The series generator is arranged in an entirely different manner to the shunt wound machine. By reference to Fig. 3 it is seen that the whole current generated by the armature is used in energizing the field magnets, a comparatively few turns of heavy wire sufficing. Two machines of similar design and of the same size, one series and one shunt wound, will require the same magnetic flux in the fields under similar conditions and the ampere turns for the series wound machine would be found to be the same as those for the shunt wound to produce an equal amount of magnetism. The series wound generator cannot build up voltage unless it is connected to an external load, as there is no current flowing through the fields and any voltage generated is due to residual magnetism only. Consequently the no load voltage of the series machine is zero as compared to the shunt machine, whose voltage under similar conditions is at its greatest value.

It may be remarked that the series wound generator is very seldom met with in practice although the series motor is an extremely useful type and one used very largely where large starting torque and variable speed are required.

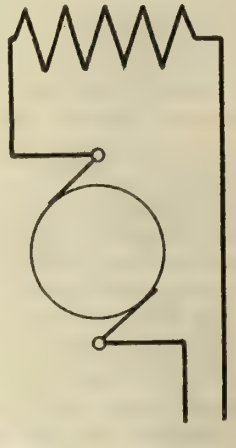


FIG. 3—DIAGRAM OF SERIES WOUND MACHINE

The Compound Wound Machine

The compound wound generator or motor is the most largely used type and it owes its popularity through the ability of the designer to control its characteristics to meet any requirement usually found in practice. The interpole type of

machine will be taken up in a later section of the course.

The compound wound dynamo or motor has both a shunt and a series field winding. As the current supplied by the generator to the external circuit increases the current through the series field increases and thus strengthens the magnetic flux and this increase in field strength automatically raises the e m f generated. If this increase is just enough to balance the drop which would be caused in a shunt wound machine the voltage will remain constant in value and would have a value represented by the line aB, Fig. 2.

The amount of this compounding effect of the series winding can be regulated so that the voltage will drop, remain stationary or rise, with increasing load. A generator in which the voltage drops is said to be under-compounded, one in which the voltage remains stationary is said to be compounded flat, and one in which the voltage rises is said to be over-compounded. An over-compounded dynamo is of use where power is to be delivered at the end of a transmission line, the extra rise in voltage automatically compensating for the line drop and keeping the terminal voltage constant. It is possible to regulate the compounding effect of a generator by means of a resistance shunted across the series field of the generator and in effect by passing a certain desired amount of the current around the series field.

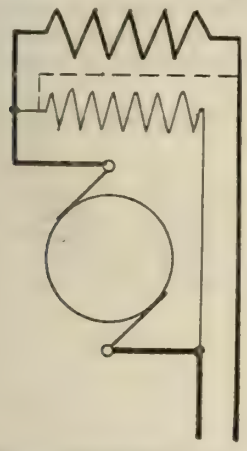


FIG. 4—DIAGRAM ILLUSTRATING CONNECTIONS FOR COMPOUND WOUND GENERATOR

Compound Wound Motor

It is readily surmised that the shunt and series windings of a machine may either assist or oppose each other, according to the way in which they are connected up. If they assist each other the machine is said to be cumulative wound and if they oppose each other the machine is said to be differential wound In the case of the cumulative compound motor the strength of the magnetic field increases with an increase of current in the series field since both fields act together and the series field counteracts the weakening of the shunt field.

It is a well known fact that a generator operates equally well as a motor and it is sometimes of use to know what changes would be necessary if it be desired to make this change. The direction in which a direct current generator will operate when it is changed to a motor may be quite easily determined.

It is well to remember that in the dynamo the armature conductors are pushed by the mechanical force applied from outside in a direction opposite to that in which they would go in a motor if the current in each case had the same direction. With this in mind, then, if the direction of the armature current and the direction of the magnetic flux through the magnetic circuit of the machine both remain unchanged, or if both are changed when the machine is changed from a generator or a motor, the direction of rotation will be reversed.

If either one of the above directions be changed and the other remain the same the direction of rotation will remain the same.

To reverse the direction of rotation of a motor either the direction of the armature current or of the magnetic flux must be changed, but not both.

If a shunt generator be changed to a motor it will run in the same direction as before, no matter which way the current enters or leaves it, for, if the polarity remains the same the direction of the shunt field will remain the same while the armature current reverses in direction, and if the polarity be changed the shunt field will be reversed, while the armature current will remain the same.

This leads to the general statement that a shunt generator when changed to a motor will operate in the same direction, regardless of the polarity of its terminals, if no change in connections has been made.

If a series generator be changed to a motor it will reverse in direction, for if the polarity is kept the same both armature and field currents will be changed and if the polarity is changed the armature and field currents will BOTH remain as they were.

The cumulative compound generator presents a slightly more difficult problem when changed over to a motor, for it will combine the characteristics of both shunt and series motors and will become a differential compound motor. Likewise if the machine is a differential compound generator it will become a cumulative compound motor. The direction of rotation of such a machine will depend upon the relative strengths of the two fields. For example a differential compound motor may start up under the influence of the series winding and after the shunt field current has had time to build up in value, the armature may stop and start to rotate in the opposite direction.

Next month's section will go into these relations more fully and will be illustrated with diagrams showing the various arrangements that are possible.

Answers to Last Month's Problems

1. Cores of armatures are built up of thin sheets or laminations to prevent the formation of eddy-currents in the iron of the armature. These eddy-currents if formed would be a source of considerable loss of power and would generate considerable heat.

2. Two general methods of winding direct current armatures are in common use, the lap winding and the wave winding.

3. Consult last month's course for the answer to this question.

4. In the lap winding as many brushes are required as there are poles to the field magnets. In the wave winding only two brushes are required.

This Month's Problems

1. What are the common methods of winding the field-magnets of direct current generators and motors?

2. What is the difference between these methods?

3. Is it possible to overload the shunt wound generator?

4. Will a shunt wound generator run as a motor without reversing ?

5. Will a series wound generator run as a motor without reversing?

NEW PROCESS OF TUNGSTEN FILAMANUFACTURE

A NEW German process for making lamp filaments of tungsten involves forming the lamp filament out of one long crystal. It is impossible, according to the "Electrician" to make tungsten crystals form gradually out of a mixture of tungsten powder and thorium oxide. The mixture is squirted through diamond dies into a filament of 0.02 m.m. to 1 m.m. diameter. This filament is then drawn through a chamber in which it is rapidly heated to a temperature of 2,400 deg. C. to 2,600 deg. C., and with a velocity of about 2.5 miles per hour, which is rather slower than the crystallization velocity of tungsten, so that a single crystal of indefinite length is formed. The chamber is filled with a neutral gas, and the heating is performed in two stages by a pair of electrically-heated coils, through the centre of which the filament is passed. The filament in this state is ready for use in a lamp without further treatment. It is softer than drawn tungsten wire at low temperatures and hard at high temperatures, which makes it particularly suitable for use in lamps. Filaments consisting of a single crystal of 25m. length have been produced in this manner.

Canadian Agents.—Jones and Glassco of Montreal have just been appointed Canadian Agents for the Lamson Co. of Boston, Mass. They are one of the largest manufacturers in the world of pneumatic tube carriers, and also manufacture gravity carriers and belt and chain conveyors.

Turbo-Alternator Rotors: Features of Mechanical Design-I.

A Review of the Conditions Underlying the Mechanical Design of the High-speed Alternator Rotor—Suggested Specifications For Guidance in Purchasing Equipment

By S. F. BARCLAY, Ph.D., B.Sc.

THE history of the development of the alternator for direct coupling to high-speed steam turbines is very similar to that connected with the evolution of other outstanding features of modern machinery. In dealing with the subject of rotor design before the Institution of Electrical Engineers, London, Eng., recently, the author pointed out that old construction had been applied to meet new conditions, and as failures developed improvements had been introduced to overcome them. The process is lengthy and wasteful, but essentially natural.

Features of Early Design

The outstanding feature of the earlier electrical machinery was the disregard of mechanical soundness. Reliance was placed on string and tape in an astonishing degree. Nothing has led to the development of electrical machinery from the mechanical point of view more than making alternators suitable for direct coupling to high-speed steam turbines. With the advent of peripheral speeds of over 4½ miles per minute the unsound construction of earlier times has disappeared, and the modern turbo-alternator rotor is not surpassed as a high-class engineering production.

The need for the use of material of the highest grade is obvious when it is recalled that at the periphery of a 31-in. diameter rotor running at 3,600 r.p.m. a mass of 1 lb. exerts a centrifugal force of 2½ tons, and in the case of a 5,000 kw. alternator at 3,000 r.p.m. the total centrifugal force at the normal running speed is about 15,000 tons. The kinetic energy of such a rotor at the normal running speed is about 7,000 foot tons—

FIG. 1

5,000 kw. 3,000 rev. per min. alternator with 31 in. diam. rotor. Curves showing the much lower bursting stress in a solid as compared with a laminated rotor of the same diameter. Stress calculated at 20 per cent. above normal speed.

equal to the muzzle energy of 23 75-mm. field guns, and sufficient to hurl 380 lb. of steel a distance of 6 miles.

It is clear that eliminating weakness of construction by the lessons of failure is not a permissible policy with such machinery. The precise nature of the duty at the various parts of the rotor must be thoroughly investigated, the material employed must be of the highest grade, and the factor of safety must have satisfactory value.

Severity of Conditions

The conditions to be faced are most severe, and the author doubts if they are sufficiently well realized by either user or maker. Even with the smaller sizes of high-speed machines that marked the progress of a few years ago mechanical failures were not unknown, and the author is of the opinion that with the machines for large outputs at from 1,500 to 3,600 r.p.m., such as are being made to-day, mechanical failures must result unless greater attention is paid to the excellence of design and of material.

It is somewhat remarkable that the specifications drawn up by consulting engineers make little attempt to ensure mechanical excellence, although the electrical performance is usually very fully stipulated. Occasionally one notices in specifications that the engineer has some uneasiness with regard to the mechanical performance and endeavors to safeguard his client's interests by specifying the tensile qualities of the rotor steel and by calling for an unusually high overspeed test, but one never sees stimulated the all-essential permissible ratio between the stress and the quality of the material in the direction of the stress.

For instance ,it is not sufficient to test the tensile qualities of the steel in an axial direction at the end of the shaft when the maximum stress is in the body of the rotor in a radial direction; nor is it logical to display concern in the quality of the material and disregard the complementary factor—intensity of stress. It will be shown later that an excessive overspeed test is on the one hand undesirable, and on the other does not necessarily establish mechanical soundness.

Comparison of the Solid and the Laminated Rotor

Even up to a few years ago the controversy as to the relative merits of the salient-pole rotor and of the cylindrical rotor still flourished, but with the advent of large outputs at high speeds the former type has now disappeared. There still remains, however, some discussion as to the advantages of the solid as compared with the laminated rotor. From the electrical point of view, for polyphase work there is no essential difference. For a given design theoretical considerations would indicate that the maximum momentary short-circuit current would be less with the laminated than with the solid rotor, for the same reason that there is a greater resistance to the flow of the rotor eddy-currents at the moment of short-circuit, on the creation

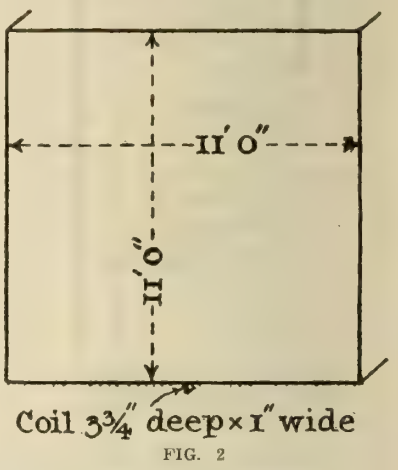


FIG. 2

of which depends the momentary loss of the stator self-induction. Since, however, the alternator with a solid rotor can quite well be designed to stand short-circuit at the terminals without damage, this property of the laminated rotor is without practical value.

On the other hand, the better electrical contact that is established between the slot wedges with the solid rotor causes the rotor to constitute a more effective damping winding and so gives greater electrical stability. With an unbalanced load there is less heating with a laminated than with a solid core, but again this quality is usually of no advantage, since by exercising certain obvious precautions the solid rotor can be employed successfully with any degree of unbalanced load that occurs in practice.

In a normal turbo-alternator the output is limited by the rotor heating, and it is obviously a great advantage of the solid rotor that the ventilating channels can be arranged to secure the best cooling effect, whereas with the laminated rotor they have to be provided where mechanical considerations permit.

Weakness of Laminated Rotor

The essential weakness of the laminated rotor is the presence of the central hole through which the shaft passes. On account of the thickness of the metal between the bottom of the slot and the

inner bore being comparable in magnitude with the diameter of the bore, the maximum stress exceeds considerably the average stress, and the design becomes

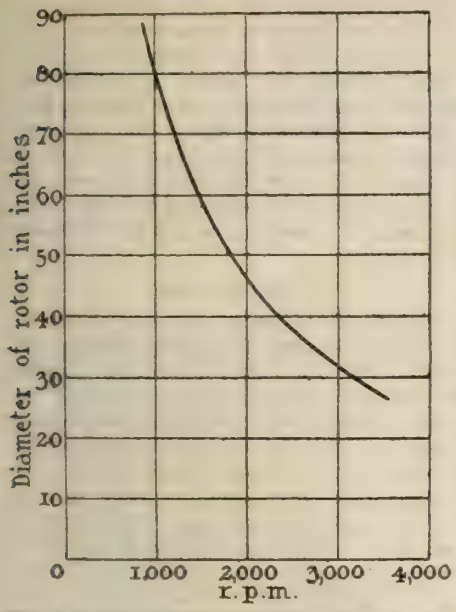


FIG. 3—RELATIONSHIP BETWEEN MAXIMUM RUNNING SPEED AND MAXIMUM DESIRABLE ROTOR DIAMETER.

limited by the stress at the inner periphery.

As an example, with a 3,500 kw. alternator at 3,000 r.p.m. the maximum stress on the inner fibres exceeds the average stress across the belt of metal by about 20 per cent. In addition to the stress caused by the centrifugal force, there is to be considered the stress due to the shrinkage fit of the stampings on the shaft. To ensure that the core shall remain tight on the shaft when running at the overspeed, the amount of the shrinkage must exceed the amount by which the core opens due to the centrifugal force.

Thus in the case being considered the shaft diameter would be about 12 inches, and at the overspeed of 3,600 r.p.m. the inner bore would increase about 0.018 inch in diameter. Making allowance for normal tolerances in workmanship, the shrinkage would need to be not less than 0.02 inch to ensure that the core shall always remain tight on the shaft. This requirement for mechanical soundness gives an appreciable increase to the stress of core discs. Just at this part of the core disc where the stress is a maximum the strength is very considerably reduced by the keyway cut into the lamination. The weakness could be avoided if instead of cutting the keyway in the disc a projecting tongue could be formed to register in a keyway in the rotor shaft. Such an arrangement is not practicable because the tongue would prevent the inner bore of the core being machined.

To give the essential good fit of the core on the shaft, the core should be bolted solidly together between stout end-plates and be bored to a smooth surface, and the shaft then be ground to suit with the necessary shrinkage allowance. Apart from being desirable to ensure a good fit, it is vitally important to bore out the core in order to remove the metal that is strained and weakened by the punch. This matter will be referred to later.

Solid Rotor Advantages

The solid rotor has the great advantage that the bursting stress is always less than the stress in the tooth and the former stress has therefore never to be considered. A comparison of the hoop stress for a laminated and a solid rotor is shown in Fig. 1 for a 3,750-kw. alternator. It will be seen that even with a much deeper tooth the maximum stress in the forged rotor is only 13,800 lb., against 34,500 lb. in the laminations.

Another matter to receive consideration when discussing the laminated rotor is the question of the material available for the core discs. Such material is prepared by rolling down hot slabs into sheets of the thickness required. The structure of the steel is influenced very considerably by the finishing temperature of rolling and by the rate of cooling. With a large, thin sheet it is impracticable to maintain a uniform temperature throughout, and a micro-examination after rolling shows appreciable variations in the crystalline structure at different parts of the sheet.

Careful annealing by the re-crystallization that results does much to remove such variations, but no matter what care the manufacturer may exercise, some variations in the finished sheet are unavoidable, and particularly so when thorough annealing is not permissible on account of the lowering of the tensile strength. Moreover, the fibre is determined by the direction of rolling; the effect of the final passes predominates, although the earlier passes have a slight permanent effect. Even at a given part of a given sheet the ductility is found to vary somewhat according to the direction chosen, although the tensile strength may be fairly uniform. Minute local imperfections that would be without effect on a fairly thick plate may appreciably weaken a thin plate.

Since material of this kind is inherently less dependable than a high-class forging, the factor of safety should be higher than with the solid rotor, but due to the weakening effect of the central hole the designer has to be content with a lower factor of safety.

Manufacturing Features

To meet the demands of the electrical engineer for steel sheets having a high tensile strength, some manufacturers have taken advantage of the additional strength given by cold working. An interesting theory of the hardening of metals by cold working has been put forward by Professor Beilby. By making the final passes through the rolls at a low temperature the tensile strength is considerably increased. The action is to deform the crystals and to produce amorphous material on the surfaces of the gliding planes, resulting in appreciable hardening. Up to a certain point the more the steel is reduced in area the more the strength is increased in this way, but beyond that point the steel is rapidly weakened.

The effect of annealing such material is to remove largely the effects of the cold working, by the re-crystallization of the amorphous material that results. The elongation may be brought to a low value according to the extent of cold working—even to less than 1 per cent. Under a tensile test such material breaks abruptly without any appreciable stretching. With the steel sheets that are prepared in this way for rotors, the cold working is not carried so far, and there is usually an elongation of about 5 per cent. with a yield point of about 35 tons per square inch and a breaking strength about 40 tons per square inch.

The effect of the cold working with large thin sheets is essentially somewhat uncertain, and such material cannot be regarded as being of a high grade. There is always the chance of the process being carried too far locally and of minute internal flaws being caused. Another danger of material worked in this way and only partly annealed is the possibility of there being what is known as "rectangular brittleness." This remarkable phenomenon is more usually encountered with pure iron and very mild steel, but the author has had experience of it occurring in some degree with steel of the kind in question.

A Heat-Treating Feature

It has been discovered that if steel is worked at a temperature below 500° C., and is then annealed at a temperature below the critical point, it is liable to become coarsely crystalline. It was shown by an interesting experiment by Professor Sauveur, and independently by Mr. H. S. Kipling, that in addition to the critical temperature there is also a critical range of deformation, and if the steel is worked either more or less the phenomenon does not occur. Dr. Stead found that the property he designated "rectangular brittleness" is due to the material crystallizing with the cleavages

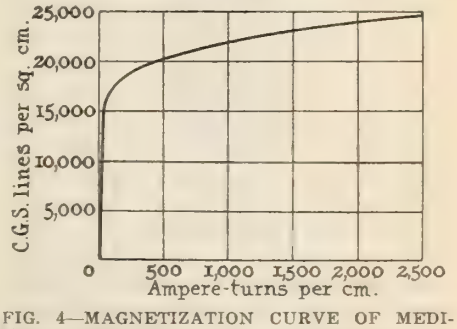


FIG. 4—MAGNETIZATION CURVE OF MEDIUM CARBON STEEL (OIL HARDENED) FOR TURBO-ALTERNATOR ROTORS.

at an angle of 45° to the direction of rolling and at 90° to the surface of the sheet. It is obvious that if the crystals are all similarly oriented the sheet would be readily fractured if the stress were

applied at right angles to any of the three cleavages, although it remains tough in directions at 45° to the cleavage planes. Annealing at a temperature above the critical point would remove this weakness, but it would at the same time largely remove the effect of the cold working and very considerably lower the tensile strength.

Reference has already been made to the weakening effect of punching metal sheets. If a micro-section of the sheet is

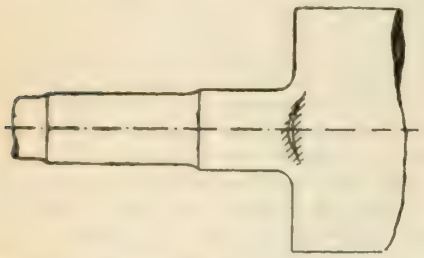


FIG. 5—FORGING DEFECT IN HIGH-SPEED ROTOR.

made it is clearly seen that the effect of punching the metal or, in a slightly less degree, of cutting it with shears is to distort and harden the crystals. Metal that was quite ductile before punching is found to be brittle round the punched edge. It is most important, therefore, that the core should be assembled in a jig and be bored out, since otherwise there would be brittleness and weakness at the part subjected to the greatest intensity of stress.

In place of cold working another method of producing plates of high tensile strength is to employ a high carbon content. The ductility of such steel, however, is not good, and it cannot be regarded as being suitable for the duty. An entirely satisfactory high-tensile plate could be produced using nickel-chrome steel, but a rotor constructed with such plates would be more expensive than a solid forged carbon steel rotor, and would be less satisfactory mechanically and electrically.

Critical Speed

Another point to receive consideration with the laminated rotor is the question of the critical speed. Practically always, the running speed is above the first critical speed, and with large outputs at 3,000 r.p.m. the running speed may be above the second critical speed. If the laminations were fairly loose in the axial direction the critical speed of the shaft could be accurately determined, but for mechanical soundness it is desirable to assemble the laminations under heavy end pressure. Additional stiffness may be given to the shaft, the deflection being reduced and the critical speed raised.

The stiffening effect is usually not permanent; under the combined action of vibration, stress and pressure, the minute undulations in the laminations are removed, and in the course of time the end pressure which might have been initially 200 tons is found to have disappeared. In the case of a typical 3,750-kw. alternator at 3,000 r.p.m., with a shaft diameter of 12 inches, a core diameter of 27 inches, a core length of 50 inches, and a distance between bearing centres of 134 inches, the first critical speed with the laminations absolutely solid would be about 2,000 r.p.m. and with the laminations free would be only about 1,400 r.p.m.

It will be seen that with a newly constructed rotor the critical speed may have a satisfactory value, but after some running there may be a lowering of the critical speed and some vibration may result. The author has had experience of several cases of slight incurable vibration with laminated rotors that has developed after prolonged running, but in only one case was the vibration so bad that the rotor had to be reconstructed.

When high-grade forgings are available the solid forging is undoubtedly preferable for all sizes of rotors for polyphase work. For small outputs the laminated rotor can be made satisfactory, but to employ the construction for large outputs is to take unnecessary risks. It is the author's opinion that for outputs in excess of 3,000 kw. at 3,000 r.p.m. the laminated construction should be employed only when it is impossible to obtain suitable forgings.

Thick Plate Construction

For large-diameter rotors at medium speeds thick plates are sometimes employed instead of laminations. This construction is preferable to using thin sheets, but the weakness of the centre hole and the high hoop stress, together with the unsuitability of using rolled plate with a pronounced fibre subjected to high stress in all directions, are still present, and when the critical speed is below the running speed trouble with it is equally if not more pronounced.

Another alternative is the construction of using plates of considerable thickness held together with through bolts with a short shaft length at either end and no central hole. The great weakness of this construction is the difficulty of making the bolts satisfactory. The deflection is due almost entirely to the elongation of the bolts, the area of the plates being large compared with the area of the bolts and the compression of the plates therefore negligible. A very slight elongation of the bolts takes all compression off the plates, and consequently at the underside of the rotor the plates are out of contact. Each time the rotor turns round, stress in addition to the initial stress is thrown on the bolts. In the case of a 1,500-r.p.m. rotor this intermittent superimposed stress is applied and removed over two million times a day.

It is claimed for the construction that the variation of stress can be maintained at so low a value that in spite of the rapid variation the duty is within the capacity of the steel. It is to be remembered, however, that the calculated stress may be considerably exceeded. In the first instance, it is difficult to know exactly the initial stress, which is usually determined either by measuring the pull on the spanner tightening the nuts or by measuring the elongation of the bolts. Again, the action of tightening the nuts may impose a very considerable torsional stress. Also, the driving torque imposes a longitudinal as well as a shear stress on the bolts. Above all, a bolt cannot be regarded as being dependable for carrying a rapidly fluctuating stress.

A Case in Point

The design usually calls for the bolts to be a reamered fit in the plates, and there is thus a sudden reduction of area at the parts where the thread is cut. The added elongation when the additional load is thrown on the bolts by the action of the rotor turning round is not uniformly distributed over the whole length, but is concentrated to an extent dependent on the reduction of area at the short length between the end of the fitting part and the face of the nut. In the course of time this concentration of elongation in company with the weakening effect of cutting the threads tends to cause failure by fatigue close to the nut. With one case that came to the author's notice of a 6,000-kw. 1,500-r.p.m. alternator constructed in this way, it was found that after 2½ years' running some of the plates at the centre of the core had moved slightly out of centre. On dismantling the rotor it was found that the opening and closing of the plates at each revolution, as described above, had caused fretting of the spigots and between the bolts and the reamered holes, and where initially there had been a good fit there was found to be a clearance on the spigot and in the bolt holes of 1-50 inch.

Another disadvantage of the plate construction is apparent when the critical speed is considered. Since the bolt area in tension is small compared with the rotor weight, the deflection in the body of the core is considerable and hence the critical speed is very low. It is almost impossible to avoid some degree of synchronism of the normal speed with the harmonics of the natural period of

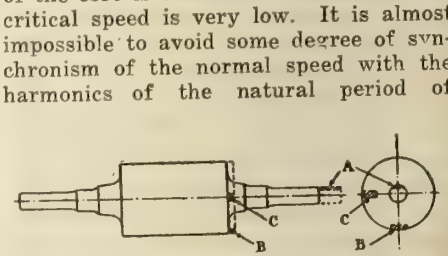


FIG. 6—TESTS FROM AN OIL HARDENED CARBON-STEEL ROTOR.

transverse vibration. The effect of the plates meeting, by the great area of compression they offer, prevents any appreciable swing of the rotor beyond the neutral axis. Vibration is thus damped, and such rotor has no real critical speed, but there may be sufficient vibration to be appreciable.

Such a construction can be seriously

considered only with relatively large and relatively low-speed rotors, and is only to be employed when forgings are unobtainable.

Maximum Diameter of Forged Rotor

The forged rotor having no central hole is very much stronger in its resistance to bursting than is the laminated rotor as shown in Fig. 1. It can be shown mathematically that a minutely small hole through the centre of a rotating cylinder doubles the stress. In addition to the gain due to the omission of the hole, there is the greater area of steel to carry the load. The capacity of the added area to carry load is considerably greater than the extra load due to the centrifugal force of the added metal, and so altogether the bursting stress is so low that it has not to be considered.

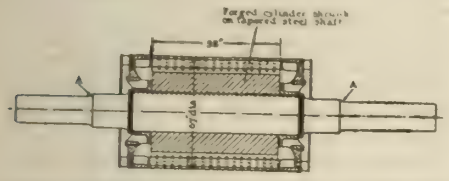


FIG. 7—ROTOR FOR A LARGE 1,000-REV. PER MIN. TURBO-ALTERNATOR.

The maximum stress with the solid forged rotor is always in the tooth, but the stress never reaches a high value, the maximum rotor diameter being determined by other considerations.

With the type of winding now in universal use, of concentric coils of flat copper strip, there is a fairly clearly defined limit to the rotor diameter that may be employed for a given speed. There are to be considered the stability of the end windings exterior to the core, the pressure on the insulation between turns, and the retention of the end windings against the action of centrifugal force. In the case of a 5,000-kw. alternator at 3,000 r.p.m. with a 31-in. diameter rotor, when running at the overspeed of 20 per cent. above normal the average value of the maximum pressure on the insulation is about 5,000 lb. per square inch. The desiderata of the insulation between turns are good electrical properties, capacity to stand high temperatures without deterioration, and mechanical strength. The author is very strongly of the opinion that pure, hard mica is the only material that is really suitable for the purpose. Asbestos sheet is sometimes employed, but it cannot be regarded as being a suitable material. The electrical properties of the asbestos may perhaps be made sufficiently good by careful impregnation, and it is, of course, very suitable for resisting heat, but mechanically it is not good. The space available for the rotor copper determines the rotor output and hence the alternator output, and it is obvious that the thickness of the insulation between turns must be reduced to a safe minimum. A thickness of 0.01 inch cannot be exceeded without unduly adding to the size of the machine for a given output. However carefully asbestos may be made, with such a thickness it is not possible to avoid weak spots. The copper is never absolutely flat, and any high point is very liable to crush the asbestos locally and cause short-circuiting between turns. Pure, hard mica is very good mechanically and does not yield locally in this way.

Illustrating Centrifugal Force

Fig. 2 shows a cross-section through one of the rotor coils of such an alternator, and there is drawn to scale on top of it a block of steel equal in weight to the centrifugal force exerted by the coil. When it is considered that the length of each outer coil exterior to the core is about 4 feet, it will be appreciated that the difficulty of preventing any side slipping of the coils, however well they may be supported, may become a limiting factor of speed. The illustration does not exactly reproduce the running conditions, since the centrifugal force is not uniform throughout the coil as is the pressure due to the weight, but varies from zero at the bottom to a maximum at the top. The sketch nevertheless serves to convey a much better idea of the duty than a mere statement of figures can do.

As a structure such a coil is not well adapted to carry a great load without distortion—particularly having regard to the high-frequency vibration that must be present in some degree, however perfect the balance. Moreover, the tendency to move due to expansion which may not take place uniformly with all the turns at either end of the core, and to the low coefficient of friction between the polished surfaces of the copper and the mica, adds to the difficulties.

The stability of the coils is much improved as the breadth of the strip is increased. The practice of most makers seems to be to employ rather a large number of coils with a relatively narrow section of copper—six or seven coils per pole being common. A far better arrangement is to use fewer coils of greater copper breadth. Also, reducing the ratio of wound slots to slot pitches is not only better mechanically, but is more effective electrically, as shown by Dr. S. P. Smith. The limitation in this direction apart from electrical considerations is the section of strip that can be handled conveniently.

Under steady compression between flat surfaces mica can stand great loading before failing. In service, however, it is to be remembered that the conditions are not nearly so ideal. There is always some degree of high-frequency vibration present and the surface of the copper is never quite flat. For these reasons a big margin of safety is necessary.

Whereas the limitations due to end-coil stability and insulation pressure are indefinite, as will be seen later the limitation due to the difficulty of retaining the rotor end-windings is quite definite. Having regard to these circumstances, the author believes that for a normal speed of 3,000 r.p.m. a 32-in. diameter rotor will come to be regarded, if not as the maximum permissible size, at least as the maximum desirable size. The peripheral speed of such a rotor is 25,120 feet per minute.

For a given peripheral speed the centrifugal force of a given mass is inversely proportional to the radius. With the larger diameters, however, it will be found that with an increase of diameter there is roughly a corresponding increase in the weight of the various parts, and for speeds below 3,000 r.p.m. the desirable peripheral speed is actually reduced somewhat as the diameter is increased. In Fig. 3 is shown the relationship between the angular speed and the maximum desirable rotor diameter.

Choice of Rotor Steel

The obvious requirements of the rotor steel are that the permeability should be as high as possible and that mechanically the material should be suitable for the duty. The exciting energy required to drive the flux through the rotor varies considerably according to the relative proportions of the design and the performance of the machine. In an average case, however, it may be of the order of 15 to 20 per cent. of the full-load excitation. It is important, therefore, that the permeability should be as high as possible consistent with satisfying the mechanical requirements. As already mentioned, the maximum stress in the rotor is not great, and the designer has apparently a wide choice of steels. The choice, however, becomes rapidly narrowed down when it is stipulated that in addition to having the necessary strength the steel must have capacity to withstand shock and fatigue, be tough,

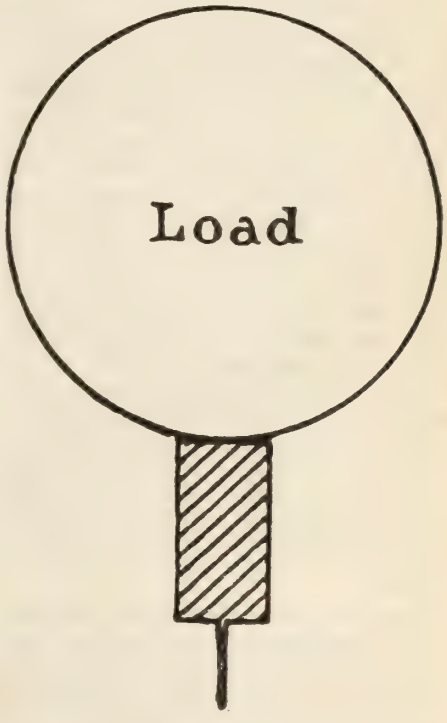


FIG. 8—SHOWING HOW A BEAM CAN BE WEAKENED BY ADDING TO ITS SECTION.

ductile, of the kind that is least likely to have flaws, the best suited to use for a large forging, and above all be dependable in the highest degree. Beyond doubt, the steel that best fills these requirements is an oil-treated carbon steel. Such a steel, containing about 0.38 per cent. carbon, after oil treatment has an ultimate strength of 38 tons per square inch, a yield point of 22 tons, an elongation of 22 per cent. on 2 inches, and a contraction of area of 40 per cent. It is of the class of steel that is used for such purposes as railway axles, and has to resist shock and fatigue and be dependable above everything, and is therefore admirably suitable for alternator rotors. The permeability of this steel is quite good, as shown in Fig. 4.

Yield Point and Elastic Limit

It is usual to express the factor of safety in terms of the ultimate strength —which is not quite logical, since it is the yield of the material that marks the

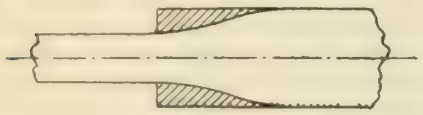


FIG. 9

A sudden increase in diameter may be regarded as adding metal to a gradual increase and is analogous to the adding of a thin rib to a beam as shown in Fig. 8.

limit of safety and not the actual fracture. The ratio between the yield point and the ultimate strength differs considerably with different classes of steel, and varies a little even with any particular steel according to the nature of the heat treatment. For example, with a mild carbon steel in the annealed state the yield point may be about 50 per cent. of the ultimate strength, and after oil hardening may be increased to 60 per cent. With a high-tensile nickel-chrome steel the ratio may be as high as 85 per cent., and with cold-drawn steel wire as high as 95 per cent. For this reason the author is of the opinion that the factor of safety should always be expressed in terms of the yield point. It would be better still to express it in terms of the elastic limit, but the difficulty is that the elastic limit cannot be determined in a tensile test and can really only be found by a long series of tests under reversals of stress.

The yield point is defined as being the stress at which there is a complete yield of the material that is observable to the eye. The true elastic limit is reached at some lower stress when incipient but not measurable permanent set is caused. In stipulating the factor of safety the nature of the duty has to be considered, and the value that would be safe for a steady load would be quite unsafe for a rapidly fluctuating load. As we have seen, the maximum stress in the solid forged rotor is in the teeth. The stress is unidirectional and constant, and a factor of safety of 2 to 1 on the yield point is to be regarded as satisfactory with dependable steel. With this factor of safety the maximum permissible tooth stress with the quality of steel suggested is 11 tons per square inch. With a well-proportioned rotor having a diameter of 31 inches—which, as explained, is approaching the largest diameter that it is desirable to employ for a normal speed of 3,000 r.p.m. with the type of rotor now being made—the maximum tooth stress at 20 per cent. overspeed is about 9½ tons per square inch. It will be seen, therefore, that the quality of steel suggested well meets the requirements.

It might be thought that, if a higher stress could be allowed, a narrower tooth could be provided and there would be more room for rotor copper and consequently a greater output. The question of the tooth density, however, has to be considered. There must be some saturation in an alternator to give it magnetic stability. There are cases on record of alternators that would not operate satisfactorily due to insufficient saturation, the excitation being overwhelmed by the armature reaction at changes of load.

With a turbo-alternator the necessary saturation must be provided in the rotor teeth—that being the only part of the machine where a high density can be arranged or is permissible. On the other hand, if the saturation is carried too far, the loss in the teeth becomes excessive. With a normal 5,000-kw. alternator at 3,000 r.p.m. the exciting energy required for the rotor teeth is of the order of 10 per cent. of the full-load excitation. With a badly-proportioned rotor the loss may be as high as 20 per cent.

In general, it will be found that with a stress of about 10 tons per square inch the corresponding tooth density is as high as it is desirable to employ, and the oil-hardened carbon steel therefore satisfies the electrical as well as the mechanical requirements.

Use of Alloy Steel

It is sometimes suggested to employ an alloy steel for the rotor, but there is very little gain, if any, in doing so with the objects immediately in view, and on the other hand there are pronounced disadvantages. For instance, if an alloy steel were employed with the object of being able to use a smaller tooth to give increased winding space, it would be found in most cases that the increased magnetization loss due, not only to the higher tooth density, but also to the lower permeability would more than offset the gain due to the increased copper space.

There is the objection to using an alloy steel that for a large rotor forging it is inherently not so reliable, there being a greater probability of internal flaws being present. A hole should always be bored through the forging when an alloy steel is used, and the bore should be carefully examined to see that there are no internal flaws. As already explained, the effect of the hole is more than to double the hoops stress. so that the body of such a rotor actually would be weaker than if a carbon steel were used.

An interesting case came to the author's notice a few years ago of a rotor forging breaking just where the shaft merges into the body of the core. The steel used was 3½ per cent. nickel having a yield point of 29 tons and an ultimate strength of 46.5 tons per square inch, and an elongation on 2 inches of 22 per cent. It was found that a huge internal cavity had been caused by the operation of forging, as shown in Fig. 5. The corresponding part at the other end of the rotor was cut open, and although there was no cavity the steel was in a highly stressed and weakened condition. Insufficient care in forging might cause weakness in this way with any steel, but it is much more probable with an alloy steel than with a carbon steel.

In another case that came to the author's notice a high carbon steel was employed having the composition of 0.61 carbon, 0.59 manganese, and 0.23 silicon, and the tensile properties of ultimate strength 49 tons per square inch, yield point 22 tons to the square inch, elongation on 2 inches 18 per cent., and reduction of area 32 per cent. After being in service for 3½ years the forging failed with a fatigue flaw in the neck of the journal. A micro-examination showed that the steel had not been properly heat treated and had a large grain size. Such a steel, and more particularly in the absence of correct heat treatment is not at all suitable for a high-speed rotor.

The use of improper steels of this kind, and bad mechanical design—with which not even a good steel could stand—have led to a number of failures that have given rise to the feeling amongst those not familiar with the conditions that the solid forged rotor is less reliable than the built-up design. For the onerous conditions of high-speed work, it is not good enough to use a block of any kind of steel in any state of heat treatment and to machine it without regard to fundamental mechanical requirements.

There is no doubt that provided the right kind of steel is used, correctly forged and correctly heat treated, and that the mechanical design is sound, the solid forged rotor is by far the best construction, and the author has never heard of a single failure when these conditions have been observed. The only justification for the built-up construction is for small rotors and when high-grade forgings are not obtainable, and for single-phase work.

The forging for the turbo-alternator with its radial stress presented a new condition to the steel maker and, not because there was any real difficulty with it but because it was a new requirement that they had not investigated, some makers would not undertake the work.

With ordinary care in forging there is no difficulty in giving the required radial test. The tensile strength radially is very much the same as in the longitudinal direction, but the elongation is usually lower. Three tests should be made from each forging—one from the shaft end, one tangentially from the core, and one radially from the core, as shown in

Fig. 6. With an oil-hardened carbon steel containing about 0.38 carbon the results shown in the table in Fig. 6 may be expected. The figures given are actual results; the makers' guarantees with regard to elongation, and particularly in the radial direction, would be somewhat lower.

Limit of Forging Size

There are limits to the size of forging that a steel manufacturer can undertake. There is the inherent limitation due to the rate of cooling of the interior of a large mass of metal. The size of the crystals and hence the properties of the steel are profoundly influenced by the rate at which it cools. If the mass of steel were unduly great, the cooling of the interior would be so slow that the mechanical quality in consequence could not be made to conform to the necessary requirement. With the forgings for turbo-alternators of the sizes so far considered the problem does not arise, and the limitations are the manufacturer's facilities for casting an ingot sufficiently large and the capacity of his forging plant.

Nothing definite, therefore, can be laid down as to the largest size of rotor that can be produced in a single piece, but it is in the neighborhood of 50-in. diameter. That is to say, for all outputs so far contemplated at 3,600, 3,000, and 2,400 r.p.m. a single forging can be obtained, and also for all except very large outputs at 1,800 and 1,500 r.p.m. For very large outputs at 1,800 r.p.m. and lower speeds a single forging may not be satisfactory. In such cases the soundest construction is to forge a hollow cylinder with a shaft extension attached to each end, or better still carried on a through shaft as shown in Fig. 7.

Forging the cylinder on a mandril does work on the steel and gives it its best qualities on the inner periphery where the hoop stress is a maximum. Moreover, in quenching, the oil has access to the bore and the maximum benefits of the heat treatment are conferred at the part of maximum hoop stress. With such large rotors there is no difficulty in so proportioning the belt of metal between the bottom of the slots and the bore that the hoop stress is kept down to a satisfactory value. For very large rotors this construction therefore constitutes an excellent arrangement.

Shaft Design

In determining the design of the shaft it is most important that the proportions should be such that the curve of deflection is smooth and free from any sudden change. The forces due to the rotor weight cause the steel to yield elastically until the reacting force balances the weight. So long as the duty on the individual crystal is within its capacity the structure is safe, but if that limit is passed the crystal deforms by slip taking place along the cleavage planes. The excessive burden falls on to the neighboring crystals, and they in turn fail, and so on until fracture is caused. For the structure to be safe, therefore, not only must the area of the steel be adequate for the load to be carried but the proportions must be such that it is free to yield elastically to exert its reactive force without any local over-stress being caused.

If the design is such that there is a tendency for some part of relatively small area to resist the general deflection, that part may be overstressed and failure may result. An example of such a case is given in Fig. 8. The beam with the fin projection and the load can be so proportioned that before the beam has deflected sufficiently to give the necessary reaction to support the load the crystals at the bottom of the rib are overstressed. Failure, therefore, would result with such a construction, whereas the beam without the fin would carry the same load satisfactorily.

Where there is an abrupt increase of diameter in a shaft the conditions are somewhat but not exactly similar. Just where the increase of diameter takes place the shaft portion is under stress and is yielding elastically. The flow of stress into the larger diameter is somewhat gradual, and the face of the metal that is rising at right angles from the smaller diameter to the larger diameter carries little or no stress, and there is therefore in intimate contact steel that is elongating and compressing elastically and steel without stress, and great weakness is thus caused. A gradual change of diameter represents a normal design, and a sudden change is to be regarded as adding metal to the normal design as shown shaded in Fig. 9. The added metal tends to prevent the normal elastic deformation and has inadequate strength for the purpose. In such a case the tendency to fail is often increased by the crystals at the junction of the two diameters being torn and weakned by the action of the cutting tool.

In Fig. 21 is shown a case of failure that came to the author's notice a few years ago. It will be noticed that there is a very sudden increase of diameter between the bearing journal and the large oil baffle that is formed solid with the shaft. After 11 months' running the shaft broke in the position shown. Not only was the design thus most unsound, but the material was unsuitable, being of a high-carbon steel that had not been heat treated and having a very coarse grain size.

Abrupt changes in the curve of deflection must therefore be carefully avoided. The shaft should be gradually stepped to avoid any sudden increase of diameter, and wherever a change of section occurs a carefully formed radius should be provided. Gauges to check the accuracy of the radii in important places, such as in the neck of the journals, should form part of every shop inspector's equipment.

In addition to being carefully formed, the radii should be given a fine finish and good polish. It has been shown by Professor Beilby that the effect of polishing is that the superficial molecules become mobile and form a thin viscous layer with surface tension analogous to that of liquids. After a very short period the layer loses its mobility and solidifies into a vitreous amorphous state, forming a very strong cementing material. On the other hand, if the surface is left rough the surface crystals are torn and weakened, and the conditions are favorable for fatigue to develop.

The need for avoiding abrupt change of section applies to all parts of the rotor, and at the junction between the teeth and the body of the rotor ample radii should be provided.

Alternating Stress

The maximum reverse stress in the rotor is in the neck of the bearing journal at the part marked "A" in Fig 7. The weight of the rotor puts the figure at the top of the shaft into compression and at the bottom of the shaft into tension. As the shaft turns round the stress changes from tension to compression. In the case of a 3,000-r.p.m. alternator the number of reversals per day is 4,320,000; that is to say, the number of reversals daily is equal to what investigators into the subject of alternating stres have regarded as a complete endurance test.

Failure from fatigue is really the same as failure under a simple tensile test in so far as it is the result of the overstressed crystals yielding plastically by slip along the cleavage planes. The essential difference is that failure by fatigue is relatively very slow and is localized, not being accompanied by any general yield of the material.

The investigations of recent years have thrown some light on the reason for steel failing under an alternating stress that could have been carried indefinitely if applied constantly. Ewing, Humphrey, and Stanton have discovered that the failure generally starts in the ferrite grains which consist of iron in its crys-

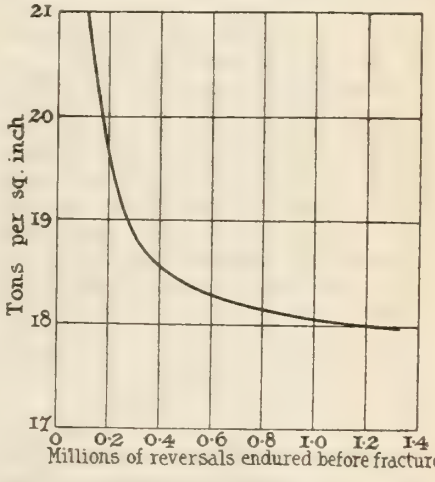


FIG. 10—ENDURANCE TESTS OF OIL HARDENED CARBON STEEL WITH 2,000 ALTERATIONS OF STRESS PER MIN.

talline and therefore softest state. The stability of the ferrite is much less than that of the aggregate, so that stress insufficient to permanently strain the aggregate would be more than sufficient to break down the ferrite grains if the stress had access to them. Professor Beilby discovered by studying the vibrations of cold-drawn reed before and after annealing that although the crystalline

phase is more elastic than the amorphous phase, yet the amplitude of vibration is greater in the latter state. It is reasonable to expect, therefore, that when an aggregate composed of two phases is subjected to rapidly alternating stress, the harder element with its greater amplitude will cause the softer element with its less amplitude to cary an undue proportion of the stress.

Under a simple tensile test, as the load is increased the first crystals to fail are those that are the worst circumstanced with regard to size and the orientation of the gliding planes. These crystals deform plastically, and the stress is therefore to a certain extent removed and becomes more distributed over the aggregate. Such a point marks the true elastic limit, and the stress has to be increased appreciably before there is the general deformation of the crystals as a whole that is observable to the eye, known as the yield point.

That a steel crystal has strength after permanent deformation is explained by Professor Beilby to be due to minute particles being torn away from the contact surfaces, of a lower order of magnitude than any crystal unit, that form an amorphous cement stronger than the crystals themselves. The action is analogous to what happens when the surface of metal is polished as explained above. With any normal metal it is found that fracture always takes place along the cleavage planes of the crystals themselves, and not by the failure of the amorphous cementing material that holds them together. The presence of this amorphous material produced by the rubbing along the gliding planes may quite well, therefore, have the effect of making the crystal stronger after yielding than it was before. This explanation agrees with the fact that under a tensile test a greater stress is required to rupture the material than was necessary to cause the yield.

The conditions necessary for failure by fatigue are that the real elastic limit of the steel is exceeded but that the yield point is not reached. If the elastic limit were not reached, the metal, would not fail however many reversals may be made; and if, on the other hand, the yield point were reached the failure would take place by ductile elongation before fatigue developed. After the first local yielding of the worst circumstanced crystals, if the load is kept constant nothing further happens and the steel would carry the load indefinitely.

If, however, the stress is quickly reversed, the slip of the crystals will be reversed, the movement being considered to be facilitated by the newly produced amorphous material being in a temporarily mobile state. At each reversal there is corresponding slip along the gliding planes, and more of the amorphous materials is produced until the crystal is exhausted and failure results. This process then begins in other crystals and spreads until complete failure is caused.

Reverse Stresses

It was thought by some of the earlier investigators into the subject of reverse stress that the liability to fail increased with the speed of reversal. It is now generally agreed that these investigators were misled by the peculiarities of the type of testing machine they employed. It is fairly certain that failure by fatigue is independent of the speed of the reversals unless the speed be very low or very high. It is well known that after plastic deformation if steel is allowed to rest the strength increases. This quality, however, is without value in shafts since the period of rest required is a matter of days unless hastened by the action of heat. On the other hand, if the speed is very high the time that the load is applied may be insufficient for yield of the material to take place. The time required for a crystal to deform is appreciable whatever stress may be applied, and it is to be expected that if the stress is applied for a very brief period only there may be insufficient time for the steel to deform plastically, although the magnitude of the stress may be sufficient to cause rupture if applied steadily. Dr. B. Hopkinson has shown that steel wire having a yield point of 17.8 tons per square inch and an ultimate strength of 28.5 tons per square inch can carry a load of 33½ tons if it is applied for about only 1-1,000th part of a second. He has also shown that with reversals at the rate of 7,000 per minute the resistance of metals to reversals of stress is appreciably greater than at low speeds. The speed at which this property becomes of value has not been clearly determined. Dr. Stanton states that with tests he made at speeds of from 100 to 2,200 reversals per minute there was no evidence that the rate of reversal had any effect on the resistance to failure. It is probable that at the normal running speed of the high-speed alternator the alternations of stress have a maximum effect, since the speed is not sufficiently high for it to have any ameliorating effect, and on the other hand the great speed tends to bring unforeseen load into play. It becomes necessary, therefore, to give very careful attention to the design in this respect.

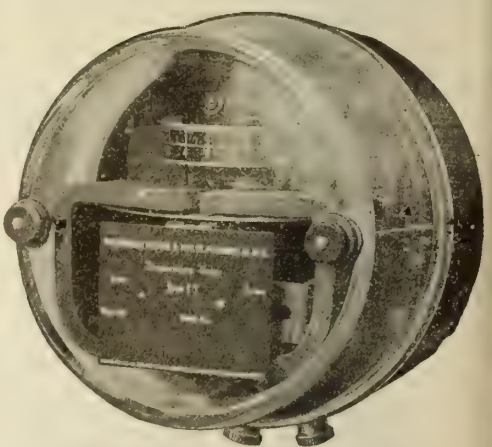
When making tests under alternating stress the procedure is to apply a load that it is known will produce failure and note the number of alternations before breakdown results. The test is repeated with a similar specimen under a reduced load, and so on until the load is found under which the specimen will not break however many alternations may be made. If the results are plotted the curve is parabolic as shown in Fig 10, the horizontal asymptote showing the stress with which an indefinite number of reversals would not produce fracture.

The fatigue failure is so insidious in its action and so many unforeseen factors may be present to contribute to it that a big margin of safety is desirable. For instance, the calculated stress may be much exceeded by a slight error of alignment, and the possibility of minute irregularities or flaws must be considered, which for any other condition of loading would be without practical effect. Moreover, the torsional stress which is a contributing factor may have its normal value much exceeded by a short-circuit. Further, in expressing the factor of safety in terms of the yield point it is to be remembered that the true elastic limit, which, as explained, determines fatigue failure, is considerably lower than the yield point. It has been shown by Ewing and Humphrey by observing the creation of slip bands under alternations of stress that the true elastic limit of a carbon steel may be only 52 per cent. of the yield point. Taking all these factors into consideration, it is the author's opinion that the combined calculated stress in the neck of the journal should not exceed 7½ per cent. of the yield point of the steel. With the high bearing duties of to-day—journal speeds of 6,500 feet per minute being quite satisfactory—there is no difficulty in keeping within the factor of safety.

(To be continued)

MAKING TEMPERATURE TRIP THE CIRCUIT-BREAKER

The oldest form of overload protection is electromagnetic, cutting off the current if it reaches a value deemed dangerous. The fact that most electrical apparatus can withstand momentary overloads without danger has gradually led operators to push up the current values at which electromagnetic protective devices will operate, or to dispense with them entirely, rather than undergo the inconvenience of having them disconnect the machinery on momentary peaks.



WESTINGHOUSE TYPE CT RELAY

A method of visual protection on the basis of temperature was the next step. Exploring coils were built into the apparatus and used to indicate the temperature of hot spots by means of electrical instruments.

The latest step is a relay, the type CT, built by the Westinghouse Electric and Manufacturing Company, which automatically trips the circuit-breaker when the temperature reaches the danger point under excessive current. It may be used to protect any alternating-current apparatus from excessive heating if the apparatus is so arranged that exploring coils can be installed.

The relay is intended to protect ap-

paratus against overheating from sustained overloads. To afford this protection with the least interruption of service the breaker should be tripped through the direct effect of the temperature of the apparatus. The relay should be so arranged that it prevents the breaker from tripping if the overload is of such short duration that the temperature does not rise to a dangerous value; while, if the overload persists the breaker must be tripped out as soon as the temperature rises beyond the critical value. This is accomplished in the type CT relay as follows:

The type CT temperature relay operates on the Wheatstone bridge principle. Two arms of the bridge are copper exploring coils arranged to be placed in the oil or embedded in the windings of the apparatus to be protected, the other two arms are unchanging resistance mounted in the relay. The current for the bridge is supplied by the current transformer connected in the circuit of the apparatus to be protected. The relay has two windings, corresponding to and co-operating to produce torque in a manner similar to the current and voltage coils of a wattmeter. The main winding is a coil operated directly by the current transformer. The auxiliary coils are connected to the Wheatstone bridge arms similarly to a galvanometer connection, and thus receive current, the magnitude and direction of which depends upon the resistance of the search coils. Above a certain temperature the torque of the relay is in the contact direction and below, in the opposite direction. It will thus be noted that in order to close the contact, two predetermined conditions must co-exist: excess current and excess temperature. Neither one will separately trip the relay.

The type CT relay is similar in construction to the Westinghouse Type Co. except that it has special windings and two additional terminals.

The construction of the exploring coils will vary, depending on the kind of apparatus with which they are to be used.

A WORKING HYGROMETER

HYGROMETERS are used in factories for ascertaining the amount of water vapor in the air by means of a moving part in two forms—one employing a wet and a dry bulb thermometer, in which a fine thread of mercury is forced along a glass tube by reason of the expansion of a small amount of mercury in a bulb. The other type owes its movement to the alteration of length of one or more hairs under the influence of a change in the moisture in the surrounding air. The movement of the hair actuates a small pointer moving along an index, and in the case of the thermometer the mercury moves parallel to the index. In each case the force represented by the movement is exceedingly small and the instruments as used in textile factories serve as a guide for the adjustment by hand of the humidifiers that furnish the additional atmospheric moisture that is required for the treatment of cotton in dry weather.

It has for many years been known that cotton is most easily spun or woven when it contains about 8½ per cent. of moisture; with less it is liable to be brittle and to have an increased loss in waste. The amount of moisture the fibre contains depends on the state of the air surrounding it, and as the dampness of the air is constantly changing, the cotton when exposed is constantly varying in weight. Along with this change of weight is a variation in thickness of each fibre, and this variation, when the fibre is spun or woven, results in a change of length in the fabric, although the loose fibre does not alter in length, nor does any vegetable fibre appear to do so.

As soon as moistening or humidifying appliances began to be used and the variation of atmosphere dampness from hour to hour during the working day was observed the need of an automatic regulator became evident, for no manual adjustment of water supply to the spraying apparatus could keep pace with the natural changes in the air. As a makeshift, the factory windows were closed and humidity was obtained at the cost of ventilation. The gain was, however, only a partial one, for excessive humidity produced lassitude among the operatives, resulting in bad work and irregular attendance.

Many inventions have been tried to obtain automatic adjustment of the moistening apparatus which used water at a pressure of about 100 pounds per square inch, but the resistance of the valves and stuffing boxes offered serious difficulties when attempts were made to control them by a movement due to the influence of moisture on organic fibrous material. A rope may be made to lift a hundredweight suspended on it by soaking it with moisture, but the operation would take so much time as to be of no use as a humidity regulator, and if it depended for moisture on the air it might take hours to show results. Promptitude is an essential in this case, for by carefully made experiments it has been found that loose cotton fibre is influenced in less than one minute by a change of moisture in the air around it.

The many failures of regulators controlling high pressure water supplies suggested a new departure, dealing with low pressure water which was atomized mechanically for air moistening. This invention was the subject of a recent patent obtained by Mr. John Wallace, of Bombay. The experimental regulator was a band of closely woven light canvas, 70 feet long, suspended by the edge beneath a roof and exposed to the influence of atmospheric change. The canvas was free of size and one was fixed, while the other was kept in tension by weight equal to four pounds per foot in width. The free end of the canvas was connected with a recording cylinder, on which a line was drawn that showed the movement of the canvas during every hour of the twenty-four. During a period of two years that the canvas remained in tension it showed no sign of fatigue, and it proved that a piece of canvas seventy feet long and three feet wide would indicate every change of atmospheric moisture in the air by a movement of 9-16 inch for each per cent. of moisture absorbed by the cotton while kept in tension by a weight of 12 pounds. The prompt sensitiveness of the canvas was due to its very large surface. Twelve pounds weight raised 9-16 of an inch thus represents the result of the absorption of 1 per cent. of its weight in moisture by the canvas band, and a test of the resistance to movement of a balance valve passing water full bore through a 1-inch pipe at one foot of pressure was 40 grammes, or about 1½ ounces.

This experiment points to the possibility of controlling automatically the supply of moisture in the air of a cotton mill, the regulator being of cotton. The canvas band has a certain length due to a content of 8½ per cent. of moisture within its fibres, and any increase or diminution of this moisture alters the length. Having a very large surface, absorption and evaporation take place very quickly, and with each change the movement acting on a balanced valve may control the water supply flowing to the vaporizers.

This device is applicable to public buildings, palaces and hospitals where electric current or other motive power is available.

WESTERN CANADA AND ALBERTA COAL

Still Figuring On How West Is To Be Kept From the Shivers This Winter

The Westerners are having their own times just now. They are speaking in terms of heat units and B. T. U. and every other kind of heat measurement even unto calculating steam with a yard stick. They have to burn Alberta coal, and they want to know how much more fuel they will need than in the days when they consumed anthracite. The university of Edmonton compares them like this in regard to the B. T. U. value:—

Edmonton coals	8,900 to 9,200
Pennsylvania	12,800 to 14,800

The Calgary "Canadian" does not believe that the Manitoba field has been inched for Alberta coal. That paper says:

It would be far from actual facts to say that the Manitoba market has opened to Alberta coal. Possibly it can be described as "cracked." It is taken as vastly encouraging that Manitoba is in reality keenly interested in the opportunity of the Alberta coal supply. Once the prairie consumers find that Alberta coal keeps perfectly in reasonable storage; that it can always be secured when wanted, and that it cuts to a skeleton the customary corpulent coal bill from Pennsylvania; then the seams of Alberta can expect to be

made to produce night and day, winter and summer.

Need Summer Market

It's the summer market that counts after all. The big mines are crowded to the limit during the four or five winter months. The equipment must be kept up to practically a year-round capacity for this rush interval. Then comes spring and the orders disappear in a night. The demand is gone and the miners disperse.

This is the condition in the coal situation that the producers have been fighting against for years. Not until last winter when Canada had its first experience with the closing of industries and schools, and the enforcement of "heatless" days, has the argument of the Alberta coal companies gone home. It is not so hard at the present time for Manitoba, for example, to appreciate the fact that a few tons of coal, brought from Alberta at a low price during the summer and stored away in a shed or basement, can save a deal of worry, shivering and expense, when snow begins to swirl and railways lose themselves in traffic.

If this same fact could be sown on the eastward prairies and let mature the problem of all-year-round production at Alberta mines would be finally solved, and all Canada could well rejoice in the solution.

THE COST IN COAL OF AVOIDABLE BELT SLIP

ONE of the very simplest transmission losses to overcome is belt ship, and since belts are used to so great an extent it is worth while looking into the matter with considerable thoroughness. To show the extent of the loss of money through slipping of the main belt alone a chart, supplied through the courtesy of the Cling-Surface Company, Buffalo, N.Y., is shown herewith, upon which this is easily ascertained. By glancing up and down column "D" of this chart it is evident that the "cost of avoidable belt slip per year in dollars" may vary all the way from the smallest sums into the thousands of dollars.

Where the power in the first place is generated by a steam engine and is then transmitted to a generator or to the main shaft through a main belt it is evident that the "entire coal pile" passes through that in the form of energy, literally speaking.

If the belt slips, which it should not do, a certain portion of the coal pile does not "get through," but is lost into the atmosphere in the form of waste heat. A main belt is merely a "link" connecting the engine with the generator or with the machines themselves. In fact, every belt that transmits power is a connecting link and the efficiency of that link depends largely upon the freedom from slippage and the avoidance of strain on the shafts. Slipless, easy-running belts are most desirable.

If the power plant is considered as a chain of links, the first link is the coal on the grates, which only perfect combustion can turn into maximum heat; next the boiler shell and tubes—they must be clean to bring the heat link to the steam link; next the steam line from boiler to engine or turbine, large enough and well insulated; then the engine or turbine link which joins heat energy and mechanical energy—only careful design, proper valve setting and much care minimize losses here. Then, where power is distributed solely through belts and pulleys, the belts, pulleys, and shafts or electrical cables to the final motors and belts are the connecting links up to the machines themselves.

If the efficiency of every link is maintained at its highest point the power end of the plant is beyond criticism. The overall efficiency will then be very high. But if the efficiency of every link is low or indifferent the overall efficiency of the power end will be distressingly low.

Each per cent. of slip in a main drive represents a loss of 1 per cent. of the coal pile, and roughly 2 per cent. of the potential power in the driving pulley of the engine is represented by belt creep. Its loss is unavoidable because of the elasticity of the belt. This has been recognized and provided for in the chart, so the reader can proceed to connect known values, while the intersection with column "D" gives the avoidable money loss.

Simply zig-zag across the chart twice with a straight edge, as shown by the dotted lines, and the money loss is immediately found. Thus, if the total belt slip is 6 per cent. (column "A") and the cost of coal per ton is $4 (column "B") run a straight line through those two points and locate the intersection with column "C." Then from that point of intersection run over to the tons of coal burned per year (which in this instance has been stated as 1,000 tons) and the cost of ovaidable belt slip per year is shown by column "D" as being $160.

To give a clear idea as to the meaning of "total belt slip per cent." take an example. It is found by means of a revolution counter that a given driven pulley is rotating only 940 times per minute, while calculations show that without slip it should rotate 1,000 times per minute; 60 revolutions per minute, therefore, are absolutely lost. Dividing this 60 by the r.m.p., that pulley should make you get 0.060 or 6 per cent., which is the "total belt slip." After having made this determination, now it is a simple matter to apply it to the chart, as has been done and determine the money loss per year due to such slip.

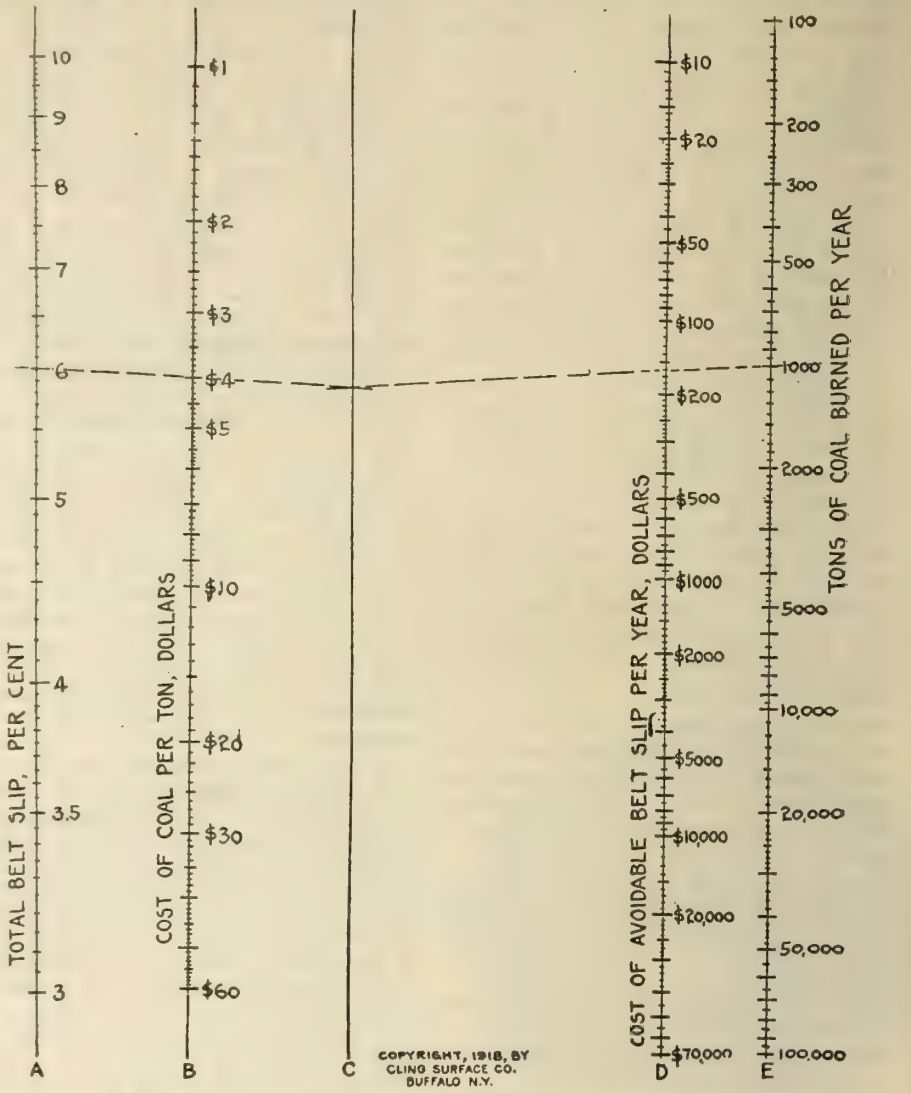


CHART SHOWING HOW AVOIDABLE BELT SLIP INFLUENCES COAL COST.

THE DETERIORATION OF STEEL PLATES SUBJECTED TO THE ACTION OF ALKALINE LIQUORS

THE present phenomenal expansion of various chemical industries has brought to the fore numerous questions relating to the design and durability of various types of apparatus connected therewith. One of the most interesting subjects recently investigated has been the action of caustic liquors upon the steel plate of which autoclaves and other apparatus are made. Anything bearing on this subject is of value to those connected with the design and operation of steam generating equipment as in many cases it is necessary to use boiler feed water having a comparatively large alkaline content.

Recent Experimental Work

Mr. C. E. Stromeyer, chief engineer of the Manchester Steam Users' Association, has recently conducted a series of tests to determine the effect of alkaline liquors upon iron and steel, as regards the promotion of brittleness and the difference in behaviour when various stresses, strength of liquor and periods of exposure are compared. His conclusions are summarized in a memorandum recently issued, from which the following is abstracted:

One recent experience with the action of caustic soda was with some evaporator tubes. These cracked above and below the tube plate. At the plate zone, where the expander had produced a compression stress in the tube there were no cracks, but tube plates in which there would be tension stresses, and also occasional rivets were very seriously affected. In order to ascertain whether, as suspected, the embrittlement of steel in contact with caustic liquor occurs only when the steel is in tension, the following experiment was carried out:

Several pairs of rings, as shown in Fig. 1, were cut out of a solid plate. Some of these rings had taper outer

FIG. 1

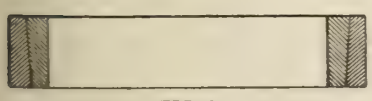


FIG. 2

edges, others had taper inner edges. They were placed one above the other as shown in Fig. 1, and the one ring was driven over the other as shown in Fig. 2. By this means the outer ring would be maintained in a condition of tension, and the inner one in compression. There were altogether seven rings. One ring was not stressed, but boiled for a short time, one pair was annealed before stressing, the other two pairs were not annealed. The one annealed, the other unannealed, but stressed rings were placed in a caustic evaporator in which the density was not excessively high, and these were returned to this office after four months' exposure. All the rings were then cut up into small segments, and of each ring one short piece was bent inwards, and the other outwards.

The results were very consistent. All the untreated samples, and also all those which were in a compressed condition when exposed to the caustic bent double without the least sign of cracking, but the two, the annealed and unannealed rings which were in tension while exposed to the caustic, cracked in innumerable places when bent. These cracks appeared both on the outer surface, which was in direct contact with the caustic, and on the inner surface which was not in contact with caustic but was pressing hard against the compressed inner ring. Evidently, therefore, the influence of the caustic had penetrated through ¼ in. of metal.

Further Experiments

In view of repeated inquiries, and also because of a very alarming experience it was decided to deal with the question on more comprehensive lines. Accordingly four sets of bars were obtained, viz., open-hearth steel both acid and basic, Bessemer steel and wrought iron. They were cut into 10-in. lengths, curved in boiler rollers, placed back to back between two stout iron plates (see

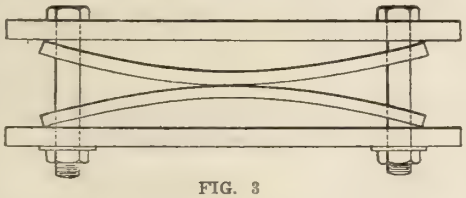


FIG. 3

Fig. 3), and the end screws were then screwed down, whereby the samples were nearly flattened as shown in Fig. 4. In the meantime four autoclaves were produced, one set of four samples was inserted in each one of these, caustic soda solutions of various strengths were poured into the several autoclaves, which were then hermetically sealed and placed in the steam space of a Babcock and Wilcox boiler and left there for four months.

On removing and opening the autoclaves it was disappointing to find that the treatment had entirely removed the spring out of the samples, the least turn of the bolt nut allowing it to be slacked back entirely. The condition of maintaining the samples in a stressed condition had, therefore, not been fulfilled, and on testing the samples by bending them, it was found that their ductility had not been impaired in the least. This experience was very disconcerting and may account for the results obtained by Professors Heyn and Parr, who could detect no effect due to straining. The experience is, however, not without practical interest, as it points to a possibility that caustic liquor may cause a slacking back of rivets and caulked edges, and lead to leakages. The experience also reminded us that during the previous tests it had been noticed that the two rings, Fig. 2, which had not been exposed in the evaporator were firmly wedged together, while the exposed ones dropped apart quite easily. Evidently nearly all of the spring had gone out of the metal.

Hardening Effect of Alkalies

The caustic liquor had, however, produced a very marked effect on the samples, Fig. 4. The samples as bent and exposed were too wide for the impact testing machine and had to be sawn in two. Much to our surprise the bandrun at the very slowest speed, and even

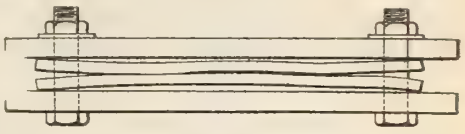


FIG. 4

then broke their teeth, and yet the original bars could be cut quite easily at the highest speed.

It will be no easy matter to devise tests which will maintain the samples in a strained condition, for in the above experiments the stress had to be produced by the elasticity of the material, and if that fails the stress disappears. The case is different in a boiler, for there the stress is due to boiler pressure, and though the caustic may relieve some stresses, as is shown by the flying off of rivet heads, the average stresses will be maintained and some local stresses may be even increased.

Professor Heyn has published nothing on this subject but wrote that he could not confirm my results. Professor Parr in the 94th bulletin of the University of Illinois deals with the following points. He notes a change of electric potential if steel is immersed in caustic. The tensile tests show a reduction of tenacity of about 30 per cent. after treatment, but this reduction was not influenced by changes in density of the liquor. The elongation improved about 10 per cent. The samples which were stressed during exposure behaved in the same way.

Judging by our experiments and the description of Professor Parr's it is doubtful whether his samples were really stressed while exposed. He also submitted some of his exposed samples to alternate (fatigue) stresses, and found a reduction of about 20 per cent. in the number of reversals before fracture occurred. The impact test results were about 10 per cent. lower for the treated than for the untreated specimens.

The Influence of Hydrogen

Professor Parr's most important results are his determination of the hydrogen which is absorbed by steel and iron when immersed in caustic soda, and as it is well known that hydrogen makes certain steels very brittle these determinations should explain the brittleness. However, as already stated, this brittleness seems to be produced only if the steel is stressed during exposure.

The seriousness of the action of caustic soda will be evident from the following case:—

At the works of one of our members, complaints were made to the manager that steam was escaping from one of the

boiler shells to such an extent as to damage the goods in a drying loft above the boiler house. A boiler maker was sent for who found some headless rivets in the butt strap of the third shell ring, and he was able to knock off a few more rivet heads. He renewed altogether nine successive rivets (in the outer or lowest row) and reported to the manager that he had noticed cracks in the shell plate between the butt straps. He suggested inserting additional rivets! Fortunately the works' manager took a more serious view of the situation and informed us. Our inspector removed a few more rivets and found more cracks, whereupon we asked that the butt straps should be removed, which was done.

Nature of the Cracks

The nature of the series of cracks was then revealed (see Fig. 5). Close to the rivet holes the cracks gaped as much as ¼ in., and the region between two rivet holes seemed to be completely disintegrated, so much so that a few pieces could be picked out. The surprising point about this case is that although the length of the crack was 5 ft. 6 in. (the boiler was built of four single-plated strakes 7 ft. 6 in. long, yet the friction of the butt straps prevented the plate from slipping out. The shell plates were 25-32 in. thick, the butt straps ¾ in. thick, the rivet holes ⅞ in. diameter, and the pitches 2½ in. lengthways and 2⅝ in., 2 in., 2⅝ in., 2 in., and 2⅝ in. circumferentially.

The cause of the cracking of the plate could not be investigated for the following reason. I had been empowered to buy the whole or part of the boiler, but difficulties were constantly raised by the owner, and as time was passing I offered to send a man to the works who would cut out the fractured plate. Instead of assisting in the discovery of the cause the owner induced the builders of the boiler to buy it back. When we heard of this we at once applied to them for some portion of the plate, but after some delay we were informed that they were quite satisfied in their own minds as to the cause of the failure, and that they had in the meantime sold the boiler to a second-hand dealer. After some delay we received his name and at once applied to him, but the answer was equally unsatisfactory. The only piece of information which was obtained from the boiler-makers was the name of the steel maker. These works have a well-established reputation, but seeing that our inspector had most carefully searched the plates without finding any brand, although the plates measured nearly 8 ft. by 25 ft., and as these boiler-makers had on previous occasions been using Continental basic steel, I do not attach much importance to this information.

Nevertheless, although the boiler-maker may have had reasons for objecting to a searching inquiry, it does not follow that the quality of the material was the only or the primary cause of the failure, which failure may have been due to the treatment which the boiler had received while in use. Until our suspicions were directed to the quality of the steel our impression had all along been that the crack was due to the introduction of caustic soda into the boiler which admittedly had been the case, for the condensed steam from some caustic evaporators at these works was drained into the hot well and was said to be very alkaline upon several occasions. As the make-up water was fairly pure and the boilers were steamed for long periods at a time, the water in the boiler might easily become concentrated to a dangerous degree.

Effect on Marine Boilers

This view receives some confirmation from a paper by Dr. Wolff of Holland, which was read at a recent meeting of the Iron and Steel Institute. His company (ship owners) seems to have had quite a crop of shell-plate failures. First one marine boiler exploded, this is almost a unique experience, then the shell plates of a sister ship boiler were found to be cracked in a very similar manner to that of the present boiler, and then other boilers failed, but about these no details were given, though it was mentioned that some were built of acid steel.

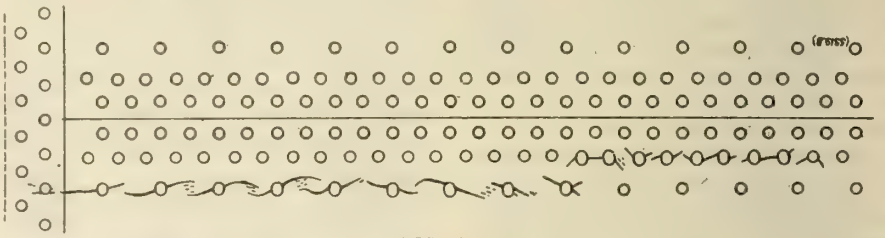


FIG. 5

RELATIVE FATIGUE TEST RESULTS EXPRESSED IN PER CENT. OF AN UNTREATED SAMPLE.

Duration of Immersion. Days.	Temperatures during Immersion. 100 Deg. C	180 Deg. C	280 Deg. C
	%	%	%
5	..	..	79
8	..	..	56
10	..	64	57
13	..	..	**80**
15	..	69, 82	75, 73, 79
16	..	..	77
17	85	..	..
19	..	82	..
23	..	88	..
24	..	90	..
30	110	..	..

Dr. Wolff seems to attribute these failures to the well-known irregular distribution of stresses in riveted joints, which are common, of course, to all marine boilers, of which there are probably 50,000 afloat and perfectly safe, but at the end of his paper he makes a very significant remark, based on Professor Mercia's experiments, and published in Professor Parr's paper (see above), which seem to suggest that the boilers in question had been dosed with soda for some considerable length of time. Professor Parr's paper contains the results of a number of experiments from which the information contained in Table III has been extracted. Samples of steel were immersed in solutions of caustic soda. One set was kept at a temperature of 100 deg. C. (212 deg. F.), another at 180 deg. C. (356 deg. F.), and a third at 280 deg. C. (536 deg. F.). Occasionally samples were withdrawn and tested and the results compared with those of untreated samples. These results were all reduced to percentages of the original. The tenacity, elongation, etc., do not seem to have been affected, but, as will be seen from Table III, caustic soda seems to have had a marked effect on the fatigue properties of these samples, unless, as may well have happened, the standard untreated sample had by some accident appeared better than it really was. This is quite possible for on the fifteenth day two samples were tested, and the results differed by 13 per cent.

It is doubtful whether Dr. Wolff is justified in drawing the conclusion that caustic soda causes at first a deterioration as regards fatigue and then an improvement, nor is he justified in judging the behaviour of boiler plates, which are subjected to static stresses by fatigue test experiments. However, he says, "that as the boilers crack after having been in service for one or more years, recovery of the material from the effect of alkali, mentioned by the author, should have taken place long before the cracks started."

We have therefore his case and ours in which there is a strong suspicion, though no actual proof, that caustic soda in boilers leads to dangerous embrittlement of the plates. Carbonate of soda, as is well known, is gradually converted into caustic soda under high pressure boiler conditions. This change was, in fact, the cause of a number of boiler explosions in America which led to the committee being appointed, on whose work Professor Parr based his report. But American boilers are built of basic steel which will occasionally crack even if not exposed to caustic soda, and the question still remains unsettled as to what was the cause of these several failures; was it the use of basic steel, or was it due to caustic soda?

A DEAD SHOT

The valor and candid simplicity of our Indian Babu are proverbial. A story goes of one, anent the German East campaign, who was about the most laconic, competent, deadly earnest station-master and marksman combined that ever lived. A regiment of men like him would end the war, for this is the wire he sent: "One hundred Germans attacking station. Send immediately one rifle and one hundred rounds of ammunition."—Tit-Bits.

Everyone has some important work that calls him. Get at it to-day.—T. A. Clark.

Blessed is the man who has found his work—and then—gets busy!—Backbone.

Power Users Should Look Right Ahead Now

Ontario is Using and Calling For More Power Than is Available —The Steam Plant Should be Utilized For Power Where Steam is Necessary For Heating Purposes—Time to Take the Warning

By F. W. SUTHERLAND, Assoc. Editor Power House.

RECENT reports concerning the available coal supply granted the Ontario district by the U.S. Fuel Administration point very strongly to the necessity for economy in coal consumption during the coming winter. It is extremely probable that only about 70 per cent. of last winter's supply will be available.

This will probably work greatly to the disadvantage of the manufacturer employed on the so-called non-essential industries and very little relief can be expected from Hydro-electric developments until the new year when the new penstock and turbines will be available at the Ontario Power Company's plant for the furnishing of about 50,000 additional horse-power.

The extent to which the consumption of electricity has increased may be judged from the demands made upon the Niagara system of the Hydro-Electric Power Commission. The Toronto system in November, 1917, had over 50,000 customers and a connected load of about 75,000 horse-power for which at that time only about 50,000 horse-power was available. The result of this power scarcity last winter was seen in the curtailment of street and store-lighting and in the cutting off of feeders serving a purely residential load at times during the day when the peak load came on.

It is idle to expect any improvement in this condition during the coming winter, at least until new supplies of power are made available and in the distribution of the available power, munition plants, in the wider application of the term, must necessarily come first. Undoubtedly much power and light are absolutely wasted and the time is probably close at hand when drastic measures must be taken to curtail the use of electric energy now employed on luxuries and thus make it available for necessary purposes.

Niagara and the Munitions Industries

The diverse and extensive demands upon manufacturers for materials of war and of the necessity for ample supplies of power consequent upon this demand are sometimes overlooked. Of the immense amount of power generated in the Niagara district the greater part is used in manufacturing of munitions of war such as abrasives, aluminum, chemicals, steel and other electro-chemical and metallurgical products. The Niagara district supplies the bulk of the ferro-alloys, all-essential in the steel industry. Abrasives, cyanides, aluminum, carbon, electrodes, and many other products are urgently needed in the war game.

The average individual has little or no idea of the important part played by abrasives, to use the term in its widest sense. If asked concerning his knowledge of the subject, he would undoubtedly reply that it extended to the sharpening of the various cutting instruments with which he was familiar and that he possessed a vague idea that sometimes "grinding wheels were used in machine shops for various kinds of rough work."

So far is this from the truth that it need only be mentioned that modern grinding methods alone make possible the standardization and quantity production of munitions by means of the close limits in workmanship made available by their use. Not only are abrasives necessary in the making of munitions but their use is all-essential in the manufacture of machine tools, textile machinery and other means whereby everything the soldier uses and wears is made. It is interesting to note that the artificial manufacture of corundum being carried on in the Niagara district has a direct and important bearing on the production of ferro-alloys, ferro-silicon being produced in quantities as a necessary part of the process.

1. One means whereby the power shortage may be somewhat minimized is by the use of steam power wherever available. This recommendation may seem somewhat futile in the face of the scarcity of coal but much can be done in the efficient utilization of the available supply. It is a notorious fact that central station energy can often be sold for a lower figure than that for which power can be generated in the isolated fact. This in a large measure is due solely to the inefficient operation of the smaller plant and when steam is used for heating or industrial processes it is not only cheaper to generate power from it and to use the exhaust steam, but it is a serious waste of the country's resources not to take advantage of this source of power. While the most efficient prime mover is only able to extract a small percentage of the total heat put into the working fluid, steam, when this power can be generated at a cost consisting of capital charges and maintainance only and the remaining heat utilized for industrial heating and other uses, the steam engine or turbine becomes a good investment and a direct aid to conservation.

Aside from the above means of deriving energy the more efficient operation of every steam plant or other means of using fuel for industrial uses or heating is a matter of some concern. The average power or industrial heating plant is after all no more economical than that notorious fuel consumer, the house furnace, and better operation ought to be rigorously enforced. It is an easy and not very costly thing to provide indicators, gas analysis apparatus and other means of testing fuel consumption and the benefits derived from their use more than balance the outlay involved. The elimination of soot and scale on boiler surfaces and proper methods of firing are also steps in the right direction.

2. The curtailment of power used for street and ornamental lighting has been of much benefit and the continuation of this means of saving energy may be expected for some time to come. It is probable that in addition further restrictions will be enforced tending to the limitation of power used in industries not essential to the winning of the war. This if put into effect would have a twofold advantage in that it would also divert a certain amount of labor into very desirable channels.

3. The more efficient utilization of the capacity of existing plants in the Niagara district has been gone into rather carefully and much is being done along this line. Water is being used up to the limit fixed by international treaty and the excess capacity of the plants is thus being utilized. The new Chippawa project which the Hydro-Electric Commission has started will, with the more efficient utilization of the water, due to the greater head, provide about 200,000 horse-power, but this will not be available for about two to three years. The size of the individual units (50,000 horse-power) is larger than in any other hydraulic development in the world. While this plant is under construction the commission are moving as rapidly as possible to have additional equipment installed so as to have available in about ten months an additional 50,000 horse-power from the plant of the Ontario Power Company.

The situation as at present existing must necessarily work to the disadvantage of the places somewhat remote from the source at which power is generated and the recent action of the National Abrasives Company in moving to the Falls is explained when the engineering requirements in connection with the transmission losses in this case amounting to possibly 10 per cent. are obviated and an equal amount of power saved for other essential industries.

The MacLean Publishing Company
LIMITED
(ESTABLISHED 1888)

JOHN BAYNE MACLEAN - - - - - President
H. T. HUNTER - - - - - - Vice-President
H. V. TYRRELL - - - - - - General Manager

PUBLISHERS OF

POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power, and to the design and operation of Refrigerating Machinery.

B. G. NEWTON, Manager. A. R. KENNEDY, Editor.
Associate Editors:
W. F. SUTHERLAND J. H. RODGERS (Montreal) T. H. FENNER

OFFICES

CANADA—
Montreal—Southam Building, 128 Bleury St., Telephone Main 1004.
Toronto—143-153 University Ave., Telephone Main 7324.
Winnipeg—1207 Union Trust Building, Telephone Main 3449.
Eastern Representative—E. M. Pattison.
Ontario Representative—S. S. Moore.
Toronto and Hamilton Representative—J. N. Robinson.

UNITED STATES—
New York—R. B. Huestis, 111 Broadway, New York, Telephone 8971 Rector
Chicago—A. H. Byrne, 900 Lytton Bldg., 14 E. Jackson Street, 'Phone Harrison 1147
Boston— C. L. Morton, Room 733, Old South Bldg., Telephone Main 1024

GREAT BRITAIN—
London—The MacLean Company of Great Britain, Limited, 88 Fleet Street, E.C., E. J. Dodd, Director, Telephone Central 11960. Address: Atabek, London, England.

SUBSCRIPTION RATE

Canada, $1.00; United States, $1.50; Great Britain, Australia and other colonies, 4s. 2d. per year; other countries, $1.50. Advertising rates on request.

Subscribers who are not receiving their paper regularly will confer a favor by telling us. We should be notified at once of any change in address, giving both old and new.

Office of Publication, 143-153 University Avenue, Toronto, Ontario.

Vol. XI. SEPTEMBER, 1918 No. 9

PRINCIPAL CONTENTS

Refrigerating Plant of Armour & Company 245
General 248
Pulverized Fuel Combustion 249
Power Plant Management, III. 250
General 252
Relation of Efficiency to Boiler Room Capacity....Efficiency in Refrigeration.
Electricity and Hydraulics 254
Principles and Operation of Modern Electrical Equipment.
Turbo-Alternator Rotors: Features of Mechanical Design..... 256
General 262
The Cost in Coal of Avoidable Belt Slip 264
The Deterioration of Steel Plates Subjected to the Action of Alkaline Liquors 265
Power Users Should Look Ahead Right Now 267
Editorial 268
Association and Personal 269
The Operators' Point of View 270
Babbitting and Scraping Hints for the Power House Engineer....Emergency Repair to Piston....Method of Saving Fuel....Enquiry re Graded Certificates....Graded Certificates.
New Equipment 274
Winnipeg Men Are Anxious About Supply of Alberta Coal This Winter 275
Selected Market Quotations 48
Trade Gossip 49

Instruction as an Aid in Power Plant Operation

WHEN the railroads were forced to adopt the air brake they were quick to see the advantages of thorough instruction in the care and maintenance of the system. Models of all the necessary apparatus used to make up the complete braking system were installed in cars under the charge of competent instructors. The sectional models showed all the parts that ordinarily would be concealed from view and the men were able to learn the functions and names of the various parts with very little trouble and much more thoroughly than would have been the case if left to themselves. It is unnecessary to comment on the many manuals and books of instruction issued on the same system and the advantages of the instruction offered are well demonstrated in the remarkably high efficiency obtained to-day.

Modern power plant equipment has been brought to a high state of efficiency in the past few years and while many improvements may yet be effected, these will probably be along the lines of more efficient plant management and operation.

Since the inherent efficiency of the equipment cannot easily be increased, a writer in *Industrial Management* goes on to say that attention must be turned to methods of increasing operating efficiency and as operating depends almost entirely upon the skill and experience of the operator an effort should be made to increase his knowledge of the machinery he is operating. Systemization and standardization of operating methods will also be in order.

It seems a poor policy for a company that is spending thousands of dollars annually instructing the public in the mechanism of electrically operated machines that it sells to install machinery costing thousands of dollars in its power plant, without so much as furnishing the men who are to operate the new equipment with the manufacturer's catalogs and instruction bulletins. Yet this is being done daily.

Probably the greatest fault in the methods of instruction that are being used by a few companies to aid the operating men is that the courses are prepared by men who are not thoroughly familiar with what the practical man needs to help him most in his everyday work. This is the cause of a great deal of energy being wasted by the instructor and instructed. The universal method or system of instruction consists of a series of lectures or talks given by college professors or technically trained engineers who are wasting time lecturing on the theory of power plant economics to men who in a great many instances are not familiar with the apparatus which they are operating. This educational work is usually too broad and advanced to apply to the problems which the practical man must solve daily.

Costly breakdowns and serious interruptions of service would many times be prevented if the operator thoroughly understood all the constructional details of the machinery in his care. The instruction and aid that the practical man needs most to enable him to increase the operating efficiency of the modern power plant is that which will acquaint him with the constructional details and the best methods of operating the machinery in the particular plant in which he is working.

The system which in practice will benefit the employee and the employer the most will be one that will familiarize the operator with the working theory of the machine, the correct names, positions, actions, relations and adjustments of all the various parts, the proper method of dismantling and assembling the machine when making inspections or repairs, proper operating methods, most likely causes and remedies of troubles that may arise while the machine is in operation, and finally the running of tests by the men on the job.

Oshawa Reformer.—There is one regretable feature in the situation, that is that many who have been making the highest wages they ever made in their lives have been living up to every cent of it and were they out of work for a few weeks, or even a few days, they would be bankrupt, and a charge on the town, as was the case through the slump of 1913. They never seem to learn the importance of preparing for a "rainy day."

Association and Personal

Word was received last week of the death in action on August 28th of Harold C. Fogarty, formerly associate editor of CANADIAN MACHINERY. Enlisting July 2nd, 1915, going overseas as a member of the 198th Battalion the following spring, he was reported wounded last year and was in hospital for some time. He was a keen student and his training as a machinist and draftsman made him peculiarly fitted for editorial work. During his work on this paper he made a wide circle of friends who will learn with sincere regret of his death.

Albert E. Gilverson, president of Rice Lewis & Son, Limited, has received word that his youngest son, Pte. Russell Lloyd Gilverson, was wounded on Monday, September 2. Pte. Gilverson enlisted in the fall of 1915, and has been of late attached to "J" Battery, 1st Canadian Machine Gun Battalion. He was educated at Woodstock College, was an enthusiast in athletics and a lover of the gun, being an accurate shot and one of the youngest and most active members of the Mimico Gun Club. On leaving college Pte. Gilverson entered the service of his father's company and occupied an important position in the sporting goods department and was well known and very popular in sporting circles in Toronto.

Tillsonburg, Ont.—An electric motor and pumps may be added to the present equipment of the waterworks pumping plant. The matter is now before the Town Council.

Power Shortage.—At a meeting of the members of the Board of Trade and Industrial Committee and manufacturers of the city last evening the recent further ten per cent. cut in the city's supply of Hydro-electric power was discussed. A resolution was adopted that a strong protest should be lodged with the Dominion Controller, Sir Henry Drayton.

Newcastle, N. B.—An electric light plant at an estimated cost of $125,000 may be erected here. The contemplated project is having the consideration of the Light and Water Commission of the City Council.

The new Dartmouth plant of the Imperial Oil Company was recently inspected by the members of the Rotary and Commercial Clubs and the Board of Trade. The entire property covers 479 acres and the output, when under maximum operation, will approximate 10,000 barrels of oil per day.

Removed Works.—The Lancashire Dynamo & Motor Co. of Canada, Limited, announce that on September 1st, 1918, their head office and works will be located on the south-east corner of Niagara and Bathurst streets, Toronto. The works will be equipped to handle repairs and rewinding of all types of electrical machinery efficiently.

Chicago. — Two big exhaust relief valves, weighing 12,300 pounds each have been shipped to the American Gas & Electric Co., at Peach Bottom, Va., by the G. M. Davis Regulator Co., Chicago. These are 42-inch valves, measuring eighty inches from face to face of the flanges. The bodies and discs are of cast iron and the stems, seat rings and stuffing box glands are of bronze. The water drains are supplied with outside connections, ¾ in. inlet and 1 in. overflow. Heavy brackets cast on each side of the bodies provide means for support. This is a repeat order, as two similar Davis valves were previously supplied to the same company.

Rossland, B.C.—The Consolidated Mining & Smelting Company of Canada, Limited, at Rossland, B.C., is to give a $500 scholarship in 1919 to the son of any employee of the company working at day labor who heads his class in the matriculation examinations for applied science in the British Columbia university, according to announcement just made by Mr. J. J. Warren, managing director of the company. The object of the company is apparently to encourage the technical or scientific education of the sons of its workmen. The constantly broadening field of the company's operations should provide workmen's sons full opportunity to use their scientific training to their advantage and in their own home towns where their families live.

SOME OF THE THINGS SEEN AT TORONTO EX.

Cowan and Co.

Cowan and Co., of Galt, are showing several of their line of woodworking tools—a gear driven upright borer, a hollow chisel mortiser, and box makers' cut off saw forming part of the equipment. A buzz planer with round cylinder and guard is shown and this machine may be fitted with either high speed or carbon steel knives.

One of the latest machines shown by Cowan and Co. is a manufacturing scroll saw in which several valuable improvements have been effected. Upper works, which formerly gave tension to scroll saws, have been done away with and a guide arm carrying a swinging guide plate substituted. This enables the insertion of the saw in a starting hole to be accomplished with a minimum amount of effort and this together with the elimination of inertia effects of a heavy tension mechanism enables a high rate of speed and consequently production to be maintained.

Electric Soldering

The Clemens Electrical Corporation, Ltd., Hamilton, are featuring the J. C. electrical soldering tools. The heat necessary for successful soldering is developed at the spot where needed and in the body of the metal itself by the action of carbon resistance tips connected to a low voltage and large capacity electric current. The source of supply may be either a transformer supplied with the outfit or a storage battery for work around garages, etc.

A special type of solder feeding tool and single prong soldering tool are used for soldering small lug terminals, switchboard wiring and automobile parts.

International Chemical Co.

The International Chemical Co., Toronto, are showing the Betson plastic fire brick products, used for forming jointless one-piece furnace linings in new or old settings. The old lining of pre-brick is stripped away and a lining of the plastic brick is built up by placing it in chunks and consolidating it with a mallet. Gas tight vertical baffles for water-tube boilers are readily made up by the use of this material. Horizontal baffles are also easily constructed.

Amalgatex is a concrete floor hardener, which, unlike paints, forms a chemical union with the cement of the floor and eliminates the wear and dusting so common to concrete floors.

Another product featured by this company is a boiler compound, "Protecto," which has a mechanical action on the scale itself. Water treatment will not entirely prevent scale and corrosion and this preservative forces its way through the scale, crowding off the scale and incrustations and films, the metal protecting it from further action.

For the prevention of air leakage into boiler settings a boiler coating is shown. Protecto coat, as it is called, is a semi-plastic combination of synthetic rubber, long fibred asbestos, gums and non-drying oils firmly adherent to the brickwork and expanding and contracting with it.

The Operators' Point of View

BABBITTING AND SCRAPING HINTS FOR THE POWER HOUSE ENGINEER

By M. H. P.

TO make a bearing ready for pouring, secure the mandrel in position and make tight around the ends of the journal, either with putty or with moistened clay. When putty cannot be obtained, clay worked between the hands until free from lumps and plastic makes a very good substitute. In making tight around the end of the box, particularly where there is considerable space between the casting and the mandrel, take care not to press the putty or clay into the lining space. Should there be ¼ inch or more space some wooden heads should be cut out to fit the mandrel and clamped against the box casting. If it is a repair job and there is neither time or opportunity to fit heads, then rub some putty into a small cord and wind around the mandrel close against the end of the box. The cord will serve as heads, and some more putty daubed on the coils will make everything tight.

Covering Mandrels With Paper

Bearings may be cast direct upon the shaft which is to run in them, but it is better to have a mandrel for that purpose. If the journal must be used, place a sheet of strong, smooth paper around the journal so that the babbitt does not come in direct contact with the metal. This is also excellent practice in all cases where mandrels are used for babbitting single boxes. Where many are poured in succession the mandrel becomes heated and does not chill the hot babbitt, hence the paper becomes unnecessary.

When poured directly upon the journal, babbitt pinches the shaft along the line of division between box and cap, and scraping is necessary to make the journal fit the box after the lining has been poured. The thickness of paper around the journal, combined with the shrink of the soft metal, relieves the journal so that on rough work little or no scraping will be found necessary, the arrangement of the liners giving all the adjustment necessary. On fine work, however, scraping will be necessary. In fact, all fast running and close fitting bearings should be scraped to fit the journal which is to run in it.

Sometimes the soft lining is peened to make it tight in the casting. When babbitt or other lining metal is poured into a cold casting the lining becomes chilled before the iron casting becomes heated, therefore, when the soft lining finally cools it shrinks away from the casting and becomes a loose, rattling nuisance which must be peened to make it tight in the journal bearing casting. Heating the box before pouring in the soft metal lining is a cure for looseness, as the iron casting then shrinks with the soft metal lining on cooling and holds fast when cold.

There is another way of fastening a lining tightly into a cold casting, and that is by using one of the antimony alloys as a lining. Antimony, when alloyed with lead and with some other soft metals, loses the power of shrinking during the freezing process, and like water expands and fills the casting so tightly that there is no rattle or looseness. Therefore, when forced to line a cold bearing, use an antimony alloy. It is for this purpose that the antimony alloy is used for casting printing type. The expansion of the alloy during the instant of solidifying or freezing causes the metal to expand into every corner of the mold. The same is true with the antimony alloy in the journal bearing.

Forming Oil Channels

Oil channels may be formed in the lining by winding small cord around the mandrel. The cord should be of the hard spun variety and preferably should be rubbed smooth with putty before being wound upon the mandrel. The cord

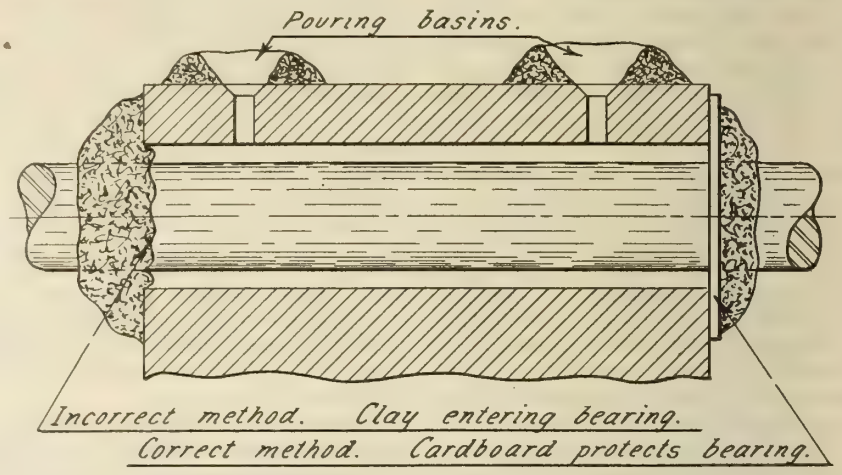


FIG. 1.—RIGHT AND WRONG METHODS OF STOPPING OFF ENDS OF BEARING.

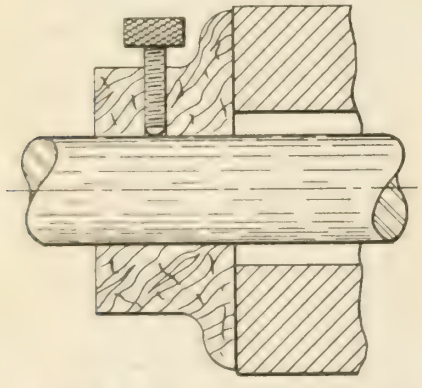


FIG. 2.—THE USE OF WOODEN HEADS.

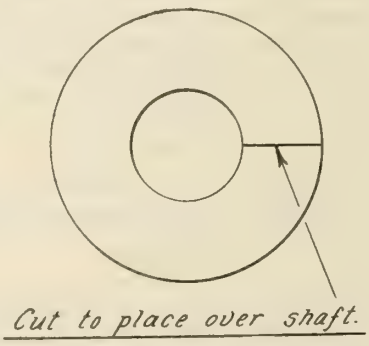


FIG. 3.

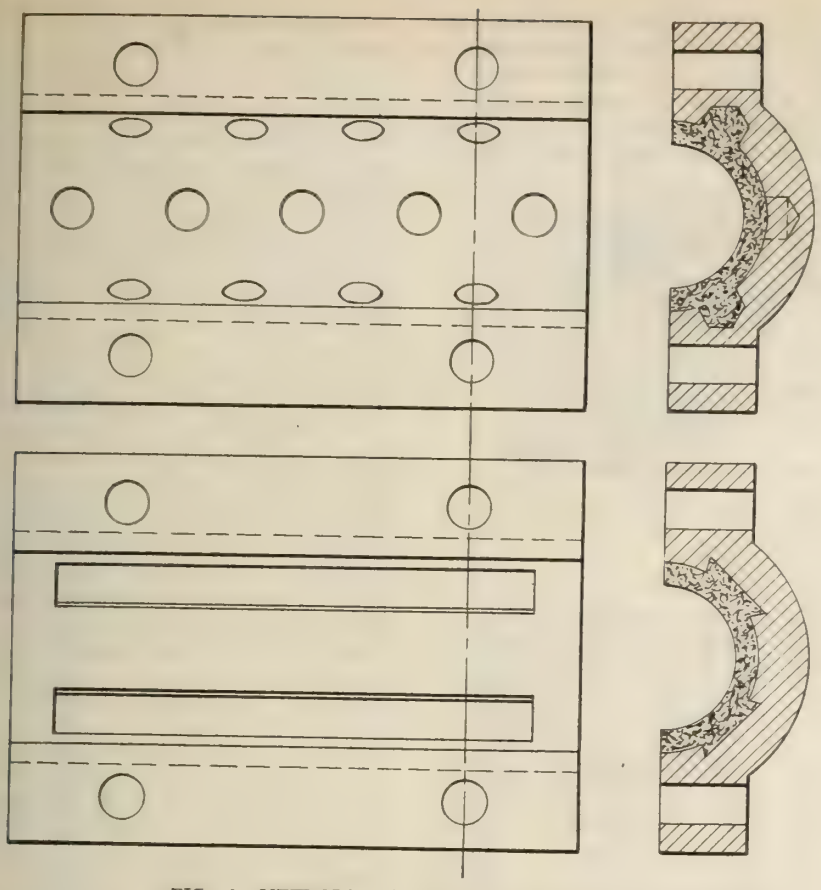


FIG. 4.—METHODS OF KEYING BABBITT IN BEARINGS.

must be wound in the direction that the shaft is to run. It does not work well when a passage must carry oil against the rotation of a shaft. When cap and box are to be poured together, cut two notches in each liner, one notch at one end, then clamp the cap in place, taking care that the liners are against the shaft before tightening down the cap bolts.

If there are holes in the cap for pouring in the lining, besides the oil holes, then proceed to fit a white pine plug in the latter hole, fitting the plug tightly against the mandrel and let it project through the hole in the cap. After pouring, the cap may be easily removed by driving a cold chisel between cap and box, breaking off the metal which connects the cap and box linings through the four notches mentioned. These notches should not be more than ¼ inch on a side, and the section of soft metal lining being small is easily broken by driving in the cold-chisel. The four bits of ruptured metal should be carefully chipped or filed off smooth with the surfaces from which they project. Then drive out the plug in the oil hole and the cap is ready for scraping to fit the shaft.

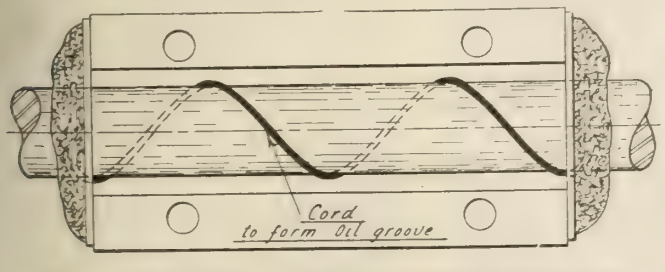


FIG. 5.—THE USE OF A CORD TO FORM OIL GROOVES.

Heating Babbitt Metal

Before pouring a bearing, it is very important that the babbitt metal be heated to the proper temperature. This may be roughly determined by inserting a piece of wood—white pine or similar soft wood—into the hot babbitt and noting the effect upon the wood. It is best to whittle the stick to a smooth, flat surface, similar to the paddle used for stirring paint. The surface of the molten metal should be kept covered with a layer of charcoal to prevent oxidization of the alloy. Thrust the whittled stick through the layer of dust on top of the hot metal and note results to the stick. If the metal is too hot it can be felt to be boiling around the stick, which will be charred more or less, or not affected at all, according to the temperature of the molten metal.

It is certain that the metal is too hot when the stick trembles in the hand and smoke rises from the submerged end of the stick. When there is scarcely any trembling to be felt in the stick while it is immersed in the hot babbitt, then the alloy is ready to pour. If the stick is not colored at all and metal almost adheres to the stick, then the metal is not hot enough and it will not flow properly if poured at that temperature.

When babbitt metal is at the right temperature the stick will be faintly charred after being immersed three or four seconds in the molten metal. Two or three tests will blacken the stick even when the metal is not quite hot enough to pour, therefore it is best to whittle a new surface on the test-stick after each immersion.

Pouring Soft Metal Bearings

Do not heat soft metal too hot, zinc is easily driven out of an alloy by too high temperature when melting, lead soon turns into dross upon exposure to the oxygen of the air when melted, and the higher the temperature of the melted metal the faster it will be rusted out by exposure to the air. It is for the purpose of preventing this loss of some of the metals that the surface of the molten alloy is kept covered with charcoal. But when the alloy is overheated, then oxidization proceeds much more rapidly and much metal is lost.

Do not skim the surface of the metal until it is clean of all dirt. When the ladle is tipped up, the bit of iron forms a floating dam which effectually prevents the covering of dirt from flowing out of the ladle, while the molten metal has free passage under.

When babbitt metal is melted in a pot, the alloy may be dipped out with ladles as required for pouring, and before dipping the ladle into the pot, push the covering to one side with the ladle, then pass the ladle below the surface of the alloy, taking care that the ladle is entirely submerged. Then lift the ladle out quickly and an excess of metal will be forced up by and above the ladle. As this excess of metal flows away, it forces back the charcoal covering on top of the alloy, and the ladleful of metal comes out of the pot clean, with no signs of dirt.

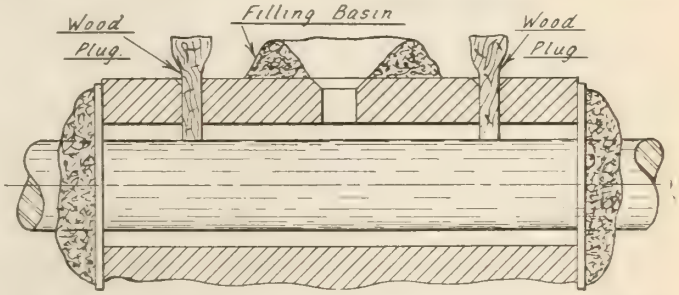


FIG. 6.—THE USE OF WOODEN PLUGS TO FORM OIL HOLES.

The metal must be poured very quickly when thus dipped up clean, for the reason that oxidization is going on all the time. Hasten the pouring operation once the

metal is heated and exposed to the air ready for pouring. The pouring must be done steadily.

Pouring Thin Solid Boxes

It has already been stated that the temperature of the alloy, when poured, should be just high enough to slightly char a soft wood stick. But when thin solid boxes must be poured, and there is a long narrow or thin space to be filled with soft metal, then it is sometimes necessary to pour the metal hotter than described. In such cases the metals to come in contact with the soft metal should always be heated as much as possible before pouring in the lining. When a ladleful of metal fails to fill a box, do not try to fill the box by pouring hot metal on top of the cold. Take down and chip out the partially filled bearing, set it up again, and pour from a supply sufficient to fill the bearing.

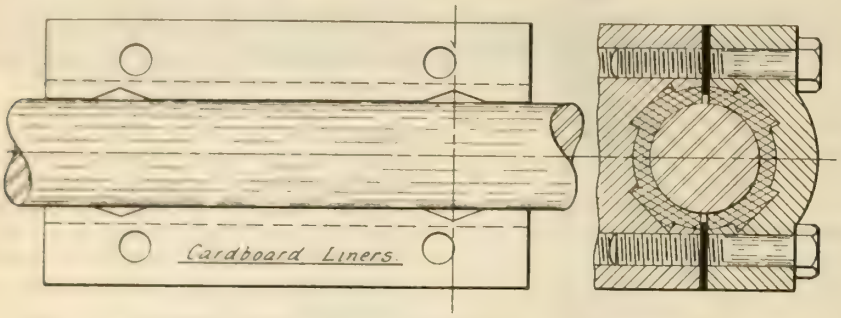


FIG. 7.—SHOWING THE USE OF CARDBOARD LINERS IN POURING A SPLIT BEARING.

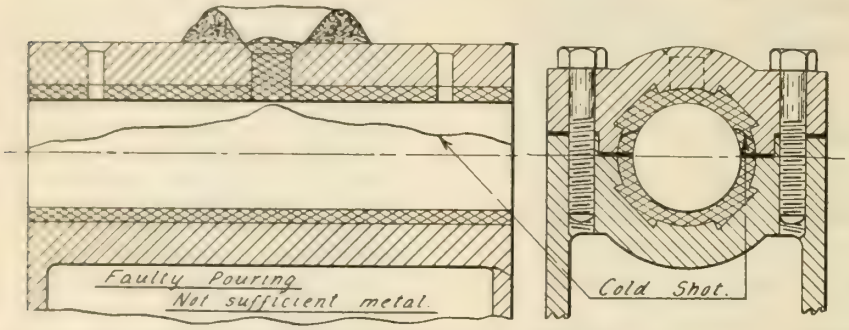


FIG 8.—THE RESULT OF FAULTY POURING. NOT SUFFICIENT METAL IN LADLE TO COMPLETE THE BEARING AT ONE POUR.

Scraping Bearings

In order to make a first class babbitting job the scraping operation is necessary. Even for rough work, should it be possible to make a good bearing without scraping, a better one can be made if the operation of fitting the bearing to the journal be carefully followed out. unless the journals are properly fitted to their bearings it requires a great deal of preliminary running so that the bearing will not heat. When a shaft hits a bearing only in two spots, at opposite sides and ends of a bearing, it cannot be expected that the shaft will run cool and steady in that bearing.

When a shaft is made up in a bearing and given a turn or two, and black spots appear in two or three parts of the babbitt with no marking elsewhere, then it is sure evidence that the shaft touches the bearing only at those two or three spots. The remedy is to remove the metal at those points until the shaft touches at four or five places instead of at two or three. Then remove the four or five and secure a bearing at eight or ten. Continue this work until the shaft has a bearing in many spots. In this way innumerable points of bearings could be obtained between the shaft and the babbitt, and it could be assumed that they touched each other at all points and that the contact between them was practically perfect.

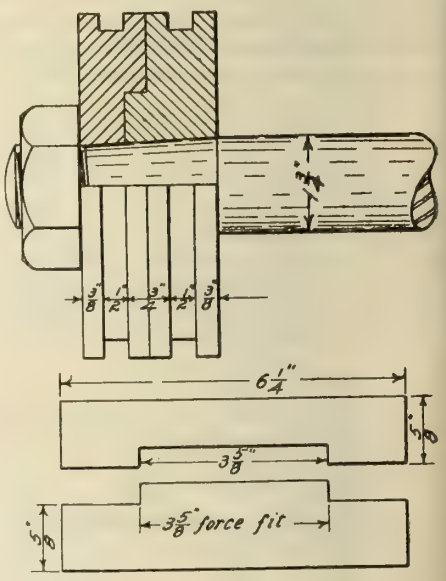
When fitting a bearing to a shaft as above, the blackened spots are removed by scraping, hence the name of the operation becomes that of scraping a bearing. A good job of fitting as above described may be done by the use of a common carpenter's chisel. By the use of this tool the blackened spots may be removed. A little plumbago or red lead mixed with oil and rubbed on the shaft each time will leave new spots to scrape off and the operation may be continued indefinitely.

EMERGENCY REPAIR TO PISTON

By J. H. HOULDSWORTH

Emergency repairs are frequently an important factor in maintaining the efficiency of a machine shop or power plant. Under certain conditions it is very often necessary that repairs be made at once to avoid shut down of the plant or one of the departments. Where equipment must be operated without rest the maintenance of such requires the most careful attention on the part of the engineer in charge.

The accompanying sketch shows the repairs made to a piston when the same was required at a time when all foundries were closed. This piston was used in a pump which was operated twenty-two hours per day, and the break developed at a time when a replacement in the ordinary way was impossible owing to the fact that it happened about noon on Saturday, with all foundries closed for the week. Repair was absolutely essential so some method had to be adopted to get the pump running again. After dismantling the pump it was found that the rod was also bent. The latter was not so serious, as the straightening was soon accomplished. Having a look around the shop we discovered a couple of old balance weights with a diameter of 7½ inches and a thickness of 2¼ inches, from which we made a very satisfactory piston as shown. We had two lathes available, so one was set to work to rough down the weight to about ⅛ inch of the required diameter of 6¼ inches, and the hole bored ⅛ inch smaller than the small end of the taper. The other lathe was then started on the second casting, this being roughed in a similar manner, with the exception that the hub of one was made a force fit for the other. One of the pieces was then removed and pressed into the other without removing the latter from the face plate. The two were then held firmly together by means of suitable clamps, and the center hole bored out to fit the taper end of the rod. After securing the piston on the rod the rod with the piston was placed on the lathe centers and the head finished to the proper diameter and the piston ring grooves turned in. We were able in this way to have the pump working before night, thus avoiding the necessity of obtaining a new pump. The pump was shortly afterwards replaced by one of greater capacity, and the old one sold, but the latter is still in good working condition, no trouble having developed from the impromptu repair.



PISTON REPAIR SAVES SHUTDOWN.

METHOD OF SAVING FUEL

By James Creeney

I noticed in the plant which I have charge of, the firemen, when checking the fire closed the ash pit doors; one day I noticed the increased current of air that went rushing through the air holes in the fire doors when the ash pit doors were closed, this made me think. We all know that the pressure inside a furnace is much less than the atmospheric pressure on the outside and for this reason cracks and other holes in the boiler settings lower the efficiency of the furnace by admitting cold air through these cracks. Now, by closing the ash pit doors the path of least resistance was stopped by which the air supplied the demand of the chimney, therefore the pressure inside the furnace must have been greatly decreased, causing a much greater leakage of cold air through the settings and rapid lowering of the furnace temperature. I fixed up the dampers in the uptake pipe so that the firemen could check their fires by closing it and leaving the ash pit doors open; by doing this we increased the air pressure inside the furnace and therefore decreased the amount of cold air entering through cracks. I have not made an evaporative test, but feel confident that a coal saving and less boiler strain is the result of the change. Some of our engineer friends will say that there should be no holes or cracks in the boiler setting to admit cold air, but in the absence of a flue gas analyzer it is next to impossible to know whether they have all been stopped or not.

ENQUIRY RE GRADED CERTIFICATES

A correspondent enquires if the proposed second class grade of certificate was to be issued without further examination to holders of present certificates.

The proposed certificates were intended to be issued to holders of the present licences upon the passing of an examination, this examination to be purely voluntary, the present certificate remaining the official government qualification. —Editor.

GRADED CERTIFICATES

By F. T.

The subject of graded certificates for engineers has again been occupying the attention of both engineers and legislators. This much-vexed question has a number of different angles of approach, and while in some cases and under certain conditions graded certificates may be of great value to both engineers and manufacturers, under different conditions they may be worse than useless. The agitation for this change in the licensing law has come mostly from the better class of engineers themselves, and has been opposed by the unions for their own reasons. Let us examine, from a common sense point of view just what advantages there are to be derived from the issue of different classes of qualifications.

In the first place let us get away from the idea that each man who has passed a certain kind of examination is equal to every other man who has gone through the same test. The individual retains his own characteristics, and no two personalities are alike. All that any graded certificate can do is to guarantee that the holder has had a certain amount of practical experience and is possessed of a certain amount of fundamental knowledge of his business. How far that knowledge goes depends upon the standard set by the governing body, and the standard of the examining body itself. A certificate cannot give any guarantee as to the holder's ability to handle men, or his ability to make a success of any plant he may be appointed to take charge of. What a certificate can do and should do is to indicate that the holder has had ambition and energy enough to get the highest endorsement of his qualifications that he could, and that any plant owner who engages him knows he is getting a man of definite practical experience and a definite standard of technical knowledge. This object can only be achieved by the issue of graded certificates by a competent body of examiners, and this is the most important point to watch, because it has not infrequently happened that the examiners have not been up to the standard of the examined. In one province that has a system of graded certificates the examinations do not achieve the aim they were set for, due to the conditions under which they are held. In this case the candidates in the various grades have to answer in writing a varying number of questions the lower grade having the least number. The next grade answers the questions previously asked and a few more, slightly more difficult, and so on through the four grades. These questions never vary, the result being that the questions and answers are common property, to be obtained by asking one's immediate friend. Such a system as this defeats its own object, as the only thing it guarantees is that the holder of a certificate has been engaged in stationary engineering for a certain time, its value as a gauge of his technical knowledge being non existent. In the same way, a certificate which lumps all men together regardless of their experience and knowledge is equally at fault. Consider a man coming from any province or country where a high standard of graded certificate is in force to a district where there is but one grade. His superior knowledge and qualifications are immediately discounted as far as his certificate is concerned, and while that man may soon prove his worth when he secures employment, until he does he is open to competition from men much below his own standard.

It would seem then that it is highly advantageous to the high grade engineer to secure graded certificates, and equally advantageous to the employer. To the trades unions it presents the objection that it makes one man better than another, with which they cannot agree, and to the politician the voice of the trades unions, with their accompanying votes, is loud in the ear. It is interesting in this connection to hear that a conference is taking place in Winnipeg at the present time, having as its object the drafting of an uniform examination law for all the provinces.

READER'S QUERY

Question—We have a large tank for fuel oil, 6 ft. dia. x 33 ft. long inside dimensions. The surface of the oil is 4 feet from top of tank, and I wish to know the quantity in gallons remaining in the tank?—A Subscriber.

Answer—The contents of this tank when full would be—6 x 6 x .7854 x 33 = 933.05 cub. feet. As there are 6.25 gals. to one cub. foot volume 933.05 x 625 = 5831.56 gals. In order to calculate the amount of oil remaining in tank at any level, it is necessary to make a series of calculations, covering half the diameter of the tank, because all levels below the centre line of tank will be covered by the calculations made for the upper half. In dealing with fuel oil, it is best to have as close measurements as possible, giving the quantities at each difference of 1" in height. Now when the level of the oil is 1" from the top of the tank, we have a certain volume of the tank empty, and by calculating this volume, and subtracting, we get the amount of oil remaining. The calculation is as follows: Area of segment multiplied by length = volume. A good rule for the area of a segment is: $\frac{4h^2}{3} \times \sqrt{\frac{d}{h}} - .608$

where h = height of segment.
d = diameter of circle.

Now the height of the segment is one inch, the height from surface of the oil to top of tank, and the diameter is 72 inches, so we have

$\frac{4 \times 1 \times 1}{3} \times \sqrt{\frac{72}{1}} - .608 = 11.22$ sq. inches.

The area of the segment being in square inches, we must reduce the 33 feet to inches, before multiplying 11.22 x 396 = 4443.12 cubic inches. Divide this by 1728 to bring to cubic feet 4443.12÷1728=2.57 cubic feet. Multiply by 6.25 for number of gallons=2.57 x 6.25=16.06. That is, 16.06 gals. have been taken out, leaving 5831.56—16.06 = 5815.5 gals.

This method can be used for every point required. Let us see how much oil is contained in the tank when surface of oil is 4 feet from top of tank. Instead of taking the volume of the empty space, we will take the volume of oil remaining. We have $\frac{4h^2}{3} \times \sqrt{\frac{d}{h}} - .608$. Putting the figures $\frac{4 \times 2 \times 2}{3} \times \sqrt{\frac{6}{2}} - .608 = 8.208$ sq. feet. 8.208 x 33=270.87 cubic feet.

270.87 x 6.25 = 1692.9 gals. Say 1693 gals., which is the answer our correspondent wants.

To show how close a measurement this method gives, takes the 3 foot level, or the tank half full. We have seen that the total quantity it can hold is 5831.56 gals. Therefore, at half full, it must contain 2915.78 gals. Check this by our calculation.

$\frac{4 \times 3 \times 3}{3} \times \sqrt{\frac{6}{3}} - .608 \times 33 \times 6.25 = 2920$ gals.

This shows an error of 4.22 gals., or 1.44% at the point where the greatest error can happen. Do not forget that the quantity of the oil does not vary in direct proportion to the height, but to the area of the segment exposed.

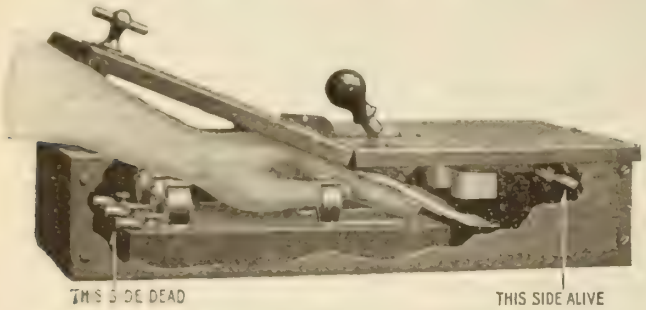
T. H. F.

John Dennis, who has been on the Government Inspecting staff, has resigned to take up the position of Master Mechanic at the St. Lawrence Starch Co., at Port Credit.

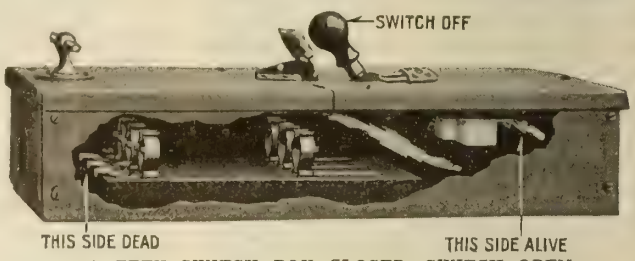
SAFETY SWITCH

In many steel mills, factories, mines and similar industries where most of the workmen have little knowledge of electricity, it is desirable to use switches having no live parts exposed or accessible in the ordinary operation of the switches or when replacing fuses.

This is fully accomplished in the Krantz Auto-Lock Switch, marketed by the Westinghouse Electric & Manufacturing Company, which is intended for use on main circuits or wherever an ordinary knife switch is applied. The switching parts and fuses are enclosed in a steel box, the cover of which is in two parts, one being screwed on to form a permanent covering for that end of the box containing the switch, and the other part being hinged so as to swing back and permit the renewal of fuses, which are located in this portion of the box. An ingenious latching mechanism makes it impossible to open the cover without first throwing the switch to the "off" position and rendering all fuses and other accessible parts dead. Thus fuses may be replaced at any time with absolute safety. As long as the door of the case is open the switch contacts can not be closed.



SWITCH, SHOWING IMPOSSIBILITY OF TOUCHING LIVE PARTS.



SAFETY SWITCH BOX CLOSED, SWITCH OPEN.

By using a padlock, the switch handle can be locked in the "off" position, making it impossible for any one to close the switch except the person holding the key to the padlock. By using another padlock the cover may be locked shut, so that the fuses cannot be tampered with. Either of these padlocks can be used independently of the other so that the switch cover can be locked shut with the switch either "on" or "off", or the switch can be locked in the "off" position with the cover either locked or open.

Contact is made by means of a laminated spring copper brush, double ended, with auxiliary arcing contacts at each end. The outer leaves of the brush are bronze to provide additional spring pressure.

The stationary contacts are of hard-drawn copper and are mounted on slate bases, one of which in the fused switch carries one of the fuse clips, while the other forms the terminal block for the incoming line and is mounted under the stationary portion of the cover.

The operating mechanism is galvanized steel of the toggle type, and is attached to the under side of the stationary end of the cover. This mechanism can be easily removed for inspection by re-

In closing, the pressure between the contacts causes the laminations of the brush to spread apart, giving it a wiping or self-cleaning action.

The double-ended brushes provide a double break, dividing the arc between the two ends, each of which is provided with a separate arcing tip.

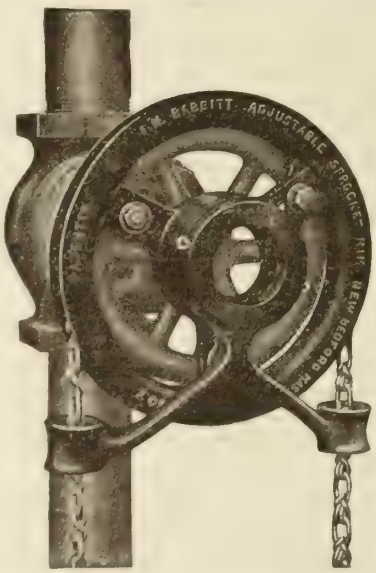
In the closed position the switch is held in positive contact by throwing a toggle over the center. A spring provides a quick-break for opening, the mechanism being independent of the operating handle.

These switches are supplied for 250 500 and 600 volt, for either alternating or direct-current, service, and in capacities up to 2,000 amperes.

The safety features of this switch have been recognized by the American Museum of Safety, which has awarded it a gold medal and special mention.

AN IMPROVED RIM FOR CHAIN-OPERATED VALVES

The Babbitt adjustable sprocket rim eliminates entirely the inconvenience of carrying heavy ladders and appeals strongly to engineers, since chain operation is much easier than the old-fashioned "ladder" method. In addition to this, the element of danger from the use of a ladder is no small one, and the last report of the Massachusetts Industrial Accident Board showed over 900 accidents due to falling ladders. In the engine room where the floors are frequently oiled, there is particular danger of the ladder slipping.



RIM FOR CHAIN OPERATED VALVES.

A recent improvement on this rim is a chain guard consisting of two arms through which the chain passes. The arrangement can be clearly seen in the illustration. In any ordinary installation this guard to prevent the chain from jumping off the wheel is entirely unnecessary, but on board ship, or where the valve stem is not horizontal or where other unusual conditions exist, such a device is sometimes advisable. Steam Specialty Co., of New Bedford, Mass.

Electric heating presents a very desirable load for the central station, because it operates a high load factor, takes, for the larger installations, a comparatively large number of kilowatt-hours at one point with relatively long hours of usage, and is practically a non-inductive load resulting in a high power factor. After the connection is once made, very little attention is required on the part of the central station, and, where necessary, the load can be adjusted so as to be largely off-peak.

There is considerable work for the mechanical engineer in conservation of heat units around an oil refinery and in most all branches of the oil industry. There are large refineries operating to-day and using four to five hundred per cent. more fuel than is necessary to do the work. It is possible to save, by proper distribution of the heat available around the oil refineries in the United States, at least 2 per cent. of the total crude oil put through these refineries. There are large oil refineries operating to-day that are using as fuel 4 per cent. of the crude oil run through them to do less work than the plant described is doing on 1.1 per cent. of the crude oil run through as fuel, and the losses due to non-condensable gases, &c., are 2 per cent., against 0.75 per cent.

Allied Tungsten Pool.—An international agreement for the pooling of all available tungsten among the United States and the Allies, reached through the Inter-allied Munitions Council at Paris, was announced by Chairman Baruch of the War Industries Board. Its terms will be made public if the arrangement is finally approved by President Wilson. Tungsten is produced largely in Colorado, but some comes from South America and Sweden and other European countries. Distribution of the supply probably will be directed by the War Industries Board.

WINNIPEG MEN ARE ANXIOUS ABOUT SUPPLY OF ALBERTA COAL THIS WINTER

THE Winnipeg City Council committee, after visiting the Alberta coal areas, and looking into the prospects of securing Alberta coal for this winter, reported in part as follows:

"Regarding the question of cost of producing a ton of coal, your committee found difficulty in arriving at a true estimate as to the actual cost of production. We met a number of mine operators, and it was only in one or two instances that we were shown the actual cost sheets. Such instances could not be taken as an average cost of producing one ton of coal at the mine head because cost of mining varied from mine to mine. In some mines for instance, the miner will receive 67c for mining and loading one ton of coal, while in some other districts it runs as high as $1.33. Again, some mines require very little timbering to be done, and in other mines cost of timbering will run as high as 35c per ton.

"The items just mentioned are determined largely by the natural coal deposits in the mines. The impurities contained in coal deposits in some mines are greater than others, this also having an effect on the cost of production.

Get $7.05 a Day

"Your committee also enquired into the wages of the men working in the mines. In the Lethbridge district the average wage earned by the men who worked on contract and were known as "contract men" is $4.55 for a full working day. In the Drumheller district are average wage earned by 'contract men' is $7.05 for each working day.

"It is well to point out here that the coal sold from the Lethbridge district costs more at the mine head than the coal from the Drumheller district.

Cost of Production

"Mr. Armstrong, while having the power to determine the price of coal at the mine heads and determine rates of pay to the employees in the mining industries, informed us he did not have any figures to show what it costs to produce a ton of coal at the various mines. One day prior to our first interview with him, Mr. Armstrong had sent a request to the Dominion Fuel Controller to audit the books of the various mining companies in order to try and determine the cost of production.

"Regarding the second phase of our inquiry, the quantity of coal available for shipment from the Alberta mines, your committee begs to submit the following facts and figures, namely:

"In 1916 the exact total of the coal produced in Alberta was 2,172,801 tons.

"In 1917 the figures were approximately 2,125,000 tons. These figures are for lignite coal suitable for domestic purposes.

What Mines Produce

"According to Mr. Sterling, chief inspector of Alberta mines, the total production for 1918 is expected to yield 3,225,000. After careful investigation of the needs of the three prairie provinces we are of the opinion that the above quantity would be sufficient to meet the requirements, but the following facts cannot be too strongly emphasized. In order that the full amount required to meet the needs of the three prairie provinces be obtained, there must be continuous production at the mines, such production can only continue so long as orders are received from the dealers and consumers. There are no facilities at the mines for storing coal and if such were the case we believe that the cost would be considerably increased per ton. At present coal is shipped direct from mine to purchaser, storage at the mines would mean that coal would have to be handled at least on two or more occasions, this accounting for the extra cost if such were the case and, further, if large quantities were held in reserve it would almost be impossible to obtain the necessary transportation at short notice. It is on account of this fact that we beg to emphasize the necessity of ordering coal by all who are able to do so and to store same in proper manner.

"Regarding the labor situation, your committee found, generally speaking, an ample supply of men available for the time of the year, and whilst most operators stated their desire for increased staff and output, we believe that as soon as harvest is over the labor supply will be sufficient to meet requirements, and the amount of freight cars allotted by the railway companies. In addition to the above and after meeting with several of the employers and officials of the miners' unions, there is nothing at present that would lead us to believe that the men would cease operating the mines during the year.

Coal Values

"Your committee, on the question of the quality of coal of Western Canadian mines, had difficulty in obtaining relative value of Western coal and anthracite coal. A great deal depends on the knowledge of the use of Alberta coal. Different persons using the same quality of coal obtain different results. It is admitted by all interested in Alberta coal that its value is not as great for heating purposes as anthracite coal, but such estimates vary from 25 to 75 per cent."

Demand For Tools.—Several firms in Manchester have recently inspected a number of Canadian catalogues on file in the office of the Trade Commissioner at Ottawa, and they have undertaken to correspond with manufacturers in the hope that future, if not immediate, business will result. From time to time opportunities for the creation and extension of trade in all kinds of tools have been reported, and Canadian manufacturers are advised to keep in touch with the requirements of the British market.

SUBMERSIBLE PUMPS IN SALVAGE WORK

One of the interesting features of modern ship salvaging appliances is the submersible motor pump. These pumps are caried on the salvaging vessel, and when in use are lowered into the hold of the sunken vessel, which it is desired to pump out, and supplied with current from the engine room of the salvage steamer. They are made in convenient sizes, from 4" to 8", the smaller size having a capacity of 150 tons an hour, against a head of 70 feet, while the 8" size is capable of throwing 350 tons of water against a head of 70 ft. per hour. They have proved effective in operation. A good instance is the case of a torpedoed vessel recently salved. The cargo of this ship was valued at $15,000,000, mainly food stuffs. After the torpedoing, an effort had been made to beach the vessel, but she sank before getting high enough. The damage consisted of a hole between No. 1 and 2 hatchway, 40 feet long by 28 feet deep. The submersible pumps were used in this case very advantageously. The pumps were placed in position, and holes drilled through bulkheads of No. 4 and 5 holds, engine room bulkhead, allowing the pumps to pump the after end clear. The 'tween deck hatches in damaged part were closed, and the pumps put to pump out the forward end. Enough water had now been pumped out to enable the ship to be moved higher up the beach, with the result of drying out the shelter and 'tween deck. The final stage was to discharge enough cargo to allow the ship to be floated off the beach, and taken to a repairing port.

Approves Rate Increases.—Director-General McAdoo has approved the application of the American Railway Express Company for further rate increases estimated to yield $23,670,000, and has sent the proposal to the Interstate Commerce Commission for final action. The Commission announced that public hearings on the matter will begin Tuesday, October 9.

Guelph.—At the regular meeting of the Light and Heat Commission at the city hall, Manager Heeg submitted the schedule he had prepared showing where power could be saved by the co-operation of the power-users of the city. The schedule, which is not a very complicated one, shows that the greatest saving of power must be accomplished between the hours of 5 and 6 o'clock in the evening, when the load is at its highest. This schedule, which has been concurred in by the manufacturers, who are the heavy users of power, and which was also approved by the Commission this morning, will go into effect at once. Notices will be sent out to all power users to that effect. The chief object of the schedule is to allow the local munition plants all the power they require.

SELECTED MARKET QUOTATIONS

A Record of Prices Current on Raw, Semi-finished, and Finished Materials Entering Into the Manufacture and Operation of Power Plant Equipment

BOILER TUBES

Size	Seamless	Lap-welded
1 in.	$36 00	$.....
1¼ in.	40 00	.....
1½ in.	43 00	36 00
1¾ in.	43 00	36 00
2 in.	50 00	36 00
2¼ in.	53 00	38 00
2½ in.	55 00	42 00
3 in.	64 00	50 00
3¼ in.	.....	58 00
3½ in.	77 00	60 00
4 in.	90 00	75 00

Prices per 100 feet, Montreal and Toronto.

PLATES

	Montreal	Toronto
Plates, ¼ to ½	$10 00	$10 00
Heads	10 30	10 25
Tank plates, 3-16 in.	10 50	10 10

WROUGHT PIPE

Effective Jan. 7, 1918.
Standard Buttweld.

Size	Black Per 100 feet	Galvanized Per 100 feet
⅛ in.	$ 6 00	$ 8 00
¼ in.	5 16	7 29
⅜ in.	5 16	7 29
½ in.	6 55	8 12
¾ in.	8 28	10 41
1 in.	12 24	15 39
1¼ in.	16 56	20 82
1½ in.	19 80	24 89
2 in.	26 64	33 49
2½ in.	42 72	53 53
3 in.	55 85	70 00
3½ in.	70 84	87 86
4 in.	83 93	104 10
Standard	Lapweld	
2 in.	29 60	36 08
2½ in.	44 46	54 70
3 in.	58 14	71 53
3½ in.	72 68	90 62
4 in.	86 11	107 37
4½ in.	97 79	122 56
5 in.	114 00	142 82
6 in.	147 80	185 28
7 in.	192 86	241 57
8L in.	202 50	253 75
8 in.	233 30	292 32
9 in.	279 50	350 18
10L in.	259 20	324 80
10 in.	333 70	418 18

Prices—Ontario, Quebec and Maritime Provinces

WROUGHT NIPPLES

4" and under, 45%.
4½" and larger, 40%.
4" and under, running thread, 25%.
Standard couplings, 4" and under 35%.
4½" and larger, 15%.

IRON PIPE FITTINGS

Malleable fittings, class A, 20% on list; class B and C, net list. Cast iron fittings, 25% off list. Malleable bushings, 25 and 7½%; cast bushings, 25%; unions, 45%; plugs, 20% off list. Net prices malleable fittings: Class B black, 24½c lb.; Class C black, 15¾c lb.; galvanized, Class B, 34c lb.; Class C, 24½c lb. F.O.B. Toronto.

COLD ROLLED SHAFTING.

At mill ..... list plus 40%
At warehouse ..... list plus 50%
Discounts off new list. Warehouse price at Montreal and Toronto.

FINISHED IRON AND STEEL

Per lb to Large Buyers	Cents
Iron bars, base, Toronto	$5 25
Steel bars, base, Toronto	5 50
Steel bars, 2" to 4" base	6 00
Iron bars, base, Montreal	5 25
Steel bars, base, Montreal	5 50
Reinforcing bars, base	5 25
Tank steel shapes	5 75

SHEETS

	Montreal	Toronto
Sheets, Black, No. 28.	$ 8 00	$ 8 25
Sheets, Black, No. 10.	10 00	10 00
Canada plates, dull, 52 sheets	9 00	8 65
Canada plates, all bright	9 50	9 50
Apollo brand, 10¾ oz. galvanized	....	....
Queen's Head, 28 B.W.G.	....	....
Fleur-de-Lis, 28 B.W.G.		
Gorbal"s Best, No. 28.		
Colborne Crown, No. 28	....	....
Premier, No. 28 U.S.	....	9 20
Premier, 10¾ oz.	....	9 50

PROOF COIL CHAIN B

¼ in.	$14 35
5-16 in.	13 85
⅜ in.	13 50
7-16 in.	12 90
½ in.	13 20
9-16 in.	12 70
⅝ in.	12 50
¾ in.	12 40
⅞ in.	12 90
1 in.	12 65
Extra for B.B. Chain	1 20
Extra for B.B.B. Chain	1 80

ELECTRIC WELD COIL CHAIN B.B.

¼ in.	$13 00
3-16 in.	12 50
⅜ in.	11 75
5-16 in.	11 40
⅜ in.	11 00
7-16 in.	10 60
½ in.	10 40
⅝ in.	10 00
¾ in.	9 90

Prices per 100 lbs.

FILES AND RASPS

	Per Cent.
Great Western, American	50
Kearney & Foot, Arcade	50
J. Barton Smith, Eagle	50
McClelland, Globe	50
Whitman & Barnes	50
Black Diamond	37½
Delta Files	37½
Nicholson	37½
Globe	50
Vulcan	50
Disston	50
P.H. and Imperial	50

OILS AND COMPOUNDS

Castor oil, per lb.	....
Royalite, per gal., bulk	18
Palacine	21
Machine oil, per gal.	26½
Black oil, per gal.	15
Cylinder oil, Capital	49½
Cylinder oil, Acme	39½
Standard cutting compound, per lb.	06
Lard oil, per gal.	2 60
Union thread cutting oil antiseptic	88
Acme cutting oil, antiseptic	37½
Imperial quenching oil	39¼
Petroleum fuel oil	13½

BELTING—No. 1 OAK TANNED.

Extra heavy, single and double	30-5%
Standard	40%
Cut leather lacing, No. 1	$1 95
Leather in sides	1 75

COAL AND COKE.

Solvay Foundry Coke	.....
Connelsville Foundry Coke	.....
Steam Lump Coal	.....
Best Slack	.....

Net ton f.o.b. Toronto.

BOLTS, NUTS AND SCREWS

	Per Cent.
Coach and lag screws	25
Stove bolts	55
Plate washers....list plus	20
Machine bolts, 7-16 and over	net
Machine bolts, ⅜ and less	10
Blank bolts	net
Bolt ends	net
Machine screws, fl. and rd. hd., steel	27½
Machine screws, o. and fil. hd., steel	10
Machine screws, fl. and rd. hd., brass ....add	20
Machine screws, o. and fil. hd., brass ....add	25
Nuts, square blank ....add	$1 50
Nuts, square, tapped....add	1 75
Nuts, hex. blank ....add	1 75
Nuts, hex. tapped ....add	2 00
Copper rivets and burrs, list plus	30
Burrs only list plus	50
Iron rivets and burrs	15
Boiler rivets, base ¾" and larger $8	50
Structural rivets, as above	8 40
Wood screws, flat, bright	72½
Wood screws, O. & R., bright	67½
Wood screws, flat, brass	37½
Wood screws, O. & R., brass	32½
Wood screws, flat, bronze	27½
Wood screws, O. & R., bronze	25

MISCELLANEOUS.

Solder, strictly	0 60
Solder, guaranteed	0 70
Babbitt metals ....18 to	1 00
Soldering coppers, 3 to 6 lbs.	0 64
Putty, 100-lb. drums	5 20
White lead, pure, cwt.	16 20
Red dry lead, 100-lb kegs, per cwt. 15	50
Glue, English	0 35
Gasoline, per gal., bulk	0 33
Benzine, per gal., bulk	0 30½
Pure turpentine, single bbls., gal.	1 03
Linseed oil, raw, single bbls.	1 95
Linseed oil, boiled, single bbls.	1 98
Lead wool, per lb.	0 15
Plumbers' oakum, per cwt.	9 00
Sandpaper, B. & A....list plus	20
Emery Cloth....list plus	20
Sal Soda	0 03½
Sulphur, rolls	0 05
Sulphur, commercial	0 04½
Rosin "D," per lb.	0 03
Rosin "G," per lb.	0 03½
Borax crystal and granula.	0 14
Wood alcohol, per gallon	1 80
Whiting, plain, per 100 lbs.	2 20

COPPER PRODUCTS

	Montreal	Toronto
Bars, ½ to 2 in.	$42 50	$43 00
Plain sheets, base 16 oz. and heavier	46 00	44 00
Copper sheet, tinned, 14x60 in., 14 oz.	48 00	48 00
Copper sheet, planished, base 16 oz. and heavier	57 00	45 00
Braziers' in. sheets, 6x4 base	45 00	44 00
Tubing T.P.S., base ¾ in. up to 3 in.	60 00	60 00

Above prices are full sheets and bars. Cut sheets and bars are 5c per lb. higher.

BRASS PRODUCTS.

Brass rods, base ½" to 1" rd.	$0 43
Sheets 24 oz. and heavier base	0 48
Brass tubing, seamless	0 55
Tubin, I.P.S., 1" base	0 55

POLISHED DRILL ROD.

Discount off list, Montreal and Toronto ..... Net

RUBBER BELTING

Standard	10%
Best grades	15%

WASTE

White.	Cents per lb.
XXX Extra	21
Peerless	21
Grand	19¾
Superior	19¾
X L C R	18½
Atlas	18½
X Empire	17¼
Ideal	17¼
X press	16
Colored.	
Lion	15
Standard	13½
No. 1	13½
Popular	12
Keen	10½
Wool Packing	
Arrow	25
Axle	20
Anvil	15
Anchor	11
Washed Wipers	
Select White	11
Mixed colored	10
Dark colored	09

This list subject to trade discount for quantity

MILLED PRODUCTS

	Per Cent.
Set screws	25
Sq. & Hex., Head Cap Screws	20
Rd. & Fil Head Cap Screws	Net
Flat & But. Hd. Cap Screws plus	Net
Fin. & Semi-fin. nuts up to 1 in.	25
Fin. and semi-fin. nuts, over 1 in., up to 1½ in.	20
Fin. and semi-fin. nuts, over 1½ in., up to 2 in., list plus	10
Studs	20
Taper pins	40
Coupling bolts, pins	10
Planer head bolts, without fillets ....list plus	10
Planer head bolts, with fillet list plus 10 and	10
Planer head bolt nuts, same as finished nuts.	
Planer bolt washers	net
Hollow set screws..list plus	20
Collar screws...list plus 30,	10
Thumb screws	20
Thumb nuts	65
Patch bolts ....add 40,	10
Cold pressed nuts to 1½ in. ....add	$4 50
Cold pressed nuts over 1½ in. ....add	$7 00

METALS

	Montreal	Toronto
Lake copper	$31 00	$29 50
Electro copper	31 00	29 50
Castings, copper	30 00	28 50
Tin	125 00	125 00
Spelter	11 50	11 00
Lead	10 00	10 00
Antimony	17 50	18 00
Aluminum	55 00	58 00

Prices per 100 lbs...

ROPES AND PACKING

Packing, square braided	0 34
Packing, No. 1 Italian	0 40
Packing, No. 2 Italian	0 32
Pure Manila rope	0 39
Transmission rope, Manila	0 45
Drilling cables, Manila	0 41

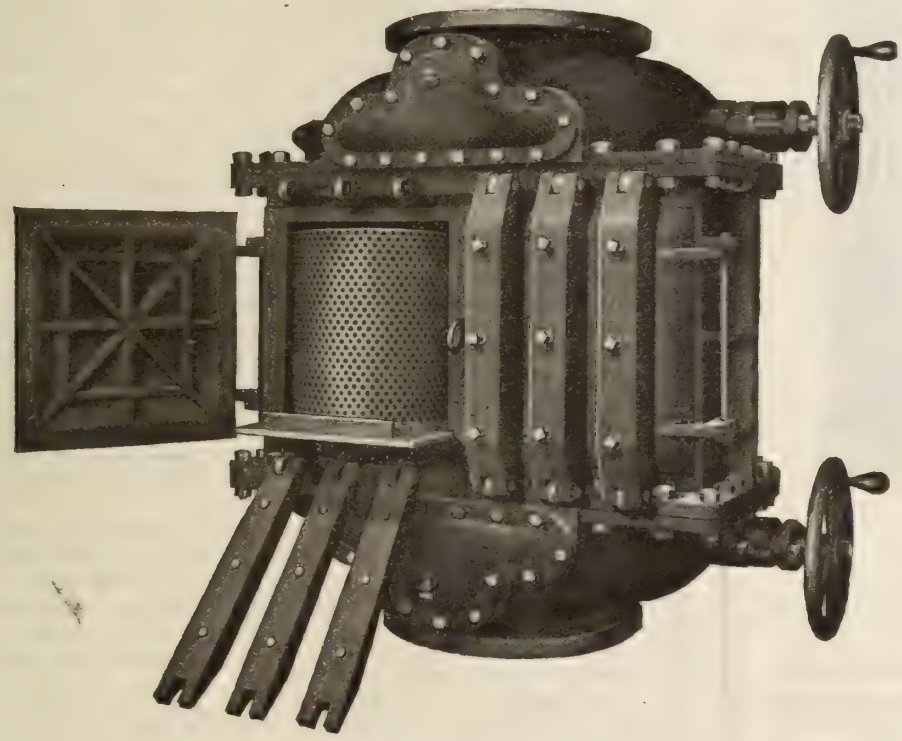
LEAD SHEETS

	Montreal	Toronto
Sheets, 3 lbs. sq. ft. lb.	$12 00	$13 25
Sheets, 3½ lbs.	12 00	13 25
Sheets, 4 to 6 lbs.	13 00	12 50

Cut sheets, ¾c per lb. extra.
Cuts sheets to size, 1c per lb. extra.

TWIN STRAINERS

eliminate clogging of pumps, condensers and other water-handling machinery

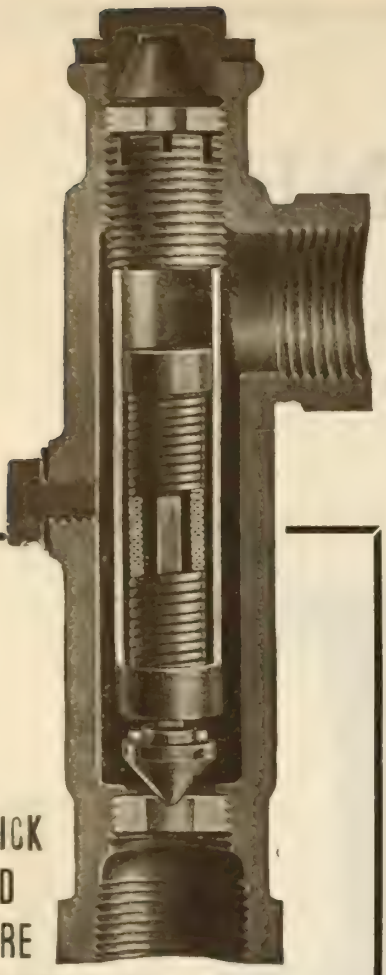


A TWIN STRAINER can't be clogged up, for when one basket is fouled with any sort of solid matter, a clean basket is put into service by simply moving two valves. The dirty basket can then be lifted out, carried to a convenient place, cleaned and then replaced in the Strainer—all this without interrupting the flow for an instant.

Full particulars in Bulletin "A," which will be sent on request

ELLIOTT COMPANY

435 GRANT STREET - PITTSBURGH, PA.



QUICK
AND
SURE
COMPACT
HYDRAULIC
AUTOMATIC

These are a few of the features of the

STEAM TRAP
SARCO

The principle employed in the Sarco makes it simplest in construction. Only one moving part. No levers, gauges, springs or other trouble makers.

In the center of the Sarco is the cartridge containing a spirally corrugated tube which is surrounded by a highly expansible fluid. On the lower end of this tube is carried the valve head.

Temperature changes immediately expand or contract the fluid contained within the cartridges and this produces hydraulic power to open or close the valve.

No loss of steam. No danger of freezing, clogging nor sticking. Used as an elbow or bend—no pit digging nor platform required. Same capacity as any other trap with equal inlet openings. Very much lower in price.

30-day free trial will prove.
Send for circular No. J 6.

Sarco Company Inc.
Woolworth Building, New York City

BUFFALO — Ellicott Square
DETROIT — New Telegraph Bldg
PHILADELPHIA — Bourse Bldg
CHICAGO — Monadnock Block.
CLEVELAND — Williamson Bldg
ATLANTA, GA. — Healey Bldg

and representatives in all principal cities.
Canada, Peacock Brothers, Montreal.

NEW REGULATIONS FOR UNIFORM CONSTRUCTION OF ALL BOILERS

WINNIPEG.—The conference of steam boiler inspectors, which has been in session in the city for the past two weeks, concluded its business, and the visiting delegates were entertained at a banquet at the Royal Alexandra. The chair was occupied by Hon. G. W. Grierson, provincial minister of public works, who had on his right Hon. A. W. Armstrong, commissioner of public works and mines for the province of Nova Scotia; Hon. T. C. Norris, premier; S. C. Oxton, deputy-minister of public works, and several representatives of local boiler firms. After dinner and the toast of "The King," short speeches were given by Hon. G. W. Grierson, Hon. A. W. Armstrong, Hon T. C. Norris, J. Peck, of British Columbia, R. N. Blackburn, of Saskatchewan, D. M. Metcalfe, of Ontario, W. J. Fulton, of the Dominion Radiator Company, F. S. Murdoch, of the Vulcan Iron Works, and W. C. Mager, of Ontario.

The object of the meeting was to discuss and draft a uniform code of regulations for the construction and inspection of steam boilers. Some of the western provinces have had a code, but it was difficult to meet all requirements and made it almost impossible for manufacturers to produce a boiler that conformed to all conditions as to pressure. The suggestion for uniformity originated in Saskatchewan some eight years ago, where the first attempt was made to arrive at a uniform code at a conference held at Regina in 1910. A code was then drafted, but some of the provinces not then being represented, it was difficult to compile a series that would be acceptable, but the draft was adopted by the governments of Alberta and Saskatchewan. However, the movement was continued and two years later the province of Ontario adopted the code, and in 1914 a second conference was held in Toronto, when the code was revised and new matter added. It was not then possible to complete the work and further consideration was deferred till the province of Manitoba recently became interested and decided to adopt a code for the province. The government was naturally anxious to adopt a code that would be acceptable throughout the Dominion, and the present conference was largely due to the initiative of R. A. Stewart, chief boiler inspector of the province, and the active interest of the department of public works. The sessions convened in the quarters of the local bureau of labor and have continued for two weeks, under the chairmanship of J. Peck, the representative of British Columbia, and the secretaryship of R. N. Blackburn, the representative of Saskatchewan. The official delegates were: Hon. A. W. Armstrong, commissioner of public works and mines, Nova Scotia; E. F. Valiquet, superintendent of the Montreal water works; Dr. Riddell, head of the Ontario bureau of labor; and D. M. Metcalfe, chief boiler inspector of the province; R. N. Blackburn, chief inspector for Saskatchewan; F. W. Hobson, chief inspector for Alberta; J. Peck, chief inspector for British Columbia, and R. A. Stewart, chief inspector for Manitoba.

The members of the conference are greatly pleased with the courtesies extended by the local government, through both Hon. Mr. Grierson, minister of public works, and the deputy, S. C. Oxton, and consider that the code of regulations adopted are equal to any such measure enacted by any government, and believe they will be acceptable to all provinces, as also by manufacturers and others interested. The code will be submitted to the government of each province, and there is every prospect that it will be endorsed and enforced by order-in-council so as to go into operation in January. A few of the members have already returned to their homes, and others leave to-day for the east and west.

HINTS ON STORING COAL

During the present year, consumers are storing coal as long in advance of winter as possible. It is important, therefore, that they should take precautions in the storage if loss through spontaneous combustion is to be prevented. There are certain simple methods of handling coal that experience has taught are necessary to obviate such a misfortune, especially where considerable quantities are to be stored. Thus, coal should be so piled that air can circulate through it freely to carry off the heat, or so closely piled that air cannot enter the pile. Low piles are preferable if space permits and alleyways should be provided to facilitate moving the coal quickly. Occasional ventilation pipes are ill-advised, but the practice of placing such pipes close together has been tried in Canada with effective results. Different kinds of coal should not be mixed in storage.

In quenching fire in a pile, water should only be used if there is an ample supply, a small amount is ineffective and very dangerous.

Where available, under-water storage is recommended as it entirely eliminates spontaneous combustion. The preparation of a suitable pit for this method of storage is sometimes costly, but old quarries, clay pits and even prairie sloughs have been used. Deterioration of coal stored under water is negligible and it absorbs very little extra moisture. —L. G. D.

Matheson, Ont.—The construction of a complete system of electric light and power at an approximate cost of $10,000 is having the consideration of James A. Lyttle, deputy clerk of the municipality and ratepayers of the town.

Hamilton, Ont.—The old boilers taken from the court house here have been reduced to pick-up-and-carry scrap without the blow of a sledge hammer. Acetylene gas jets were employed to cut up the old shells and piping. The first boiler was in pieces within two hours from the time the flame was applied.

In the new bulletin K-303, issued by the Canadian Ingersoll-Rand Company, Limited, the class EL-2 two-stage straight line compressor is described. The bulletin indicates the advantages of the tandem arrangement for certain classes of work where economy of space is to be combined with the advantages of two-stage compression, and goes on to give details of construction, including the Leaf Valves and other features. The bulletin concludes with a note on the short-belt drive, with which this type of compressor can be furnished and which has distinct advantages where space is at a premium.

Closed Large Contracts.—Several large contracts have been closed by the Chapman Double Ball Bearing Co., Ltd., Toronto. An order covering gun mounts, and for shafting in the factory manufacturing them was secured for the Dominion Steel Products at Brantford, where contracts running to about $5,000,000 have been placed for the U. S. government. The bearing in this order will run close to $60,000 for the transmission outfit. The Chapman people also have the contract for the Dominion Shipbuilding Co., Canadian Airplane and British Forgings. Other large orders placed recently included 2,000 bearings in the T. Eaton Co. building on Alice street. The Ford Co., Canadian plant's order was for 4,000, while 1,500 were placed in the Dominion Arsenal at Lindsay."

THE LIFE of a marine boiler depends to a certain extent on the care and attention bestowed on it during the first few months of its existence, provided that the plates have been properly treated at the building of the boiler—that is, all mill scale removed and the plates kept dry and free from atmospheric corrosion. The mill scale, if not removed has a very irritant action on the clean metal of the boiler, and is most hurtful to the plates if allowed to remain on them. When new boilers are put in under the varying conditions in temperatures which are found on ship board, the greatest care and attention is needed for the first period of working if the boilers are to be kept free from corrosion; the new metal of the boiler at this stage being most open to attack from all sorts of corrosive agencies. It is advisable on the first voyage to put into the boilers before closing them up 5 lb. of lime per 1000 I.H.P., and afterwards for a period of about six days 2 lb. of lime per day per 1000 I.H.P. should be passed through the hotwell as milk of lime, and 1 lb. of lime per day per 1000 I.H.P. during the remainder of the voyage.

Peterboro.—The Hydro-Electric Power Commission has notified the city of its intention to spend $1,250,000 in the erection at Ranney's Falls, Campbellford, of a power plant that will produce from 8,000 to 10,000 horse-power. The work will begin this Fall. The completion of the work will relieve the power situation in this district. When the Quaker Oats Company informed the council that it would require for its own use the surplus of 1,500 horse-power which it had been supplying the city the visible shortage of power in this city and district reached a crisis.

Geo. W. Crossan, surveyor, department of the naval service, has been appointed marine manager of the Halifax Shipyards, Ltd., Halifax, N.S. Mr. Crossan is well known in Toronto and surrounding districts, saving sailed on the Great Lakes after coming to Canada, and has taken several ships overseas since the commencement of the war. He served his apprenticeship in Napiers on the Clyde, now Beardmore, Ltd., and sailed as chief engineer of several large ships before making his permanent residence in Toronto over eight years ago. Halifax Shipyards, Ltd., have under contract with the government to build three 10,000-ton ships, and a commencement will be made early this autumn.

LARGE BALL BEARING CONTRACT

The Canadian S K F Co., 47 King street West, Toronto, has received an order for S K F ball bearing hangers for the new shop being erected by the Leaside Munitions Company at Leaside, North Toronto. This contract will cover over 400 ball bearing hangers, and constitutes the largest order for hangers ever placed in Canada. It is significant in the development of anti-friction bearings that they are being universally adopted in the largest plants for all drives, and indications point to their even wider adoption in the future owing to their great saving in power and increase in range of application. Conservation of energy is one of the outstanding problems of the day, and the use of ball bearings is one method of attaining this end.

In a plant of the size such as will be established at Leaside, when a large amount of money is involved, the efficiency of ball bearings must be positively proved and demonstrated because it is possible to purchase similar equipment of plain ring-oiled bearings at considerably less cost. The savings in power and lubrication etc. are very high for ball bearing, and warrant this extra expenditure.

The S K F bearings have been installed in several of the larger Canadian plants, including the Canadian Westinghouse Co., Duncan Lithographing Co., and the T. Eaton Co., all of Hamilton. Also the Consumers Cordage Co., Montreal, the Howard Smith Paper Co., Willards Ltd., and the Laura Secord Candy Works, Toronto, all these being complete installations, in addition to many others.

The LONG Patent Steam Trap

Automatically drains jacket kettles, separators and steam mains. Nine hundred to 1,500 feet of one-inch pipe isn't beyond its ability. Also used with splendid success in drying room systems.

Only One Movable Part

Works against 1 and 200 pounds of pressure—no possibility of freezing. Has two outlets so it can be installed in any position.

Circular gives full particulars.

Write to-day.

J. T. LONG
84 Adam Street
MONTREAL, CANADA
If your dealer does not sell it, write direct

WALTER J. FRANCIS, C.E. M. Can. Soc. C.E. M. Am. Soc. C.E. M. Inst. C.E.
FREDERICK B. BROWN, M.Sc. M. Can. Soc. C.E. Mem. Am. Soc. M.E. Mem. A.I.E.E.
WALTER J. FRANCIS & COMPANY
CONSULTING ENGINEERS
Head Office, 232 St. James St., Montreal
Cable Address, "Walfran, Montreal"—W.U. Code. Long Distance Telephone, Main 5643.

MacKinnon Steel Co. Ltd.
Formerly
MacKinnon, Holmes & Co., Ltd.
SHERBROOKE QUEBEC

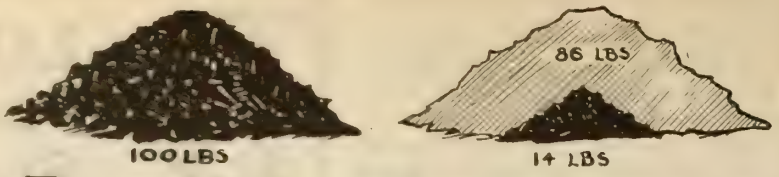
Engineers, Manufacturers and Erectors of Steel Structures

We Specialize in

Bridges, Buildings, Towers, Tanks, Penstocks, Roof Trusses, Columns, Smoke Flues and Stacks, Coal Bins, Ore Bins, Buckets, Refuse Burners, Stills, Air Receivers, etc.

WRITE FOR PRICES.

Study The Piles



Seven Times the Power for the Same Coal

The first pile represents coal used making steam to feed boiler using direct steam pump.

The black part of the second pile shows the relative amount of coal necessary to do the work with a Cole Return Trap.

In other words, you get seven times the power for the same coal—or 86% of the fuel saved.

If you want further proof get our latest folder on boiler feeding—No. 9.

GEO. W. COLE, Ltd. 2002 Dundas St. W. TORONTO

R.D. Wood & Co.

Philadelphia, Pa., U.S.A.

Water and Gas Work Supplies,
Cast Iron Pipe and Castings,
Mathews Hydrants and Valves,
Hydraulic Presses and Accumulators,
Operating Valves,
Mechanically Operated Gas Producers.

NON-CORROSIVE
CYLINDER OIL
MANUFACTURED ONLY BY
E. H. KELLOGG & CO.
NOS. 24 & 26 SOUTH ST. NEW YORK U.S.A.
FRICTION LOSS

An overload is often a necessity. But it is hard on an engine. To successfully carry an overload so that there will be no after effects on the engine a very careful selection of your oil should be made. An oil that is not [illegible] will cause a greater friction in the bearings a great [illegible] will occur. You will need to fire the boiler more often because the engine will be harder to run. In [illegible] you lose out. You work harder, have larger operating costs, and less power all because of your oil. Do as a great many Canadian engineers [illegible] Kellogg's "Non-Corrosive Cylinder Oil" a trial. Absolutely pure. Write us regarding it.

E. H. KELLOGG & CO.,
New York, U.S.A.

CONDENSED ADVERTISEMENTS

FOR SALE

FOR SALE CHEAP—ONE 30 K.W. GENERATOR Set 220 Volt D.C. Ideal Engine—Westinghouse Generator on sub-base—Switchboard; one 20 K.W. Generator Set on sub-base, same as above. These two sets are in perfect condition and we offer decided bargain for quick sale. Winnipeg Machinery Exchange, Sutherland and Gladstone Sts., Winnipeg.

POSITION WANTED

STATIONARY ENGINEER WANTS A POSITION. Can handle all makes of engines or boilers. First-class man. Holder of certificate. Apply to Chas. Mismer, 920 Concession Street, Mt. Hamilton. (p11h)

For Sale By Tender

THE UNDERNOTED LIST OF

MACHINERY

ON VIEW AT BRITANNIA SCHOOL, HAMPTON ST., ST. JAMES.

1—Ingersoll-Rand Air Compressor, 8x8, type N.E.1. with air tanks, working pressure 100 lbs.
1—Can. Westinghouse Induction Motor, 20 h.p., 550 v., 3 ph., 60 cy., 850 r.p.m., with Cutler-Hammer switch.
1—Fairbanks-Morse 25 h.p. Horizontal Oil Engine, with fuel and cooling tanks.
1—Harris Air Pump, cap. 150 gals. per min.
1—Priestman Automatic Return Water Ejector, with receiving tank.
1—Priestman Automatic Sewer Ejector.
1—Darling Bros. No. 1 Return Water Pump, connected with 1 h.p. motor with Cutler-Hammer Switch.

All above units are complete with pipe, valves, and fittings, and are in first-class working condition. They are to be sold as they now stand, and the purchaser must remove same at his own expense. Tenders received at 272 Rutland St., St. James, Manitoba.

SAM'L B. BRENNAN,
Secretary-Treasurer,
School District of St. James, No. 7

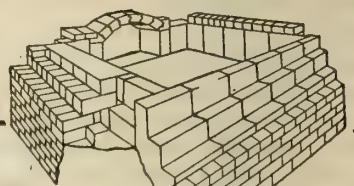
KINDLY MENTION THIS PAPER WHEN WRITING TO ADVERTISER.

THE VISCOSITY OF OIL

By M. E.

One of the most used methods of expressing the viscosity of oil is in the terms of the Engler Scale. Degrees Engler means simply the ratio of the time it takes a given quantity of an oil to flow through a standard orifice as compared with the time it would take the same volume of water to flow through. Oil is usually sold, however, on the basis of its specific gravity (generally measured in degrees Baume) and its heat value and moisture content. It is usually assumed that the heavier an oil is in degrees Baume the more viscous it is, but that is not always strictly true. It is not to be regretted, that oil is not specified in terms of specific gravity instead of in degrees Baume, because in any calculations involving the weight of the oil per gallon or per barrel, it is necessary to refer back to specific gravity. Further, the heaviest oil that can be designated on the Baume scale for liquids lighter than water is 10 deg. B. or unit specific gravity. Oils are now being used of 10 and 12 deg. B., and, no doubt, still heavier oils will be used, which will call for two different Baume scales and cause confusion.

Craft of the Hammersmith is the title of an illustrated booklet issued by the Canada Foundries & Forgings, Ltd., of Welland, Ont. The booklet illustrates by means of excellent photographic reproductions the various phases of the operations performed in the production of marine forgings at the Canada Forge plant and also views of a few typical forgings made by the company. The booklet is gotten up in an artistic manner and shows the marked development which the company has made, in this particular line, during recent years.



Gates Boiler Furnace

Patented 1916

Will last three times as long as ordinary good grade Fire Brick. These blocks are inter-locking, and made so that any handy man or fireman can renew them without disturbing any of the other brick work.

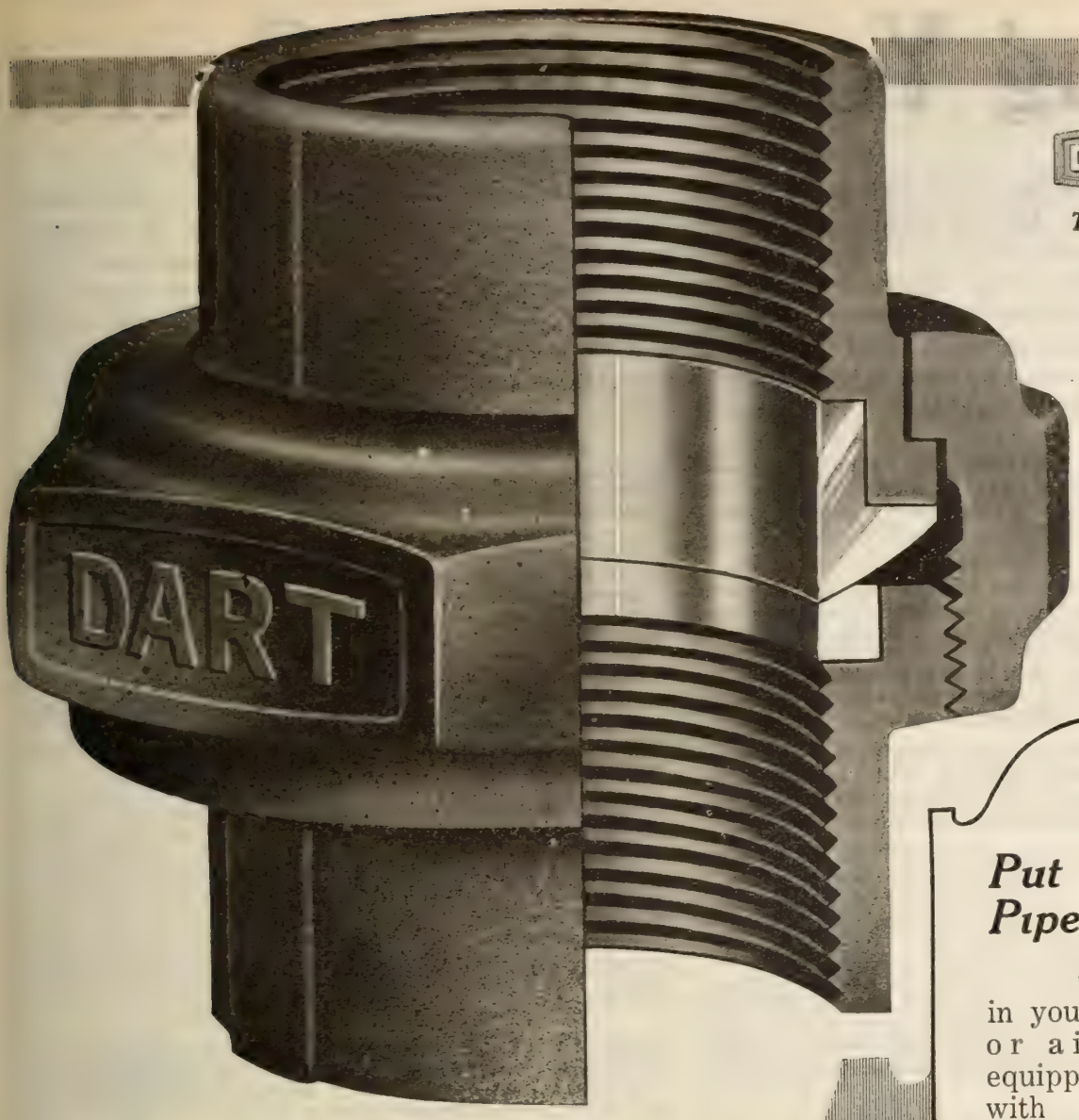
WRITE FOR PARTICULARS.

John W. Gates 2 St. James St., MONTREAL, QUE.

MONCRIEFF'S "UNIFIC" WATER GAUGE GLASSES

Stand in a Class by Themselves for Quality, Efficiency and Economy
A trial will convince you. Write for Catalog

W. J. WALL, 134-136 BLEURY ST., MONTREAL
(Canadian Representative)



DART

Trade Mark

Bronze to Bronze at The Joint

Put an end to Pipe Coupling Leaks

in your steam, water or air systems by equipping your lines with

DART UNIONS

Dart Union Pipe couplings stay tight because the Bronze faces will not rust or corrode, and the heavy iron parts will not stretch or pull apart.

The use of Dart Union Pipe Couplings means NO UPKEEP COST—NO REPLACEMENT COST—NO LOSS FROM LEAKS.

Order from your Jobber.

MANUFACTURED BY

Dart Union Co., Ltd.,

TORONTO, ONT.

Letting You Into A Secret

THEY were talking about things in general — Jones and Brown. But it was easily seen by Jones that Brown talked with a positiveness and definiteness lacking in himself. Brown evidently had real knowledge about things and this gave him an assurance lacking in Jones. Jones found himself talking in generalities, and he had the sense to know that what he had to say wasn't very convincing. In the end he spoke up. "Brown, tell me, where do you get your information? You talk like one who knows. You use facts to fortify your opinions, and you seem to have a wealth of information about things Canadian. What's the secret of your greater confidence and knowledge?"

And Brown said: "I'll tell you, Jones, how I have strengthened myself in confidence and knowledge, as you put it. I read my newspaper in a new way now, and I make it a point to know a good deal about Canada, the land of my birth, residence and affection.

"For years—until I was forty—I read newspapers, as many others do—pretty thoroughly. I read about accidents, and meetings and fires, and everything else. One day I woke up,—was awakening up, to tell the truth—to discover that I was just frittering away time when I read everything.—Then I determined to concentrate my interest on matters Canadian—the things about Canada that really matter.

"I wanted direction. I needed a focal point, as it were. What should be skipped, and what should be read closely? I was floundering. I am not much of a politician, and I abominate party politics. I wanted to see things fairly.

"Then one day I made the acquaintance of THE FINANCIAL POST. It seemed to me to give me the direction I needed. I found it was sifting things for me, and giving current affairs their right proportioning. At any rate, it was a new kind of newspaper to me, and I read it with zest.

"I am a business man, and business in its larger aspects is the special field of THE FINANCIAL POST. I found the paper written in a readable way, and that it has a breadth of interest pleasing to me. So I subscribed for THE POST, and every Saturday and over the week-end this paper is pretty thoroughly ready by me.

"I find that the reading of this paper helps me get out of my daily newspaper the meat in it. As a matter of fact, I read my daily newspaper and other papers with a new and informed interest which makes my reading a profitable thing.

"I read somewhere that an hour a day spent on any subject would make a man master of that subject in 10 years. Well, I do not know that I am seeking to be a master of Canadian affairs, but I do know that for the past two years or so I have been having a new joy in life. I am really trying to know my Canada.

"I clip a good deal, and my scrap-book on Canada is a treasure house for me, I collate the material I put in that book, and whenever I want to read up any particular subject, I have before me, gathered up, a surprising amount of material obtained from many sources.

"I take luncheon at the Club daily. There are eight of us who gather daily at the same table. One is a wholesaler, another is a banker, another a publisher, another a manufacturer, another a manufacturers' agent—and so on. We have a representative gathering.

"We talk about many things, and about Canada most of all. I take great satisfaction from the knowledge that I am able to hold up my end of the conversation. To tell you the truth, it is this reputation that spurs me on to keep myself brushed up all the time. I own up, also, to practising a little subtlety. I guide the conversation in the direction of a subject that I am well informed on, and then I bide my time, letting others wrestle with it until they have told all they know. Then is my chance, and I am able to say something useful to a company that is attentive.

"Jones, if you want to improve the quality of your information, read purposefully, objectively. Cut out the reading of everything under the sun. You are a business man, the same as I am. Why not read definitely along the line of business? You will find it a most pleasurable kind of reading, and you'll find that you will acquire the sifting mind which will enable you to pass over a lot of stuff of no value to you, and seize on material of real value.

"I recommend THE FINANCIAL POST as a paper that will give your reading direction. It has helped me much, and I believe will help you. At any rate, it is easy to try it out."

IF JONES wants to try out THE FINANCIAL POST he can have it go to him by mail for four months for a dollar bill. One thing that ought to impress and please Jones is that THE POST is not a one-man paper. It is produced by many men, each a surpassingly well-informed man on the subject he writes. One man writes on matters pertaining to agriculture, another on the iron and steel industry, another on the food problems and milling and cereal subjects, another on insurance, another on textiles, and so on. The special contributed articles which are a regular feature of THE POST are by authorities or by men of position. Besides which, THE POST surveys many fields of interest, and this survey is world-wide. It is a meatful paper, in very truth, and assures those who read it regularly an amount, kind and quality of reading not commonly found in a single newspaper. If you would make your daily reading take on a new interest and value, we suggest that you should sign and forward the coupon opposite.

THE MACLEAN PUBLISHING CO., LTD.,
Dept. P.H., 143-153 University Ave., Toronto.

Send me THE FINANCIAL POST for

one year at Three Dollars
four months at One dollar

I will remit on receipt of bill in the usual way.

.....

The MacLean Publishing Company, Limited

143-153 University Avenue, Toronto

FOR SHINGLE MILLS

WOODLAWN MILL & BOOM CO.,
Manufacturers of
WASHINGTON RED CEDAR SHINGLES
Hoquiam, Washington.

Magnolia Metal Co. Oct. 26, 1917.

Gentlemen:—

Over two years ago we babbitted our Mill with Magnolia Metal. It has been running almost continuously since, and not any bearing in the Mill has yet required attention.

We yet have part of a box of Magnolia Metal on hand, and as all our machinery is running along in such good shape, I cannot say when we will again be in the market for babbitt metal.

Yours very truly, T. R. TILLY, Supt.

PRACTICAL ENGINEER POCKET BOOK
Over 600 Pages
A valuable reference work imported from England and sold as an advertising medium at the low price of 40c post paid.
Address Montreal Office

SOLD BY LEADING DEALERS EVERYWHERE OR BY
MAGNOLIA METAL CO.
OFFICE AND FACTORY:
225 St. Ambroise Street, MONTREAL

Self-Lubricating

In Bulk

SAFETY PLASTic
METALLIC PACKING
FOR STEAM, WATER, AIR, GAS, ETC.
Pat. Dec. 22, 1903 Highest Award World's Fair, St. Louis, 1904
GUARANTEED TO LAST THREE YEARS
WITHOUT RENEWAL
Drop us a line and let us tell you all about this Remarkable Packing.
STEEL MILL PACKING CO., WINDSOR, ONT. Established 1899

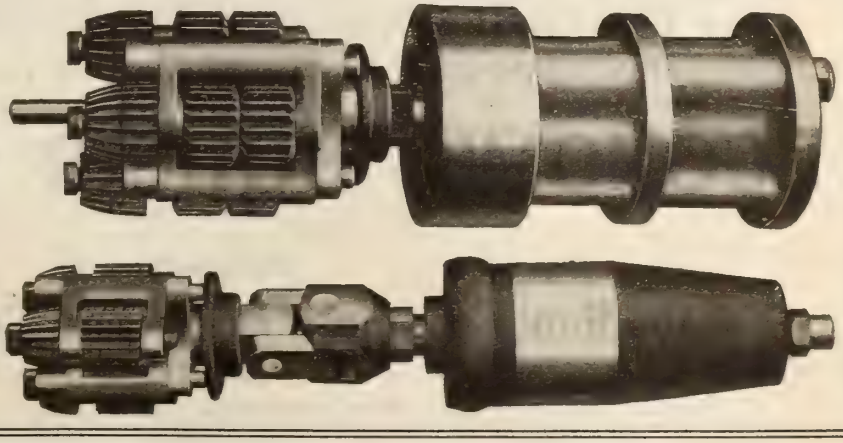
Practically Frictionless

In Cotton Tubes

ROTO TUBE CLEANERS
Type A.D.—Driven by Air or Steam
Type W.D.—Driven by Water Pressure

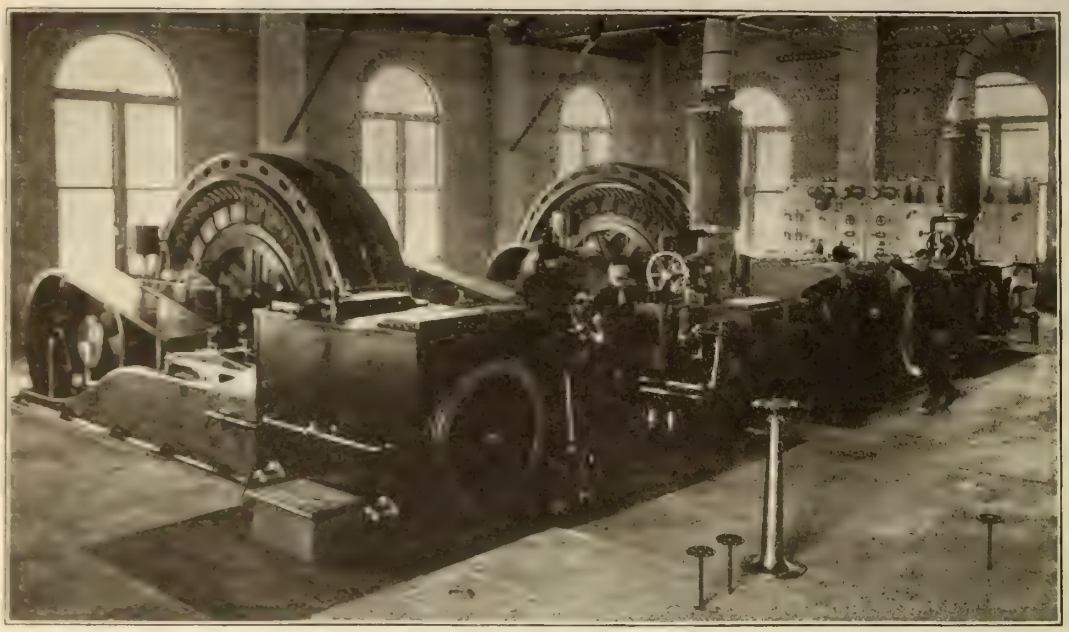
The use of Roto Cleaners is essential to the most efficient operation of Boilers, Condensers, Economizers, Evaporators, etc.
Roto succeeds where all others fail. It is faster, safer, more thorough and the standard of the largest steam power plants.

THE ROTO COMPANY
HARTFORD, CONN.
WRITE FOR CATALOG



If any advertisement interests you, tear it out now and place with letters to be answered.

25 Cycle Engine Generator Sets For Sale



1—250 KW.
1—300 KW.

25 Cycle 3 phase Westinghouse Generators Direct connected to McIntosh & Seymour Cross Compound Gridiron Valve Engines 150 R.P.M.

These units were in use only seven months and are in first class condition. Write for further particulars and quotations.

Power Plant Equipment Co., Dominion Bank Building Toronto, Ont.

SAVE COAL!!

USE

ECONOMIC BOILER COMPOUND

The cry for economy has gone through the land as a war necessity, so why not cut down your COAL CONSUMPTION? If you will send us a piece of scale from your boilers we will analyze same and send you our ECONOMIC BOILER COMPOUND, which we will guarantee to remove the scale from your boilers, or no pay for same.

ECONOMIC BOILER COMPOUND

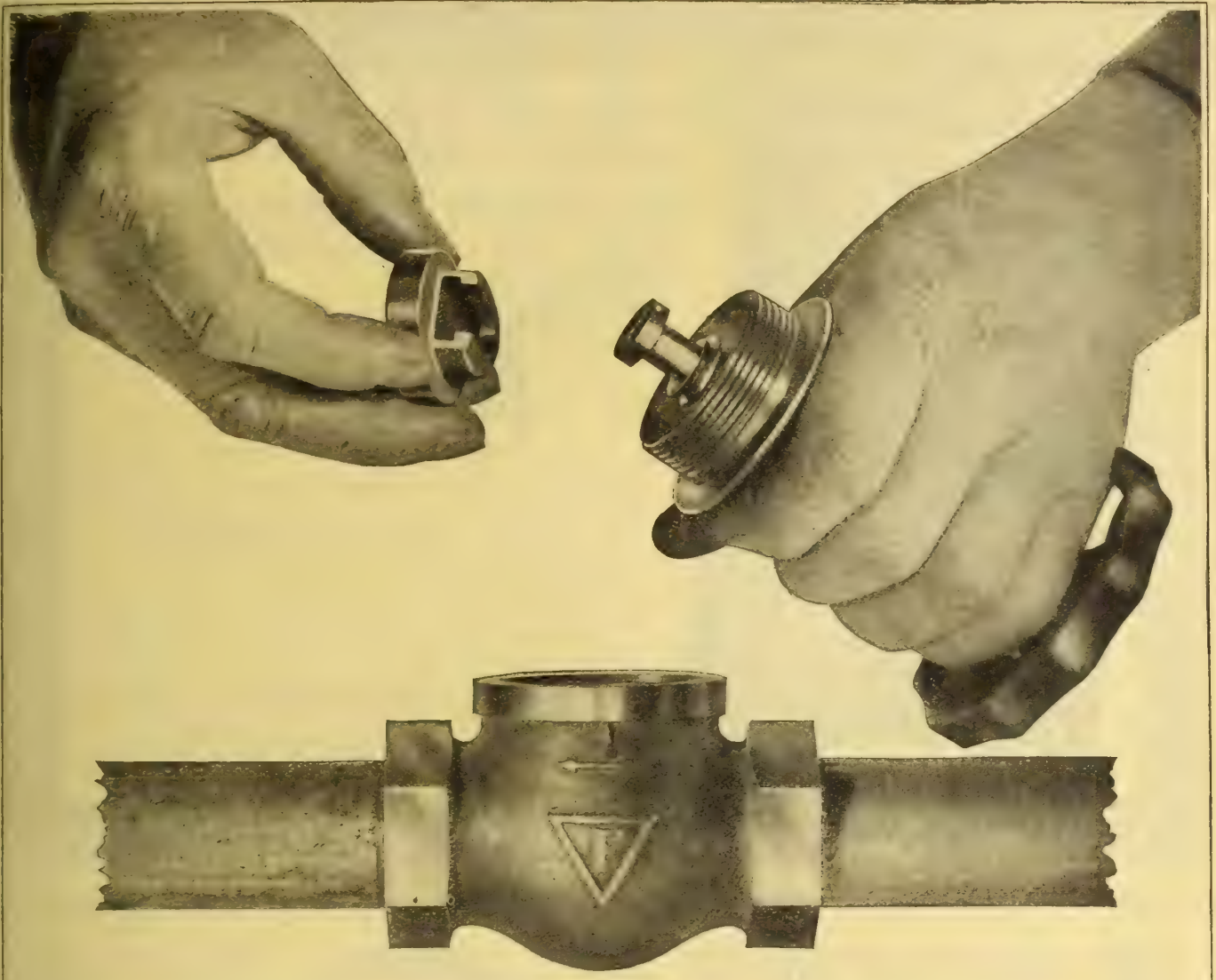
Manufactured by

Canadian Economic Lubricant Company, Limited

MONTREAL

THE CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS



FAIRBANKS RENEWABLE DISC VALVES

WOULD REDUCE YOUR VALVE EXPENSE EVEN THOUGH THEY COST DOUBLE THE PRESENT PRICE. THE BAKELITE DISC GIVES MAXIMUM SERVICE UNDER ALL CONDITIONS OF STEAM, AIR, AND WATER. WHEN THE DISC DOES WEAR OUT, IT CAN BE REPLACED IN LESS THAN ONE MINUTE WITH ONLY ONE TOOL—A WRENCH TO REMOVE THE BONNET. SPECIFY FAIRBANKS VALVES ON YOUR ORDER.

THE CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

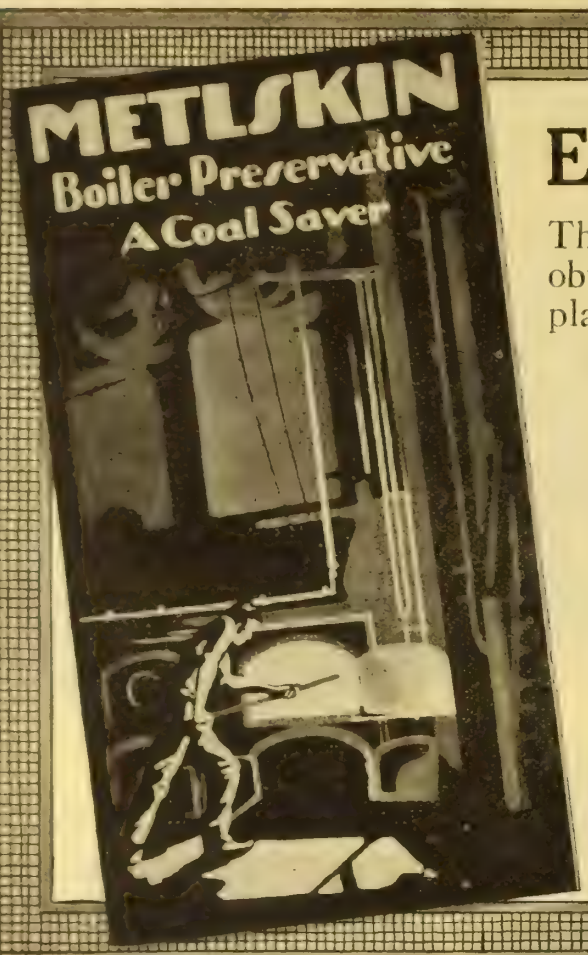
DEPARTMENTS

SCALE, VALVE, STEAM GOODS, ELECTRICAL, AUTOMOBILE SUPPLY, TRANSMISSION, OIL ENGINE, MACHINERY, PUMP, CONTRACTORS, RAILWAY, MACHINE SHOP SUPPLY

SALES OFFICES

HALIFAX, ST. JOHN, QUEBEC, MONTREAL, OTTAWA, TORONTO, HAMILTON, WINDSOR, WINNIPEG, SASKATOON, CALGARY, VANCOUVER, VICTORIA

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED



EASY ECONOMY

The fuel loss due to scale is not difficult to obviate. Some of Canada's leading power plants have found

METLSKIN BOILER PRESERVATIVE

Neither "Compound" nor "Cure-all"

a decided help in removing old scale and preventing its further formation. The cost, compared to results, was so slight as to make METLSKIN an actual dividend-payer.

The existence of boiler-scale nowadays is a misdemeanor against conservation.

If you have scale trouble send for this little book. It will prove instructive.

The CANADIAN FAIRBANKS-MORSE CO., Limited

St. John, Quebec, Montreal, Ottawa, Hamilton, Toronto, Windsor, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria.

III IMPORTANT THINGS

TO CONSIDER ABOUT A SEPARATOR.

I. THE PLAN—Is it sensible, will it work, no matter how large the Separator or how well made?

II. THE SIZE—Is it big enough regardless of plan, will it hold a good dose of water?

III. THE CONSTRUCTION—Is it strong enough, are flanges heavy, how will it look by the side of a nicely finished engine? Send for catalog and note these points in

Sweet's Separators

DIRECT SEPARATOR COMPANY

820 Geddes Street - SYRACUSE, N.Y

General Sales Agents:

Canadian Fairbanks-Morse Company, Limited

St. John, Montreal, Quebec, Ottawa, Toronto, Hamilton, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria

FOR Steam or Air Drill, Pneumatic Tools, Boiler Flue Cleaning, Syphon Connections, Suction Lines.

For all kinds of Oil, Gasoline, Paints, Hydraulics, Gas.

"PENFLEX" METAL HOSE

INTERLOCKING

An all Metal Flexible Hose. Manufactured in Bronze or Galvanized Steel. Will withstand highest pressures. Is unsurpassed for durability and pressure resisting qualities.

Large Stock Carried in Canada

Pennsylvania Flexible Metallic Tubing Co.

Philadelphia, Pa.

Canadian Agents:

The Canadian Fairbanks-Morse Co., Limited

St. John, Quebec, Montreal, Ottawa, Toronto, Hamilton, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria

THE CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED

GRATON & KNIGHT

Standardized Series

LEATHER BELTING

Tanned by us for belting use

GRATON AND KNIGHT

Holding the Line

YOU honor the Turbine as a Field Marshal, the Engine and the Generator as Generals. But, how about Private Belt, without shoulder straps or collar emblems, grimly holding the line? Too often you give him consideration only when, under cruel strain, he breaks.

The great need is to fill the line with those Privates that stand the strain better than others. A guiding rule, easy to remember, is that the demand for Graton & Knight Standardized Series Leather Belting is greater than that for any other belting in the world. It started from nothing and has grown steadily and naturally.

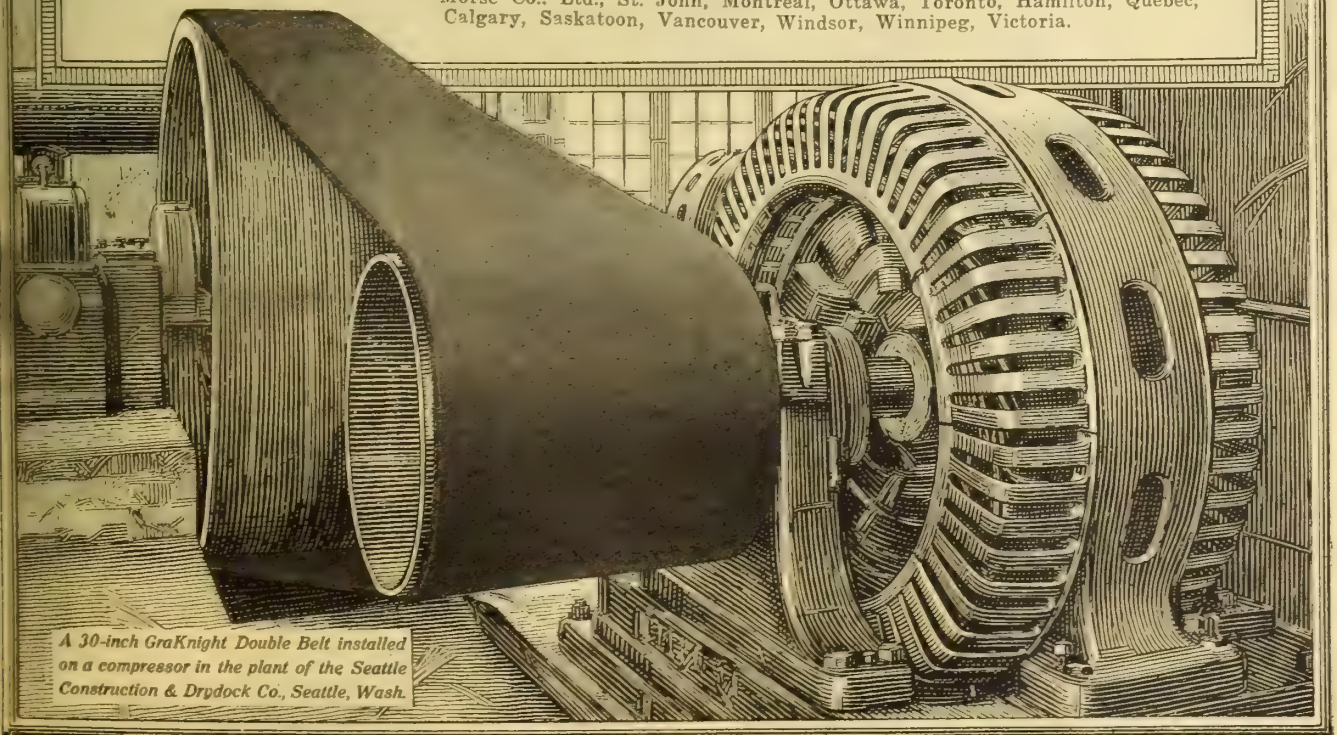
There are many technical reasons for this preference, but the big reason is *not* technical. It is simply repeated experience: Mr. A. buys a Graton & Knight Belt and observes that it gives all-round service and long wear. He doesn't always know whether to credit these qualities to the materials or the construction. What he does know is that the belt *works right*—and that is enough.

In our book, "Standardized Leather Belting," we explain scientifically why Graton & Knight Standardized Leather Belts are enlisted to hold the power line in so preponderant a number of American factories. Write for a copy.

The Graton & Knight Mfg. Co., Worcester, Mass., U.S.A.

Oak Leather Tanners, Makers of Leather Belting, Lace Leather, Packings, and Specialties.

The Canadian Graton & Knight Ltd., Montreal. Canadian Representatives: The Canadian Fairbanks-Morse Co., Ltd., St. John, Montreal, Ottawa, Toronto, Hamilton, Quebec, Calgary, Saskatoon, Vancouver, Windsor, Winnipeg, Victoria.



A 30-inch GraKnight Double Belt installed on a compressor in the plant of the Seattle Construction & Drydock Co., Seattle, Wash.

THE CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

DURABLA

When Buying Gaskets Insist on DURABLA

Recognized by Engineers in every Industry as Standard. Guaranteed to make Any Joint Permanently Tight. We carry a large stock of the DURABLA Sheet and Gaskets in All Sizes and Thicknesses. Standardize on Durabla.

Durabla Manufacturing Company
NEW YORK

Distributors for Canada:
The Canadian Fairbanks-Morse Co., Ltd.

P&C CO

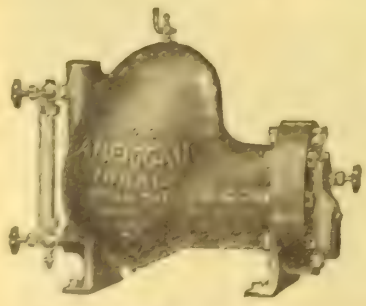
Valves and Asbestos-Packed Cocks

Send for Catalog

PRATT & CADY COMPANY, INC.
HARTFORD, CONN.

Canadian Representatives

The Canadian Fairbanks-Morse Company, Limited
Halifax St. John Quebec Montreal Ottawa Toronto Hamilton
Windsor Winnipeg Saskatoon Calgary Vancouver Victoria



All Industries Must Save Coal

AMERICAN IDEAL STEAM TRAPS

will help by Saving Steam and Removing Condensation from Steam Lines.

Write Us Today

Canadian Agents: CANADIAN FAIRBANKS-MORSE CO., Ltd. Montreal, Quebec, Toronto, Winnipeg

AMERICAN STEAM GAUGE & VALVE MANUFACTURING COMPANY
NEW YORK CHICAGO BOSTON ATLANTA PITTSBURGH

THE CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED

You Are Working Shorthanded

and every repacking of rods and valves that you can avoid is a positive help.
You can secure longer service from

"PALMETTO"

because it is made to withstand hard conditions, and not for frequent sales.

BRAIDED for RODS

Working samples to prove quality.

TWIST for VALVES

GREENE, TWEED & CO.
Sole Manufacturers
109 Duane Street New York

The Canadian Fairbanks-Morse Co., Limited, St. John, Toronto, Quebec, Hamilton, Montreal, Ottawa, Vancouver, Victoria.

THE CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

Save Fuel—You can get 50% MORE HEAT from no more steam with the ALBERGER MULTI-HEAD WATER HEATER

In fact the "Alberger" heats so fast that there can be hot water as fast as it can be drawn.

YOU MAY WONDER HOW—HERE'S THE SECRET:

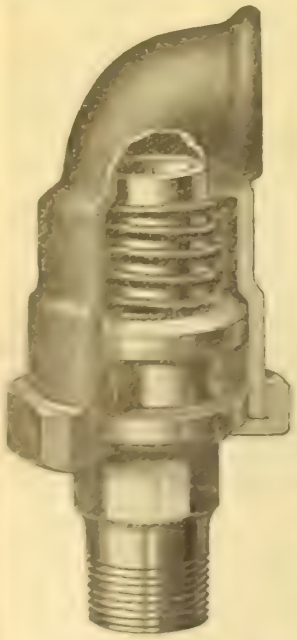
In this Alberger Heater the tubes are small and corrugated, and scale does not form; nothing collects.

The tubes are made of pure copper, absolutely no splitting. They expand into floating heads independent of the cast iron shell, which means that there cannot be trouble from expansion or contraction strain.

Write for our catalog—it will give you the fullest details.

ALBERGER HEATER COMPANY, BUFFALO, N.Y.

GENERAL SALES AGENT:
CANADIAN FAIRBANKS-MORSE COMPANY, Limited
St. John Montreal Ottawa Toronto Hamilton Quebec Calgary
Windsor Vancouver Winnipeg Victoria



Tuxeda
SWING JOINTS
Provide one of the easiest ways to save coal

Every pound of steam that escapes through a leaky connection represents a certain amount of coal wasted. Do you know that an average leak will waste 3,400 pounds of steam a month? Investigate your flexible steam connections at once and then investigate the Tuxeda Swing Joint.

A Guaranteed Solution for Your Flexible Connection Problems

Send for Bulletin "A" to

FRANKLIN WILLIAMS, INC.
New York City
General Sales Agents: Canadian Fairbanks-Morse Co., Ltd.

ADVERTISING to be successful does not necessarily have to produce a basketful of inquiries every day.

The best advertising is the kind that leaves an indelible, ineffaceable impression of the goods advertised on the minds of the greatest possible number of probable buyers, present and future.

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

CANADA'S GREATEST MAKE FOR MECHANICAL GOODS

½ lb. Bolt Turns This Shafting

A Bolt Weighing One-half Pound, Placed on the End of a 30" Pulley Spoke in the above. Installation is Sufficient to Start Rotation of the Entire 240 feet of 2-7 16" Line Shaft. The Shaft can be Turned by Twisting it Between the Thumb and Forefinger. This is Possible Because the Shaft runs in SKF Ball Bearing Hangers. Friction is Practically Eliminated.

SKF Ball Bearings

save 80% on transmission upkeep costs, and 80% on lubricant charges. They are doing this for others, why not for you? Hot boxes, rebabbitting, wear, leakage—all the annoyances of babbitt bearings are positively stopped by SKF Ball Bearings. Let us tell you why.

CANADIAN SKF COMPANY
LIMITED

Toronto, Ont. Montreal, Que.

Canadian Agents

THE CANADIAN FAIRBANKS-MORSE CO., LIMITED

St. John Quebec Montreal Ottawa Toronto Hamilton Windsor
Winnipeg Saskatoon Calgary Vancouver Victoria

KILOWATTS. 150 100 50 A.M. MONDAY P.M. A.M. TUESDAY P.M. A.M. WEDNESDAY P.M. A.M. THURSDAY P.M. A.M. FRIDAY P.M. A.M. SATUR PLAIN ROLLER BALL

The Story of War Under The Earth

THE German sappers had discovered and broken into a Canadian tunnel. They had planted a machine gun at their end and sent a shower of bullets down the dark, narrow passage whenever the Canadians made any effort to enter their underground galleries. The story of how two Canadians nailed steel snipers' shields to the front of a push cart and shoved it ahead of them up to the very teeth of the gun, and how they dropped a can of deadly explosive, hopped on to the cart, and let it coast back down the tunnel, while bullets rattled on the shield like hail and, finally, how the explosive blew up the machine gun and its crew and blocked the passage again—this remarkable story is told by Lieut. C. W. Tilbrook (who was one of the two) in the course of an article, "An Underground Tank," in October MACLEAN'S.

Recently a Toronto newspaper declared editorially that the public was tiring of war books and war stories because of the sameness of them. The newspaper was right. But the public literally devours any story of the war that is new. The series of articles that Lieut. Tilbrook has done for MACLEAN'S has been read with an astonishing amount of interest *because they are different from anything that the public has yet read.* Warfare in the tunnels is a terrible business—grim, silent, cruel. It is a strangely technical phase of warfare and the "sappers" go about their business with queer instruments that might have figured in a Jules Verne phantasy. To read of underground fighting, as Lieut. Tilbrook tells of it, is to get a vision of a new kind of war altogether—something gripping, fearsome and mystifying.

"An Underground Tank," is the best of his series. But, after all, it is only one feature in a long array that makes the October issue of MACLEAN'S one of unparalleled interest.

A STRANGE CHANGE IN WOMAN'S WORLD. By Agnes C. Laut.
The new status of women, arising out of the war, is treated in the powerful style of this famous writer, who came from the Canadian West. It introduces a new thought.

CONSCRIPTION AFTER THE WAR. By Brigadier-General A. C. Critchley.
A young Canadian who rose from Lieutenant to General in three years and originated the "Critchley Method" of military training, tells what he thinks about the need for compulsory service after the war.

THE LIFE OF MARY PICKFORD, by Arthur Stringer.
The second of a series of articles on Canada's most famous woman. No expense has been spared to produce the beautiful illustrations specially posed for the photographs.

THE FOUR FACTIONS AT OTTAWA. By J. K. Munro.
That the House will split into four, more or less, distinct groups is the guess of the author, a trained political observer. He outlines the reasons humorously, pungently and impartially. It is a political article on new lines and will be found refreshing.

BONEHEAD BILL—Another Service Poem.
Robert W. Service, most popular of poets, sends all his war verse to MACLEAN'S. In "Bonehead Bill" he depicts the grief of a soldier for his fallen foe.

THE EVENTS OF A MAD WORLD
are summed up in the "Review of Reviews" which gives reprints of the best articles from the magazines of the world. All the best and most important articles are selected—five dollars' worth for twenty cents!

October MACLEAN'S NOW ON SALE At All Newsdealers

20c. PER COPY, $2.00 PER YEAR

THE MACLEAN PUBLISHING COMPANY, LIMITED
143-153 UNIVERSITY AVENUE, TORONTO

This book should be in the hands of every pump user. A postal will bring your copy promptly

MARSH and AMERICAN

Steam and Power Driven Pumps and Air Compressors

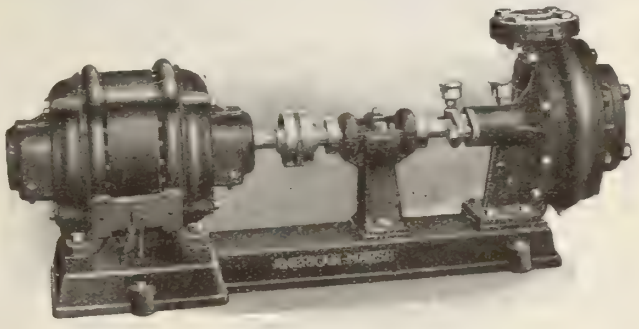
Marsh and American Pumps are especially adapted for long, hard service because they are *extra heavy* in design and of *extremely rigid construction*. Every unit is built amply strong to withstand 24-hour-a-day service and to stand up under any unforeseen strain which may be placed upon it. Piston rods on the steam pumps are extra large and made of solid bronze. The water ends are equipped with heavy cast bronze removable bushings.

This superior construction not only insures continuous and satisfactory operation, but practically *eliminates expensive shut-downs*. Marsh and American Pumps are the product of over 25 years' experience in the design and construction of high grade pumping machinery. Over 135,000 in actual service throughout the world.

The AMERICAN-MARSH LINE OF CENTRIFUGAL PUMPS is composed of both single and double suction types which are designed for heads up to 125 feet. They are equipped with wide ring oiled bearings and the single suction type has overhanging casing enabling the discharge to be taken at any angle desired.

CANADIAN AGENTS

A. R. Williams Machinery Co., Toronto.
Williams & Wilson, Montreal.
London Engine Supplies Co., London, Ont.
Stuart Machinery Co., Winnipeg.
Mechanics' Supply Co., Quebec, Que.
Gorman, Clancy & Grindley, Limited, Edmonton and Calgary.
Taylor Engineering Co. Ltd., Vancouver, B.C.



American-Marsh Centrifugal Pump.

American Steam Pump Company

Battle Creek, Mich.

Wanted—

Engineers to Contribute to Power House

THIS is a practical paper for practical engineers. It is an educational medium and out to help its readers. It is a technical school and a social meeting place combined. It is first, last and all the time an engineer's paper.

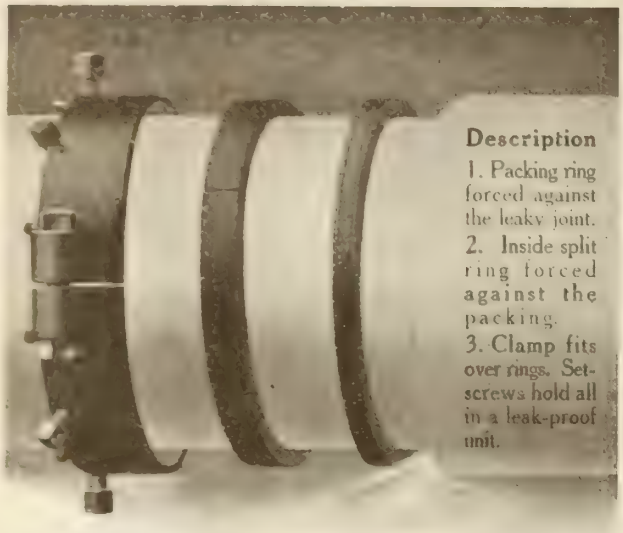
If you should meet two or three or a dozen of your brother engineers you would swap ideas—you'd tell of some idea you had worked out in your plant. Others would describe some pet schemes they had devised. And so you would be mutually benefited.

Why not make Power House your monthly meeting place? Why not describe in this paper some kink or scheme you have worked out and found successful? We will pay you for it and you, in turn, will be multiplying the usefulness of your idea five thousand fold!

Never mind polishing up your letters—just give us the idea; that's the main thing. Never mind how crude your pencil sketch may be. We have draughtsmen who will finish up your drawings so they may be reproduced.

Try this idea a time or two and see how much satisfaction you'll get out of it. Start the ball a-rolling and thus help other engineers, yourself and your paper.

POWER HOUSE, 143-153 University Avenue, Toronto, Ont.


Description
1. Packing ring forced against the leaky joint.
2. Inside split ring forced against the packing.
3. Clamp fits over rings. Set-screws hold all in a leak-proof unit.

You Can Stop That Leak

—And stop it permanently—with a Simplex Pipe-Joint Clamp.

It does not make much difference how big the opening may be—provided, of course, it is not beyond repair. Nor does it matter a great deal what is in the pipe—water, steam, gas, air, oil, ammonia, brine, etc.—the leak will be stopped absolutely.

And as long as the Yarway is left in place that joint will remain tight.

The principle of the Yarway Pipe-Joint Clamp (formerly Simplex) is very simple. There are but three parts, as shown above—one packing and two iron rings.

Any workman can make the attachment without difficulty in a few minutes.

As an example of the way in which this serviceable clamp makes good, read what one user says:

> "The fact that from the date of its installation, we have not realized that there is a steam joint at the point where placed, is sufficient evidence that it fills the bill."

Try a Yarway for 30 days subject to return if not satisfactory in every way. Write to-day stating size of line.

YARNALL-WARING COMPANY
7604-20 Queen Street
Chestnut Hill - Philadelphia

Canadian Representatives Carrying Stock:
A. McLellan, 301 Read Bldg., Montreal, Canada; Cunningham Hardware Co., New Westminster, B.C.; Jas. Robertson Company, Montreal, Canada

YARWAY
PIPE-JOINT CLAMP
Formerly the SIMPLEX

It Stands to Reason

that a packing which is constantly used all over the country, for every kind of service, with invariable success, must have just the qualities you need in packing.

VULCABESTON

"VULCABESTON" RED FIBRE STEAM PACKING "VULCABESTON" RED FIBRE STEAM PACKING "VULCABESTON" RED FIBRE STEAM PACKING

stands up under the most severe requirements. It is a *long-fibre* asbestos packing that resists heat and chemical action, is pliable, elastic and easy to handle and lasts longer than any other. TRY IT.

The Johns-Pratt Company
Hartford, Conn., U.S.A.

Montreal, Que., Ross & Greig; Toronto, Ont., James Morrison Brass Mfg. Co., Ltd.; Vancouver, B.C., Fleck Bros., Ltd.; Winnipeg, Man., Crane Co.

J-P J-P

TWO WAYS OF OPERATING

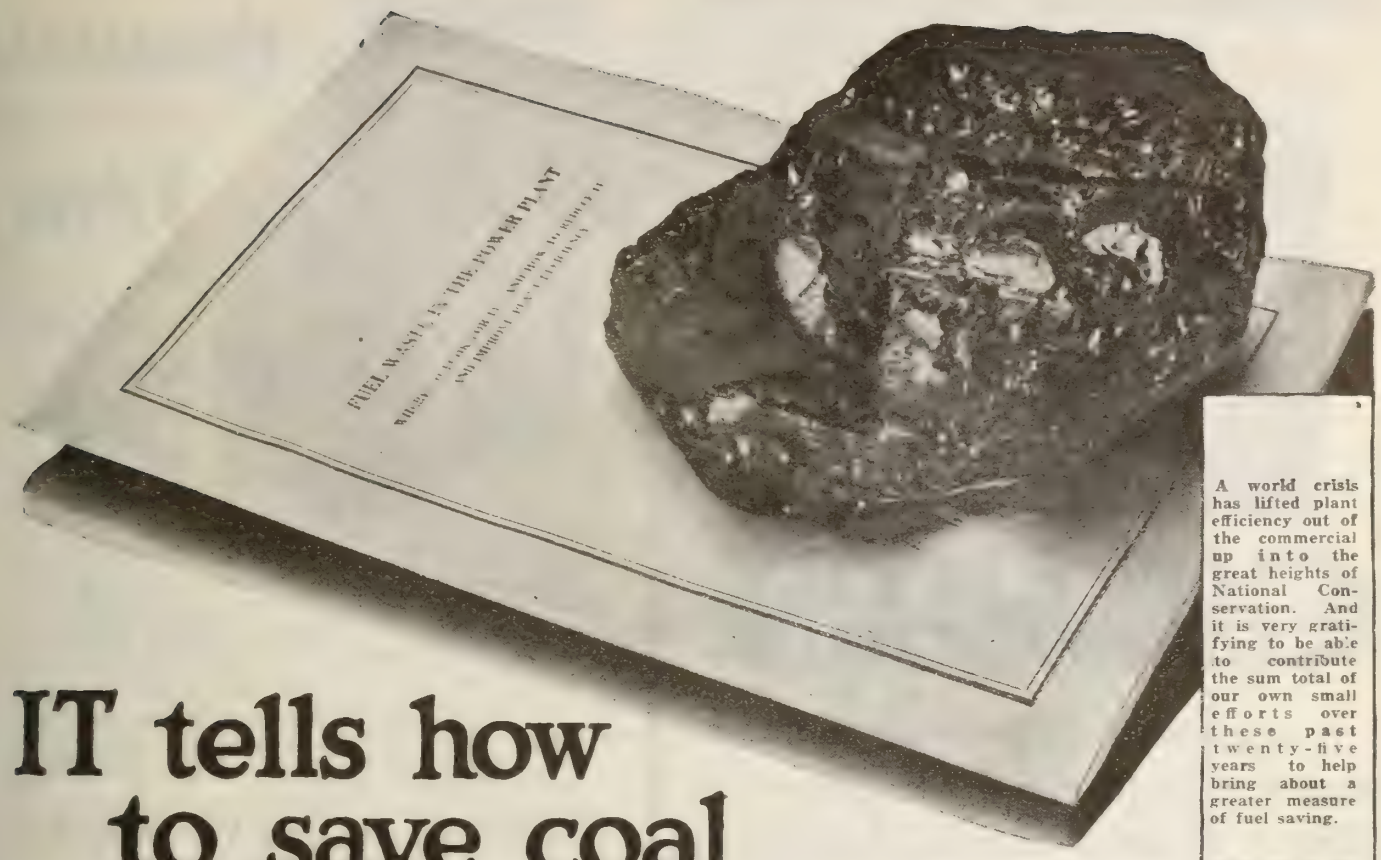
Overhead Valves

The hard way is to get a ladder, climb up and open or close the valve by hand. A

Babbitt
—Adjustable—
SPROCKET RIM
With Chain Guide

saves time and risk and puts any valve, no matter where it's located, within reach of your hand.
The cost of the Babbitt Rim is negligible, and it can be attached in 5 minutes—a wrench is the only tool you'll need.
Your dealer can probably show you a Babbitt Rim—if not, ask us direct.

BABBITT STEAM SPECIALTY CO.
NEW BEDFORD, MASSACHUSETTS
Manufactured in Canada, under Canadian Patents, exclusively by the Engineering Specialties Company, Limited, 1080 King St. West, Toronto, Ont. 93-22



IT tells how to save coal

A real help sent free to Plant Owners & Operators

WHAT question could be more pressing to those interested in a power plant or factory than that of next winter's coal supply? Particularly now, when the government has added further emphasis to the situation by its move to cut fuel waste through a plant questionnaire.

The booklet offered above, "*Fuel Waste in the Power Plant,*" is designed to be of help in assuring coal supply, by suggesting, as it does, many simple and effective measures for the reduction of preventable waste, in the burning of coal and in the use of steam for power, heating or processing.

The pamphlet does not attempt to suggest radical and expensive equipment additions. It discusses plants as they are and indicates a score of individually small but collectively large losses commonly overlooked in the operation of the power plant and factory.

A reading of this pamphlet will be reassuring to manufacturers or other plant interests in showing how inexpensively and often how readily, waste power, heat losses, wear and tear and frictional losses can be reduced. Its timeliness speaks for itself.

For sixty years we have been developing and advocating the use of coal and power saving materials and feel that we can serve the common good by sharing our experience with plant executives and engineers — particularly now when coal and power saving mean so much to everyone.

We will be glad to forward you a copy of "*Fuel Waste in the Power Plant,*" if you will write our nearest branch.

A world crisis has lifted plant efficiency out of the commercial up into the great heights of National Conservation. And it is very gratifying to be able to contribute the sum total of our own small efforts over these past twenty-five years to help bring about a greater measure of fuel saving.

Write any of the offices listed here for your copy of this new booklet—use coupon below. To ensure proper directing in the mails, give some individual's name—your own, your master mechanic's or your engineer's.

If you want to meet a Johns-Manville man in person you can so indicate on the coupon in the circle.

The CANADIAN H.W. JOHNS-MANVILLE Co., Ltd.

Hamilton
London
Montreal
Ottawa
Toronto
Vancouver

JOHNS-MANVILLE SERVICE COVERS THE CONTINENT

JOHNS-MANVILLE
Service to fuel users

H. W. JOHNS-MANVILLE CO.

City—

State

Use address nearest you—see list above.

Please send me gratis a copy of your booklet, "*Fuel Waste in the Power Plant.*"

Send to

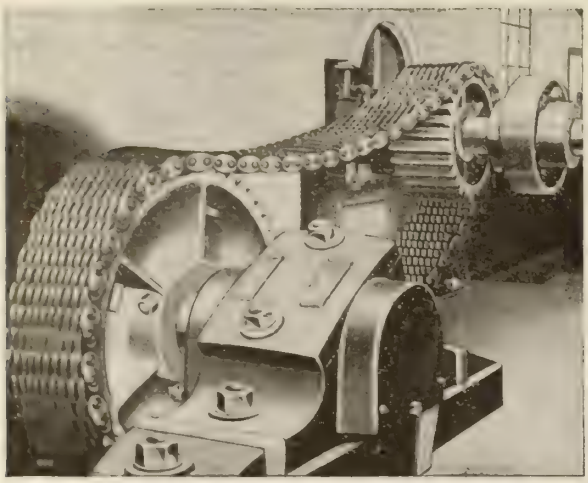
Firm name

City address

Town State

If you desire to talk in person to a Johns-Manville representative, check circle here. ○

If any advertisement interests you, tear it out now and place with letters to be answered.



COVENTRY NOISELESS CHAINS

For all kinds of power transmission — Main and Countershaft Drives, Pumps, Fans, Air Compressors, and at all times 98 per cent. of power being transmitted.

Write for our handbook C-3 on chain gearing, post free for the asking.

Head Office and Works:

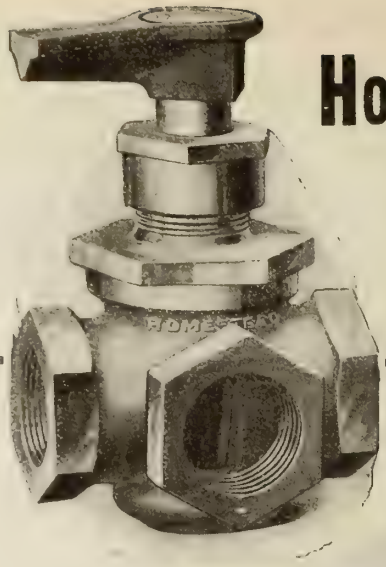
"THE COVENTRY" CHAIN CO., LTD.
COVENTRY, ENGLAND

Cables: Chains, Coventry.

Codes: A.B.C., 4th and 5th editions. Western Union.

London Office: 47 Victoria St., S.W. 1.

Agencies in all the principal countries in the World.



Homestead
Quarter-turn
Valves

Best Valve for All Services

You can use Homestead Quarter-turn Valves to better advantage where you are now using globe and gate valves. Hundreds of other power plants have benefited by the change. Why don't you? Better service is assured. Those leaks past your present gate and globe valves that can't be kept tight represent a dead loss which should be stopped. **Homestead Quarter-turn Valves stop all losses.** Best for all services, air, steam, oil, water, acids, etc., and stand pressures up to 3,000 lbs. Write for catalog.

HOMESTEAD VALVE MFG. CO.
HOMESTEAD, PA.

WILLIAMS' Improved "Vulcan" Chain Pipe Wrench

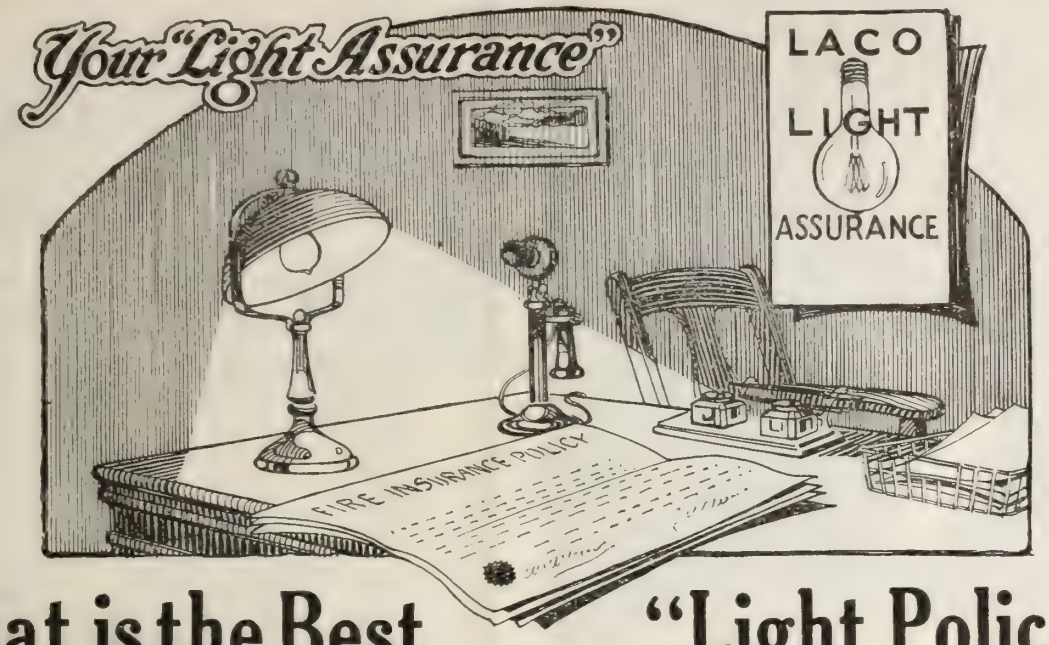
CERTIFIED O.K.

A GOOD workman is known by his tools—a tradesman by his stock. You, like the great majority of others, want only the **best** in pipe tools—that means Williams' "Vulcan" and "Agrippa"—for only in them can be obtained "certified" chains. Each and every flat-link chain is regularly "proof-tested" in a standard tension machine; it is then stamped "O" on the drop-forged swinging link and to it is attached a gray leaden seal bearing our trade-mark —the proof of quality—to certify that it has passed our standardized tests.

We certify—you verify.

Ask for booklet—it's free!

The A. G. Low Co., Ltd.,
78 Pacific Ave., Saskatoon, Sask.
Agents for Manitoba, Saskatchewan, Alberta and British Columbia.



What is the Best "Light Policy?"

THOUSANDS of manufacturers have asked this question and have found the answer to be—

A light that increases production for the same labor cost.

A light that promotes greater accuracy in workmanship, and thus reduces spoilage and accident hazard.

A light that avoids unnecessary eyestrain and bodily fatigue, and makes surroundings more cheerful, promotes neatness and sanitation, and renders superintendence more effective.

A light that reduces current and maintenance cost.

They have found such a light in

LACO NITRO LAMPS

The reduction of current and maintenance costs by Laco Nitro Lamps is due to two prime reasons: Their high candle power requires fewer lamps, and their long life reduces replacements. Official tests have proved that Laco Lamps burn 30 to 50% less current and last 25 to 50% longer than any other make.

There are no "official" statistics of their conservation of man-power, material, time, and general efficiency—but individual records from prominent plants all over the country prove beyond question their results in this direction. If, by the most conservative reckoning, they save 5 minutes of a workman's time per 8-hour day, here is a saving of 1% on wages expenditure. Surely these are facts enough to show that

The Laco Light Policy Pays Handsome Dividends

Call our lighting experts into consultation to-day, and let us devise the best system to meet your needs. Drop us a line for interesting pamphlets and data.

Canadian Laco-Philips Company, Limited

Montreal Toronto Winnipeg Vancouver

Thrift

Thrift means conservation, and in the Power Plant applies particularly to valve equipment. Where

LUNKENHEIMER REGRINDING VALVES

are used, thrift is assured because these valves can easily be repaired—the seating surfaces being regrindable and all parts interchangeable.

Users should profit by their installation, regrinding the seating surfaces or replacing a part when necessary, in preference to discarding the entire device.

To repair means to conserve. To conserve means to economize. To economize is to practice THRIFT, which is essential to our success in the war.

THE LUNKENHEIMER CO.
"QUALITY"

Largest Manufacturers of
High Grade Engineering Specialties
in the World

New York Chicago CINCINNATI OHIO., U.S.A. Boston London

Our WAR-PERIOD Appeal
ENGINEERING APPLIANCES
ARE PRIME WAR ESSENTIALS

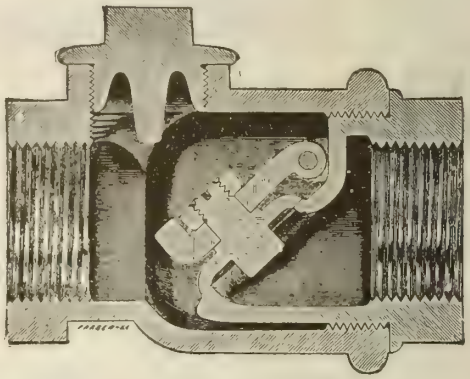
The Genuine

"McSHANE"

Straightway Swinging

CHECK VALVES

Sectional View



BRASS OR IRON

SCREWED OR FLANGED

For use Upright or Horizontally

Always Ready for Inspection

Suitable for Pressures up to 250 lbs.

T. McAVITY & SONS

LIMITED

Wholesale and Retail Hardware
Brass and Iron Founders

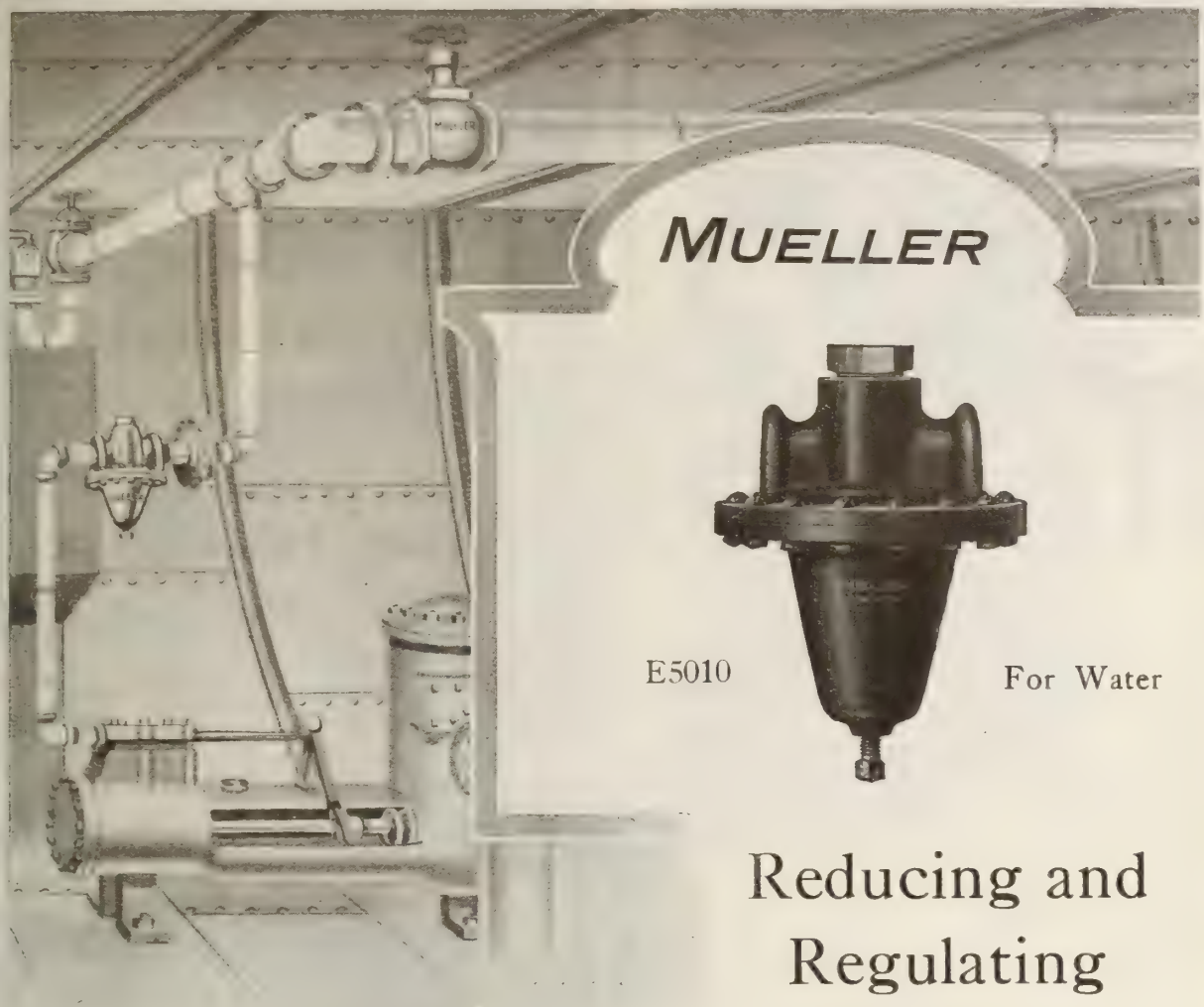
ST. JOHN, N.B.
CANADA

Montreal
T. McA. Stewart
157 St. James St.

Toronto
Harvard Turnbull & Co.
207 Excelsior Life Bldg.

Winnipeg Vancouver London, England
Durban, South Africa
Established 1834

If any advertisement interests you, tear it out now and place with letters to be answered.



MUELLER

E5010 For Water

Reducing and Regulating Valves

Before you install your valve, be absolutely sure on these three points.

1. **The right kind** of valve is the one that is adapted to your particular service. No one type will answer all purposes. Different service and at times different conditions in the same kind of service necessitates different types of valves.

2. **The right size** of valve is the size that will make the proper reduction and regulation and has a wide enough seat opening to prevent obstruction and cutting out of the seat. *A general fault is using a valve that is too large.* Ordinarily they should be smaller than the pipe to which they are attached.

3. **Proper assembling** means that valves should have working parts suitable to service, and diaphragms and springs suitable to pressure range.

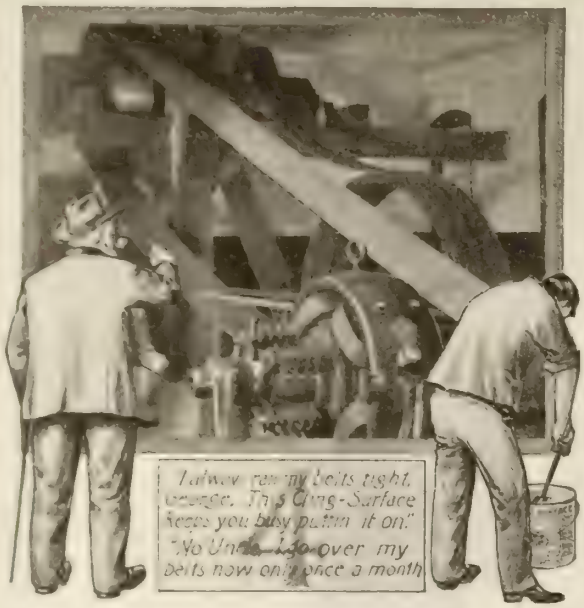
Don't guess. Consult us. When valves are installed under MUELLER supervision, we fully warrant them to perform the service for which we recommend them.

We make valves for water, steam, gas, air, oil and ammonia. There is a stock valve in our catalog that will meet your needs. If you have a specially intricate problem to solve, our experts are at your command.

H. MUELLER MFG. CO., LIMITED

SARNIA, CANADA

MUELLER


I always run my belts tight, George. This Cling-Surface keeps you busy puttin it on."
"No Uncle, I go over my belts now only once a month

WE stood and watched him.

Above and on all sides of us the belts were moving: large and small, vertical and horizontal, quarter-turn and cross belts; each moving swiftly, silently.

There seemed to be thousands! And the Superintendent had told us that this ONE MAN took care of them all! We stood and watched him.

He carried a pail, and a stick wrapped at one end with a cloth bandage. Dipping this into the pail he carefully wiped the excess off upon the edge and laid the stick against the face of a moving belt. As he worked it back and forth we saw a light stain appearing on the pulley face. He was watching this also, for apparently satisfied, he stopped the treatment and went on to the next belt.

So that was all? A dip, a wipe and a few passes back and forth across the belt face? But how long would it last?

"That belt," said the Superintendent, "is now in such fine condition that it will not require any more CLING-SURFACE for a month. It is quite pliable, waterproof and practically oilproof, and what is more important still, it never slips even under the peak load. You see it is running very slack—we haven't had to take it up for three years.

"Before I had the shop use CLING-SURFACE we ran all our belts tight, and were having trouble every day. It kept four men busy just taking up belts, and applying belt dressing, but now this one man with the new semi-liquid CLING-SURFACE treats them all."

That is the NEW way to apply the NEW semi-liquid "easy-to-use" CLING-SURFACE. It requires no heating in ordinary temperatures. It results in a money saving more than covering the cost of the CLING-SURFACE required.

The plan 10,000 firms have found successful will interest you. Let us send it free, with any special service your conditions may require.

Remember, use CLING-SURFACE and you won't need belt dressings.

Cling Surface

Cling-Surface Co.

1057 Niagara Street
Buffalo New York

For More Than 50 Years

Albany Grease has given a lubrication service of great efficiency and economy on all bearings of power and industrial plant equipment. Albany Grease is the most universally used lubricant sold to-day.

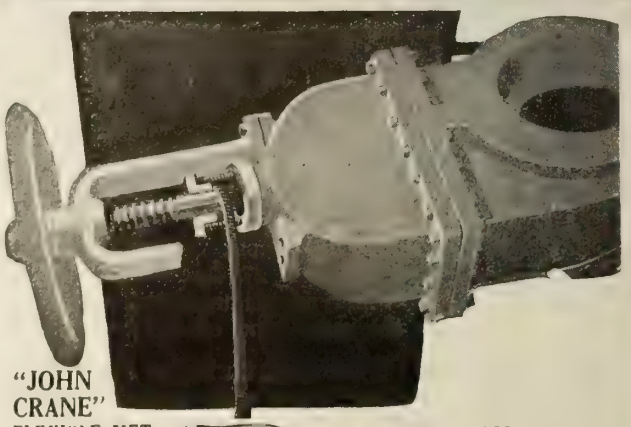
ALBANY GREASE

will keep engines and all kinds of machinery and line shafting operating cool and easy at all times. It is sold by reliable hardware and mill supply stores—everywhere. We will gladly send samples upon request.

Albany Lubricating Co.

708-10 Washington St.
New York, U.S.A.

Established 1868



"JOHN CRANE" FLEXIBLE METALLIC PACKING

is applicable to gate valves, hand valves, all kinds of plungers and rods, condenser tubes, and wherever packing is needed. It is the only really UNIVERSAL material made which packs with equal leaklessness and frictionlessness; steam, water, ammonia, gas, gasoline, acids, crude oil, distillates, vapors, etc.

Can you beat it? No. Can you equal it? No.

YOU CAN CUT IT WITH A KNIFE

just like flax. It is as flexible as flax; more durable; tighter; doesn't wear the rod a bit, but improves and gives the rod a high polish; frictionless as a babbitted bearing because "John Crane" itself is made of thin babbitt foil wound spirally from the center with the highest grade of lubricant sandwiched between the hundreds of layers.

Can you beat it? No. Can you equal it? No.

Different from the shredded, braided, twisted, granulated, shot, poured and segmental types. It is the only packing of its kind on the market. Every ambitious engineer should know all about it.

Any engineer with new rods can get this material on approval, if he speaks, now. We'll demonstrate at our own risk on any new plunger, new pump rod, new accumulator, new press, etc. Write for Bulletin No. 1 which tells all.

Crane Packing Company Box 241, Windsor, Ont.
General Office and Factory, Chicago, Ill.
NEW YORK—121 Park Row Building. PITTSBURGH—102 May Building. PHILADELPHIA—527 Colonial Trust Building.

To make a good Belt—

every step in belting manufacture must be good.

Here's a good start.

The Choicest Steers—

such as is shown in above photo, mark the beginning of

D. K. McLaren's

Genuine British Oak-Tanned Leather Belting

It's the use of the highest grade of hides and our Genuine British Oak Tanning Process that has given D. K. McLaren's belting its remarkable durability and strength.

D. K. McLaren's belting minimizes stretch and has the grip that practically eliminates slippage and power loss due to same.

Try one belt now and you'll soon want more for other parts of your plant.

GENUINE OAK

D·K·McLAREN LIMITED

HEAD OFFICE AND FACTORY:
351 St. James Street
MONTREAL, P.Q. CANADA

VANCOUVER, B.C. - 849 Beatty St.
TORONTO, ONT. - 194 King St. West
ST. JOHN, N.B. - 90 Germain Street

KERR
("New KEYSTONE" Pattern) GATE VALVES

If you have not used any of these New Pattern Valves, specify "KERR" in your next order. We want you to get acquainted with the most reliable valve on the market.

If you have been using them, we are confident that our satisfaction will bring us your repeat orders. These valves will never cause you or your customer the slightest trouble. Their high quality is consistent.

When you buy a "KERR" Valve you get a guaranteed article that is backed by a reliable firm. Many of the largest distributers of valves in Canada have sold "KERR" Valves for over 25 years, and are still recommending them as the "Best Valve." Write us for particulars.

Kerr Engine Co., Ltd., Valve Specialists **Walkerville, Ont.**

FALL REPAIRS

NOW is the time to think of Winter difficulties. The trouble is going to be to get Coal at any price. By repairing present linings with our **Plibrico-Jointless Firebrick,** or repairing old Furnaces with **Plibrico and Plibrico Bond** you will require the smallest quantity of Coal. Coating exterior Brickwork with **Stormtight Plastic** will help still further, and this material in Plastic or Liquid will put your Roofs in a position to withstand storms **Lapidolith—Concrete Hardener**—will cut out the usual Spring repairs to exposed Concrete. Your own men can apply all three materials quite satisfactorily, and a postal will bring you full particulars.

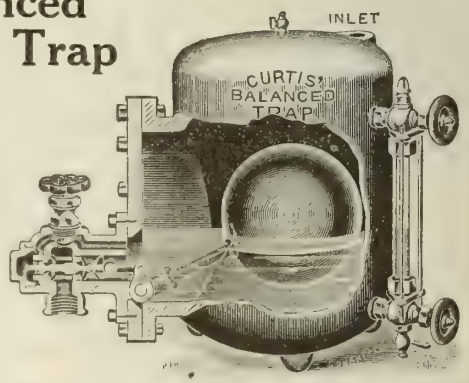
MILL SUPPLY DEPARTMENT

BEVERIDGE PAPER CO., LTD.

QUEBEC MONTREAL ST. JOHN, N.B.

CURTIS Engineering Specialties

Balanced Steam Trap



This trap is often used as a waterline trap on large plants where there is need to balance any particular circulation to prevent snapping and cracking in pipes and radiators.

This Trap Has These Points of Difference and Superiority

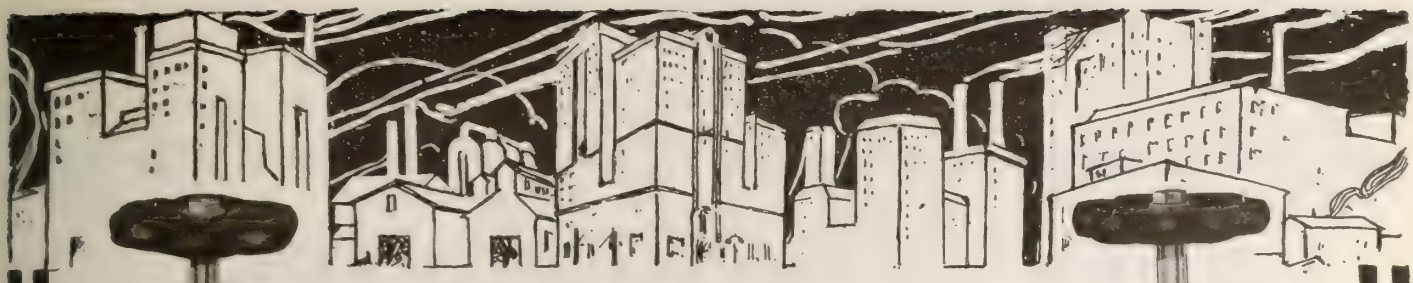
1 A perfectly balanced valve.
2 An absolutely frictionless valve.
3—The valve can be removed without breaking a joint, starting a gasket, or taking out a bolt.
4—The valve being frictionless and balanced, the whole power of the float is available for opening and closing the valve.
5—Each trap will operate perfectly on pressure varying from one to 250 lbs.

The great merit of this trap, its simplicity, its dependability and serviceability make it well worth being better acquainted with. Send for special printed matter describing it and giving prices. Address the Manufacturers.

JULIAN D'ESTE COMPANY

Main Office, 26 Canal St., Boston, Mass.

Agencies: 216 Fulton St., New York City; 174 N. Market St., Chicago, Ill.



Jenkins Bros.

Valves

EVEN an apparently insignificant hiss of steam past a poorly seating valve will cause a material fuel loss per year. Multiply this figure by the number of valves in the average plant and the loss becomes appalling.

Dependable valve service is essential—more so now than ever before in view of the great scarcity of fuel.

No matter what the type of building or plant, the best valve service is necessary. Installing good valves at the start saves repair and replacement charges and the labor costs of re-installations later.

Whether you require valves for industrial plants, public or private buildings, **Jenkins Bros.' Valves** should be your choice. You can rely upon them under conditions where other valves would fail.

They will hold absolutely tight under steam, water, air and gas pressure for very long periods of service without attention. The design is heavier than the usual commercial standard pattern of other makes, enabling us to guarantee them for 175-lb. steam or 250-lb. water-working pressure. All are fitted with renewable Jenkins discs made of a softer composition than the metal and which will seat perfectly tight in spite of inequalities or rough spots in the metal surfaces. When worn the discs may be replaced at trifling cost and the valves will become as tight as when new. The composition of the discs is varied to suit the particular requirements of each class of service.

Furnished in brass or iron body, in globe, angle, cross, check, Y or blow-off, hose whistle and other patterns.

TRADE JENKINS MARK
Jenkins Bros

Jenkins Bros. LIMITED

Head Office and Works:
103 St. Remi Street,
Montreal, Canada

Agencies in all the
Principal Countries
of the World

European Branch:
6 Great Queen Street,
London, W.C.2, England

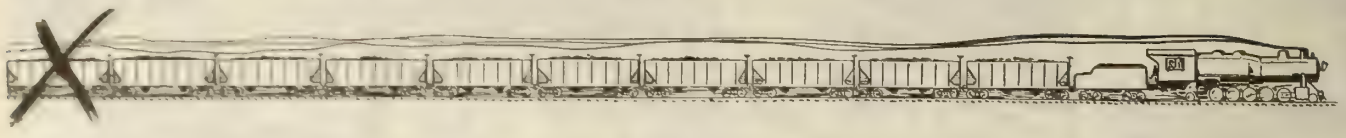
TRADE JENKINS MARK
Jenkins Bros

TRADE
JENKINS
MARK
Jenkins Bros

For 54 years Genuine Jenkins Valves have rendered faithful service in over 103 industries.

Every genuine Jenkins Valve bears the diamond trademark—the seal of an iron-clad guarantee.

Real Conservation—



GREEN'S ECONOMISERS

save one or more cars out of ten.

THE use of Economisers is more important now than ever before and all new plants should be equipped with them, also all old plants that are engaged in essential work.

The others will have to wait until after the war.

Some of the reasons for the importance of Economisers now are:

FIRST—They save 10 to 15 per cent. of the coal that would be needed if the boilers were operated without them.

SECOND—They can be used to increase the present boiler capacity or to get greater capacity out of new boiler equipment.

THIRD—The coal saving releases cars and railroad facilities which are very important under present conditions.

FOURTH—This saving also helps in overcoming the shortage of miners caused by enlistment or drafting.

FIFTH—If used to increase the boiler capacity this releases boilermakers and steel that can be used to make boilers for marine service and other important uses.

The complete list of reasons is too long to be given in detail. Our Engineers will be glad to give you others and also explain the application of Economisers to your plant.

A new Economiser Catalog will be ready soon. May we put your name on our mailing list now? Just fill in and send the coupon.

GREEN'S ECONOMISER, LTD.
TORONTO

Tear off here.

Green's Economiser, Ltd.,
605 Kent Building, Toronto.

Please send a copy of your new Economiser Catalog to

Name .....

Position .....

Company .....

Address .....

GARLOCK PACKING

FOR EVERY PURPOSE

Thirty-one years ago we began to manufacture packing and during that time we have steadily insisted upon the best of everything that enters into our product—design, material, workmanship. Constant effort has been directed toward improving and perfecting our packings to keep pace with the wonderful progress that has been made in the development of modern machinery.

Our factories, devoted exclusively to the manufacture of our packings, are the largest, most modern and best equipped in the world, and the locations of our numerous branch factories and stores are such as to afford the greatest advantage in serving our customers promptly.

We are Exclusive Packing Manufacturers—We Make Nothing Else

THE GARLOCK PACKING CO.
Hamilton, Canada
Branches in Principal Cities

POTATO SCALE POWDER

A Simple, Inexpensive Means of Saving Fuel

Canada will face a serious fuel shortage next winter. Every pound of coal should be conserved—right now. A little POTATO SCALE POWDER in the feed water of your boilers each day will save many tons of coal for Canada in the course of a few months. POTATO SCALE POWDER removes old scale from the boilers and prevents any new scale formations, thus your boilers are able to do maximum duty with a minimum amount of fuel. No pitting, foaming or other troubles, due to impurities in feed water, where POTATO SCALE POWDER is used.

Made to suit feed water conditions and contains nothing that will cause the slightest injury to boiler metal or fittings.

Large power plants in Canada and United States are constant users of POTATO SCALE POWDER. Positively guaranteed. Try a barrel and watch the result.

BOILER CLEANSER

C. C. SNOWDON

Oils Refiner, Manufacturer and Importer, Pennsylvania, Lubricating and Refined Oils, Gasoline, Potato Scale Powder, Liquid Soap, Disinfectants, Polish, Waste, Oil Tanks, etc.

Winnipeg—Cor. Notre Dame and Pine Streets, P.O. Box 1984. **Vancouver**—823 Powell Street. **Calgary**—1810-1840 Eleventh St. East, P.O. Box 1384, P.O. Drawer 166. **Edmonton**—Cor. 13th Ave. and 83rd St., P.O. Box 877.

TeGeeTRADEMARK.

ASBESTOS METALLIC GASKETS

Give Good Service

THOMSON-GORDON LIMITED
PACKINGS
HAMILTON, ONTARIO

BOILER INSPECTION

The Steam Boiler Act, Chapter 252 R.S.O., 1914 With Amendments Chapter 58—6, George V.

STEAM BOILERS.

All Steam boilers constructed for use in Ontario must be built from designs which have been approved and allotted a registration number by the Steam Boiler Branch.

Used boilers, boilers sold or exchanged, and unregistered boilers brought into the Province must be inspected prior to being put into operation.

Notice of repairs to steam boilers, stating the nature and extent of same, must be sent to the Steam Boiler Branch, and should such repairs be considered extensive by the Chief Boiler Inspector, the boilers will require to be inspected.

In each and every case the inspections must be made by Inspectors authorized to inspect boilers under the Steam Boilers Act, who are employed only by the Steam Boiler Branch of the Department of Public Works. Official certificates with the maximum working pressure stated thereon are issued to the owners of the boilers so inspected.

STEAM PIPING.

Drawings and Specifications of all high pressure steam piping must be approved and registered by the Steam Boiler Branch before any work of installation is commenced. The drawings submitted should show clearly the dimensions and layout of the main steam lines. Full particulars should be given as to the material used in the construction of the piping, and all valves and other fittings used in connection therewith must be of approved make.

Any deviation from the above requirements shall be deemed a violation of the Steam Boilers Act.

All communications in this respect should be addressed to the Steam Boiler Branch, Department of Public Works, Parliament Buildings, Toronto.

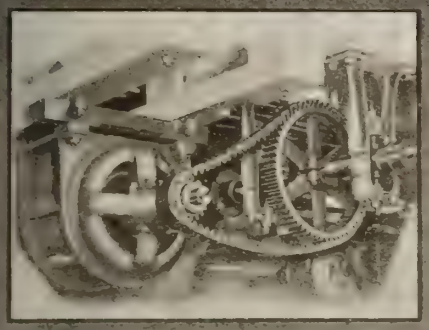
HON. F. G MACDIARMID,
Minister of Public Works and Highways

W. A. RIDDELL, M.A. Ph.D.,
Supt. Trades & Labour Branch

D. M. MEDCALF,
Chief Inspector of Steam Boilers.

MORSE DRIVES

MORSE CHAIN COMPANY ITHACA, NEW YORK



Morse Silent Chains are Serving in the War Industry Program

"Morse" adopted by Uncle Sam as a Silent Partner for use

ON SUBMARINES: Driving Oil pumps, and operating the steering and diving controls.

ON WARSHIPS: Operating gun rammers, turret turning mechanisms, and ammunition hoists.

IN ARSENALS AND FORTS: Operating big guns, and driving hoisting and machine tools.

AT PANAMA: Operating the safety gate hoists at the locks.

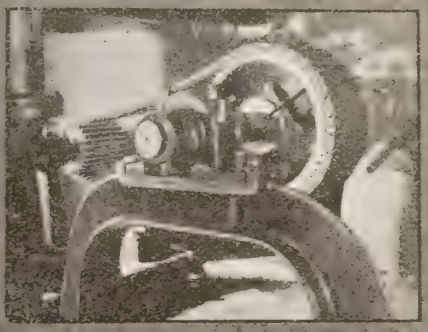
IN MINES: Driving pumps, compressors, blowers, fans and conveyors.

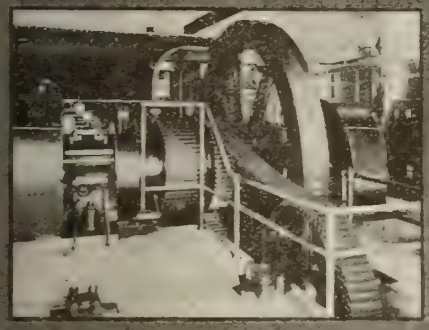
IN STEEL PLANTS: Driving rolling mills, wire drawing benches, machine tools, etc.

IN INDUSTRIAL PLANTS: Producing Munitions, Guns, Ships, Airplanes, Nitrates, Textiles, Food stuffs, etc.

The Government selects the surest, most compact, and most highly efficient power transmission obtainable.

A Chain for Every Purpose





Conserve Power — *Before Buying Pulleys and Belting investigate, know the facts* — **Increase Production**

MORSE CHAIN CO. Largest Manufacturer of Silent Chains in the World ITHACA, N. Y.

MORSE ENGINEERING SERVICE — ASSISTANCE WITHOUT OBLIGATION

Address Nearest Office

BOSTON, MASS. . . . . 141 Milk Street
CHICAGO, ILL. . . . . Merchants Loan and Trust Bldg.
CLEVELAND, OHIO . . . . . Engineers Bldg.
DETROIT, MICH. . . . . 1003 Woodward Avenue
GREENSBORO, N. C. . . . . 805 Ashboro Street
NEW YORK CITY . 50 Church Street, Hudson Terminal Bldg.
PITTSBURGH, PA. . . . . Westinghouse Bldg.
SAN FRANCISCO, CAL. . . . . Mondanock Bldg.

ATLANTA, GA. . . . . Earl F. Scott, M. E., 702 Candler Bldg.
CANADA. . . . . Jones & Glassco, Engr's'd
MONTREAL, St. Nicholas Bldg., Toronto, Bank of Hamilton Bldg.
KANSAS CITY, MO. . Morse Engineering Co., E. A. Long Bldg.
MINNEAPOLIS, MINN. . . . . 413 3rd St., Strong-Scott Mfg. Co.
ST. LOUIS, MO. . . . . Morse Engineering Co., Chemical Bldg.
LICENSEES FOR EUROPE & EASTERN HEMISPHERE
The Westinghouse Brake Co., Ltd., 82 York Road, London, N.

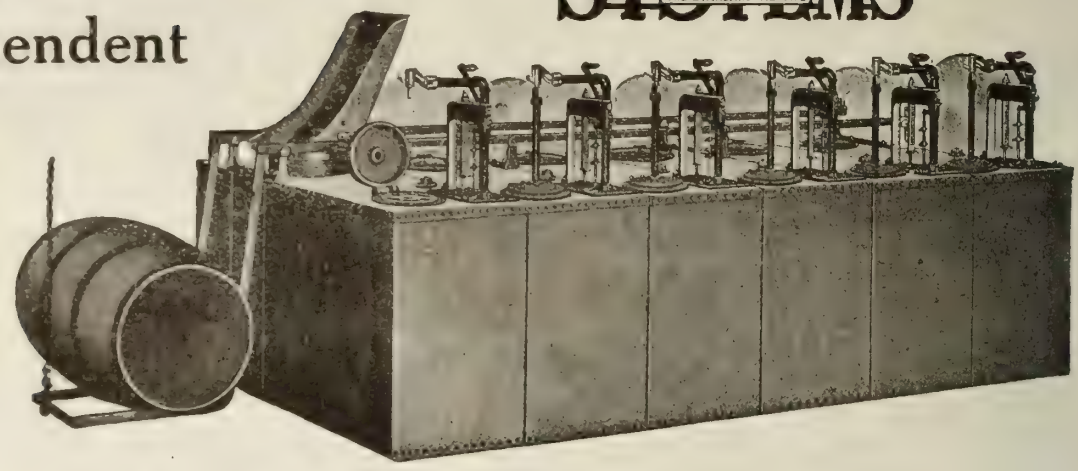
A word to the wise Superintendent

who knows

"the Office" doesn't realize the enormous quantities of oils WASTED

BOWSER
ESTABLISHED 1885

Oil Storage SYSTEMS
THE STANDARD ALWAYS



Battery of Figure 64 Units

The next time the president of your Company steps into the machine shop or power plant, speak to him about the tremendous oil waste charged against you as a formidable operating expense, but which you cannot prevent so long as you do without a Bowser Oil Storage System.

Explain the reason for so great a waste. Definitely mention seepage, evaporation, absorption, countless spills and drips.

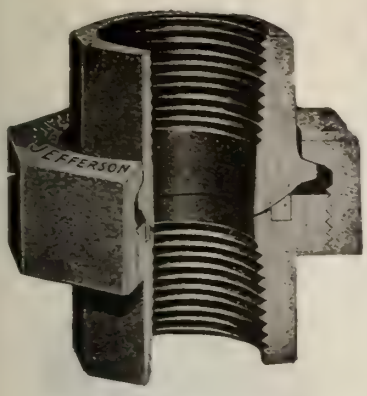
Show him the oil-soaked floor—a fire menace every hour of the day and night.

Finally hand him the Bowser Book on Oil Storage Equipment. If he doesn't thank you on the instant, he will a short time later when he discovers that Bowser Equipment has cut the oil bill in half or more.

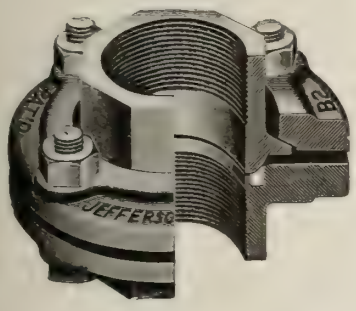
Write to-day for the Bowser Book and Full Particulars of Bowser Engineering Consultation Service.

S. F. Bowser & Co., Inc.
TORONTO, ONTARIO, CANADA

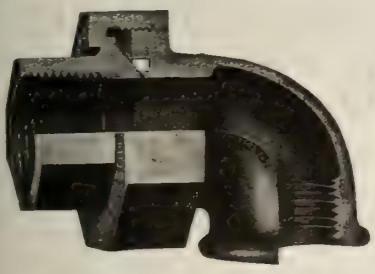
Sales Offices in All Centers *Representatives Everywhere*



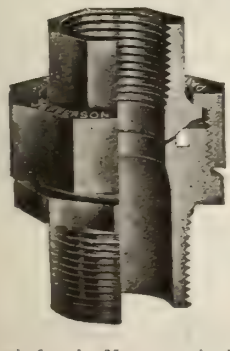
Look for the Name on the Nut



Look for the Name on the Nut



Look for the Name on the Nut



Look for the Name on the Nut

JEFFERSON UNIONS

You Can Get Every One of These Useful Types—Ask Your Jobber About Them

There are dozens of different style Jeffersons—in fact, no matter what sort of a job of pipe work you are doing there is one that will simplify the making of the connection immensely and in every style union are embodied the important Jefferson patent features which make it **the** logical pipe union for mine work.

For instance:

The Ground Ball Seat—

The joints between the union parts—to insure a perfect fit no matter how they are set up—are ground. And they are ground in pairs—that is, the two pieces which seat on each other are mated from the time they are cast till they are delivered to you; they are never separated.

The Brass Seat Ring—

Another Jefferson feature is in the brass seat ring which is a **piece of brass tubing forced into a recess back away from the runway and contents of the pipe.** This serves to prevent corrosion at the joint.

If your jobber can't supply you, write us for name of our dealer in your territory.

JEFFERSON UNION COMPANY

Lexington, Mass.

Jefferson Union Co., Lexington, Mass.
Gentlemen: Mail me postpaid, and without any obligation to me, copy of your **New Catalog.**

Name .....

Firm Name .....

Address .....

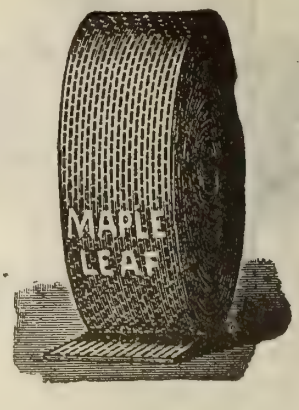
If any advertisement interests you, tear it out now and place with letters to be answered.

Dominion Belting Company, Limited
Hamilton, Canada

Sole manufacturers of the celebrated "MAPLE LEAF" Brand Stitched Cotton Duck Belting and Belt Dressing.

The demand for our products has steadily increased because the standard of quality has been maintained.

We make only one grade, the best that can be produced.



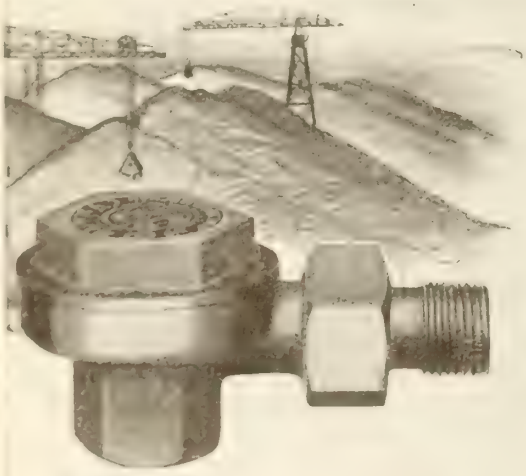
"MAPLE LEAF" is the strongest, truest running, most economical and efficient belt on the market for transmission of power, conveying, etc.

Being thoroughly waterproof it is suitable for running in wet or dry places. **"MAPLE LEAF"** Belt Dressing is different to others offered in that it is equally good for all kinds of belting, leather, rubber or Balata, as well as our own make.

Write us for prices, and if desired we will be pleased to furnish samples and further information.

A trial order will convince you of their utility.

DOMINION BELTING CO. Ltd., Hamilton, Canada-Quebec Branch: 51 Duluth Bldg., Montreal



Save Your Part of the 30,000,000 Tons

Canada will use about thirty million tons of coal during the coming winter—that is, if we can get it. That which is obtained must be made to do its work extra well. You can help in two ways—burn the coal most efficiently; tell your employer to investigate

The DUNHAM HEATING SERVICE

—a service that has brought about some remarkable savings of fuel in heating systems. Many of the largest buildings in Canada use the Dunham Radiator Trap—one of the fundamentals of the Dunham Heating Service!

Full information sent promptly on request.

The Dunham Radiator Trap
—the secret of heating efficiency

Radiators knock and pound and waste steam when they are choked up with air and water. By automatically removing these coal-wasters, the Dunham Radiator Trap gives the steam a chance to circulate easily through the radiators. No jet water at vacuum pump is required.

C. A. Dunham Company, Limited
Toronto, Canada

Halifax, Montreal, Ottawa, Winnipeg, Vancouver, Calgary

Speed up with Electric Power

C-G-E Motors and Control increase production and reduce maintenance

Here are some of the ways in which modern industry has been speeded up by putting electric power to work in the right place.

Metal mines have boosted output to meet world-wide demands. All tonnage records have been smashed in the steel industry. Greater automobile output has lowered prices and given better road transportation. More and better cloth has been produced at lower power costs. Contractors find electric drive faster, more elastic and cheaper than any other for hoists, pumps, concrete mixers, cableways and other equipment.

On the left is shown a 350 h.p., C.G.E. induction motor direct connected to a line shaft driving beating engines in a pulp mill. The illustration on the right shows two 50 h.p., C.E.G. induction motors belted to sluice pumps in a gold mill.

Any problem involving the use of power can be simplified by the application of electricity. The Canadian General Electric Company is well equipped to lend valuable assistance in working out such problems and is glad to co-operate with contractors, manufacturers and engineers in every possible way.

C-G-E MOTOR DRIVE

For further particulars write to our nearest office.

CANADIAN GENERAL ELECTRIC CO. LIMITED

Head Office: Toronto. Sales Offices: Montreal, Quebec, Halifax, Sydney, Ottawa, Cobalt, South Porcupine, London, Winnipeg, Calgary, Edmonton, Nelson and Vancouver.

HINTS TO BUYERS

DOMINION COAL COMPANY LIMITED

"Dominion" and "Springhill" BITUMINOUS STEAM and GAS COALS

GENERAL SALES OFFICE

112 St. James St. Montreal

NOTICE

TO

Stationary and Hoisting Engineers

Everyone operating a STATIONARY steam plant of 50 h.p. or over in the Province of Ontario must hold a Stationary Engineer's Certificate from the Board of Stationary and Hoisting Engineers. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary and Hoisting Engineers' Act.

Everyone operating a HOISTING steam plant working at a pressure of 20 pounds or over, irrespective of horse power, and used for hoisting in structural operations or excavating purposes, in the Province of Ontario, must hold a Hoisting Engineer's Certificate from the Board of Stationary and Hoisting Engineers. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary and Hoisting Engineers' Act.

Application forms for obtaining STATIONARY or HOISTING Engineers' Certificates, may be had upon applying to the Chairman.

HON. F. G. MACDIARMID, Minister of Public Works and Highways.
W. C. McGHIE, Chairman of Board.
W. A. RIDDELL, M. A., PH. D., Superintendent, Trades & Labour Branch.

NOTICE OF REMOVAL

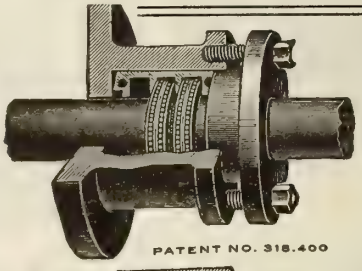
WE hereby draw your attention to CHANGE OF OUR TORONTO OFFICE address which is now located at ROOM 24, LOMBARD BLDG., 70 LOMBARD ST., Toronto, where we have installed demonstration rooms, and carry stock which enables us to give prompt shipment.

National Boiler Protector Company of Canada

Phone Main 2623

Montreal Office, 128 Bleury St.

Manufacturers—National Boiler Girth Seam Protector, National Blow Off Pipe Protector, National Plastic Lining for Boilers.



PATENT NO. 318,400

PAT. NO.	600,899	PAT. NO.	829,116
" "	534,104	" "	830,530
" "	602,328	" "	856,108
" "	654,541	" "	878,238
" "	654,542	" "	894,537
" "	725,388	" "	895,791
" "	744,490	" "	898,066
" "	775,193	" "	905,103
" "	775,194	" "	934,629
" "	791,300	" "	979,206
" "	805,869	" "	1000,76

Why not Buy the Best, when in market for Packing?

HOLMES' Metallic Packing Is Guaranteed 3 Years

Lasts many times longer. 30 days' trial. Less oil. No cutting. Easily applied to any Steam Engine, Air Compressor or Gas Engine. Satisfaction or no pay. Write us.

HOLMES METALLIC PACKING CO., Wilkes-Barre, Pa.

Incorporated 1897

McDANIEL IMPROVED STEAM TRAP

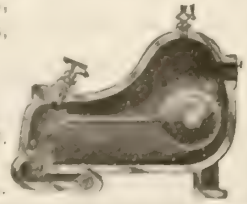
FOR HIGH OR LOW PRESSURE.

Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

MAY WE SEND ONE FOR TRIAL?

Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators.

SEND FOR CATALOGUE.



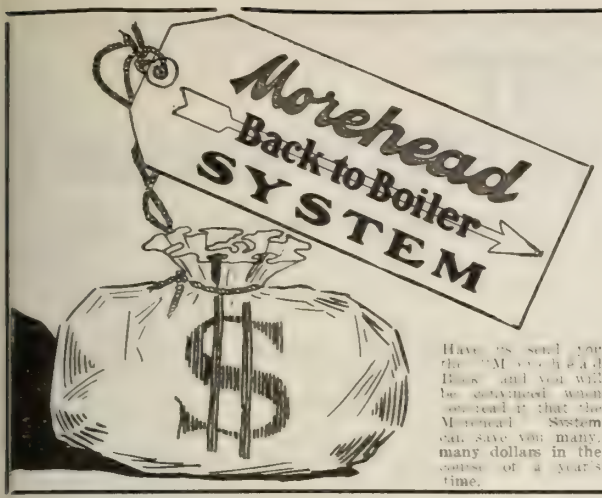
THE GARTH COMPANY
26 Craig Street MONTREAL, CAN.

WATSON & McDANIEL CO.
No. 146 N. 7th Street, PHILADELPHIA, Pa.

Water Turbines, Hydraulic Governors, Centrifugal Pumps

OUR LINDSAY WORKS

Boving Hydraulic & Engineering Co., Limited
Lindsay, Ontario



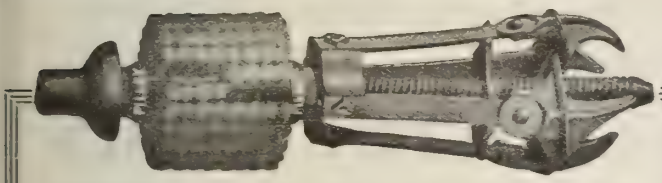
A System That Saves Many Bright Dollars!

Every dollar saved to-day is a dollar added to the nation's resources at a time when the nation needs its resources most.

Are you getting condensation back to the boilers HOT? If not you are wasting valuable heat units—heat units that represent actual dollars in coal losses. What you require is the **Morehead Back-to-Boiler System** in your plant. It delivers back to the boiler pure HOT condensation unfailingly, completely, wastelessly, and automatically.

Furthermore, the "Morehead System" saves the boilers and saves much labor; gives relief from pump troubles, maintains equally controlled **uniform** temperature in your plant, and in other ways makes for better and more economical steam service.

Canadian Morehead Mfg. Company, Limited
Woodstock, Ontario



Looks like a good tool and it's just a little better than it looks. Adopted as standard by thousands of engineers who know from experience that it always gets results.

Pilleys Combination Flue Brush and Scraper

is adjustable to the tube—scrapes and brushes thoroughly in one operation. Guaranteed against defective materials and that wires will not pull out or lay over. For sale by leading Canadian jobbers.

Eastern Office: 71 Fulton St., New York.

PILLEY PACKING & FLUE BRUSH MFG. CO.
623 South Third Street ST. LOUIS, MO.

JAMISON COLD STORAGE DOOR CO.
formerly
JONES COLD STORE DOOR CO.
OPEN RITE
"Our output exceeds others combined,
And just a few of the facts in mind
Will convince the most skeptic buyer
Ours is best; even if slightly higher."
CLOSE TITE
Manufacturers of the
ORIGINAL "JONES" AND "NOEQUAL" TYPES
HAGERSTOWN, MD. P.O.BOX 93 U.S.A.

ADVERTISING to be successful does not necessarily have to produce a basketful of inquiries every day.

The best advertising is the kind that leaves an indelible, ineffaceable impression of the goods advertised on the minds of the greatest possible number of probable buyers, present and future.

THE LADD VERTICAL WATER TUBE BOILER

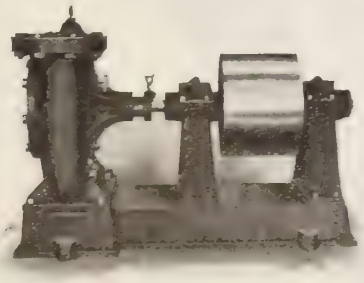
The Goldie-McCulloch Co., Ltd.
Galt, Ontario

Canadian licencees under patents 162401 and 162402 dated May 4, 1915.

The George T. Ladd Company,
Pittsburgh, Pa.

Owners and manufacturers for the United States.

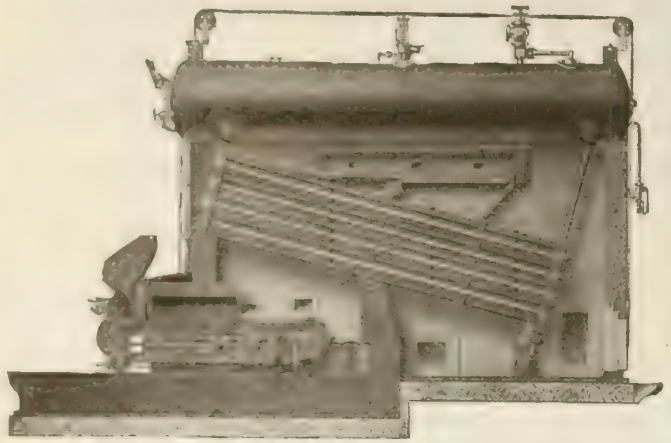
Write for new Catalogue No. 17.



Send that PUMP inquiry to
The Smart-Turner Machine Co.
LIMITED
HAMILTON, CANADA

"ALL BRITISH"
"B.&W." PATENT WATER TUBE STEAM BOILERS

HIGHEST ECONOMY, SAFETY, DURABILITY. OVER 20,000,000 H.P. IN USE.



Babcock & Wilcox Patent Water Tube Steam Boiler, Superheater and Mechanical Stoker.

ALSO

Steam Superheaters
Mechanical Stokers
Coal-Handling Machinery
Piping, Feed Water Heaters
Water Softeners and Purifiers
and **ELECTRIC CRANES**

BABCOCK & WILCOX, Limited

HEAD OFFICE FOR CANADA - COLLEGE ST. (ST. HENRY), MONTREAL
TORONTO OFFICE, TRADERS BANK BUILDING

The Wrench of 25% Greater Efficiency

TRIMO PIPE WRENCH

Two new features have been recently added to the Trimo Pipe Wrench, namely Nut-Guards, in all sizes, and unbreakable steel frames, in leading sizes.

The Nut-Guards prevent the accidental rotation of the nut while in use.

These improvements add 25% to the usefulness of the tool.

The Trimo Pipe Wrench is made with wood handles in 4 sizes, 6-in., 8-in., 10-in., 14-in. and in steel handles in all sizes, 6-in. to 48-in. inclusive.

All Trimo Pipe Wrench parts are interchangeable.

The inserted jaw in the handle can be readily replaced when worn, thus adding to the life of the tool.

Nut with Nut-Guards

Inquiries from Importers and Dealers Solicited. Send for Catalogue No. 55.

TRIMONT MANUFACTURING CO.

Cable Address: Trlwrench
Code: Western Union

Roxbury (Boston) Mass., U.S.A

POWER HOUSE BUYERS' DIRECTORY

If what you want is not listed here write us, and we will tell you where to get it. Let us suggest that you consult also the advertisers' index facing the inside back cover, after having secured advertisers' names from this directory. The information you desire may be found in the advertising pages This department is maintained for the benefit and convenience of our readers. The insertion of our advertisers names under proper headings is gladly undertaken, but does not become part of an advertising contract.

ACCUMULATORS, HYDRAULIC
Bawden Pump Co., Toronto.

AIR COCKS
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

AIR VALVES
Mueller Mfg. Co., H., Sarnia, Ont.

ALTERNATORS
Lancashire Dynamo & Motor Co., Toronto, Ont.

AMMETERS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. H. W. Johns-Manville Co., Toronto, Ont.

AMMONIA VALVES AND FITTINGS
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Frick Co., Waynesboro, Franklin Co., Pa.
Homestead Valve Mfg. Co., Pittsburgh, Pa.
York Mfg. Co., York, Pa.

AMMONIA PURIFIERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Mfg. Co., York, Pa.

AMMONIA TANKS
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford, Ont.

ANTIMONY
Dominion Metal Co., Sherbrooke, Que.

ARCHES, COMBUSTION CHAMBER
Canadian Fairbanks-Morse Co., Ltd. Montreal.

ASH CARRYING SYSTEMS
Babcock & Wilcox, Ltd. Montreal.
Waterous Engine Works Co., Brantford, Ont.

ASBESTOS SPECIALTIES
Durabla Mfg. Co., New York, N.Y.
Garlock Packing Co., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

AUTOMATIC ICE RECORDING DOORS AND CHUTES
Jamison Cold Storage Door Co., Hagerstown, Md.

BABBITT AND ANTI-FRICTION METAL
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Dominion Metal Co., Sherbrooke, Que.
Hoyt Metal Co., Toronto.
Magnolia Metal Co. Montreal.
Wm. C. Wilson & Co., Toronto.

BALL BEARINGS
Can. S K F Co., Toronto, Ont.

BALLCOCKS
D'Este Co., Julian, Boston, Mass.

BATTERIES AND ACCESSORIES
Can. H. W. Johns-Manville Co., Toronto, Ont.

BELT CEMENT
Graton & Knight Mfg. Co., Montreal.

BELT DRESSING
Cling Surface Co., Buffalo.
Jos. Dixon Crucible Co., Jersey City.
Dominion Belting Co., Hamilton, Ont.
Graton & Knight Mfg. Co., Montreal.

BELT LACING, LEATHER
Graton & Knight Mfg. Co., Montreal.

BELT TIGHTENERS
Waterous Engine Works Co., Brantford, Ont.

BELT PULLEYS
American Pulley Co., Philadelphia, Pa.
Waterous Engine Works Co., Brantford, Ont.

BELTING, BALATA
Federal Engineering Co., Toronto, Ont.

BELTING, LINK
Graton & Knight Mfg. Co., Montreal.
Waterous Engine Works Co., Brantford, Ont.

BELTING, STITCHED COTTON DUCK
Dominion Belting Co., Hamilton, Ont.

BELTING, LEATHER
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Garlock Packing Co., Hamilton, Ont.
Goodyear Tire & Rubber Co., Toronto.
Graton & Knight Mfg. Co., Montreal.
Main Belting Co., Montreal.
D. K. McLaren Ltd., Montreal.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

BELTING, RUBBER
Can. H. W. Johns-Manville Co., Toronto, Ont.
Goodyear Tire & Rubber Co., Toronto.
Jeffrey Manufacturing Co., Montreal.
Thomson-Gordon, Ltd., Hamilton, Ont.
United States Rubber Co., New York.

BELTING, WOVEN COTTON
Federal Engineering Co., Toronto, Ont.

BINS, COAL, COKE AND ORE
Jeffrey Manufacturing Co., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford, Ont.

BLOWERS
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Can. Sirocco Co., Windsor, Ont.
Coppus Eng. & Equip. Co., Worcester, Mass.
Green's Economiser, Ltd., Toronto.

BOILER COVERING
Beveridge Paper Co., Montreal, Que.

BOILER COMPOUNDS
Beveridge Paper Co., Montreal, Que.
Can. Economic Lubricant Co., Montreal, Que.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Metlskin Mfg. Co., Rochester, N.Y.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Wm. C. Wilson & Co., Toronto.

BOILER COMPOUND FEEDERS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Morehead Mfg. Co., Woodstock.
Lunkenheimer Co., Cincinnati, O.

BOILER FEED PUMPS
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Steam Boiler Equipment Co., Toronto, Ont.
Darling Bros., Ltd., Montreal, Que.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Laurie & Lamb, Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

BOILER FEED REGULATORS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Beveridge Paper Co., Montreal, Que.
Mason Regulator & Engineering Co., Montreal.
Northern Equipment Co., Erie, Pa.

BOILER GRAPHITE
Joseph Dixon Crucible Co., Jersey City, N.J.

BOILER MOUNTINGS
Babcock & Wilcox, Ltd. Montreal.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Ltd., Montreal, Que.
Inglis Co., The John, Toronto, Ont.
Lunkenheimer Co., Cincinnati, O.
Mason Regulator & Engineering Co., Montreal.

BOILER PRESERVATIVES
Johns-Pratt Co., The, Hartford, Conn.
Metlskin Co., Inc., Rochester, N.Y.

BOILER AND FURNACE BRICK WORK
Wenting, J. H., 256 Lee Ave., Toronto, Ont.

BOILER HOUSE ACCESSORIES
Babcock & Wilcox, Ltd. Montreal.
Canadian Griscom-Russell Co., Ltd., Montreal.
Cole, Ltd., Geo. W., Toronto.
Mason Regulator & Engineering Co., Montreal.

BOILER SEAM PROTECTOR
National Boiler Seam Protector Co., Montreal.

BOILER SETTINGS
Beveridge Paper Co., Montreal.
Gates, John W., St. James St., Montreal.

BOILERS, HORIZONTAL, RETURN, TUBULAR AND WATERTUBE
Babcock & Wilcox, Ltd. Montreal.
Cole, Ltd., Geo. W., Toronto.
Goldie & McCulloch Co., Galt.
Frick Co., Waynesboro, Franklin Co., Pa.
Inglis Co., The John, Toronto, Ont.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Jones Underfeed Stoker Co., Toronto.
Leonard & Sons, E., London, Can.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Ladd, The Geo. T., Co., Pittsburgh, Pa.
McAvity, T., & Sons, Ltd., St. John, N.B.
Waterous Engine Works Co., Brantford, Ont.

BOILERS, MARINE, LOCOMOTIVE AND VERTICAL
Babcock & Wilcox, Ltd. Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Goldie & McCulloch Co., Galt.
Inglis Co., The John, Toronto, Ont.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Leonard & Sons, E., London, Can.
John McDougall Caledonian Iron Works, Montreal.
Waterous Engine Works Co., Brantford, Ont.

BOOKS
Audel & Co., Theo, New York, N.Y.
MacLean Publishing Co., Toronto.

BOXES, FUSE AND METER
Johns-Pratt Co., The, Hartford, Conn.

BRASS FOUNDERS
McAvity, T., & Sons, Ltd., St. John, N.B.
D'Este Co., Julian, Boston, Mass.
Mueller Mfg. Co., H., Sarnia, Ont.

BRINE COOLERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

BRINE TANKS
Frick Co., Waynesboro, Franklin Co., Pa.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford, Ont.
York Manufacturing Co., York, Pa.

BUSHINGS
Steel Mill Packing Co., Windsor, Ont.

CABLE
Wm. C. Wilson & Co., Toronto.

CALORIMETERS
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Taylor Instrument Co., Rochester, N.Y.

CANS, OILY WASTE
Jas. Morrison Brass Mfg. Co., Toronto.

CAST IRON FITTINGS
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.

CASTINGS, BRASS AND IRON
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Hamilton Co., Wm., Peterboro, Ont.
Lunkenheimer Co., Cincinnati, O.
John McDougall Caledonian Iron Works Co., Ltd., Montreal.
McAvity, T., & Sons, Ltd., St. John, N.B.
Mueller Mfg. Co., H., Sarnia, Ont.
Victoria Foundry Co, Ottawa, Ont.
Waterous Engine Works Co., Brantford, Ont.
Wood & Co., R. D., Philadelphia, Pa.

CELLAR DRAINERS
Morrison Brass Mfg. Co., James, Toronto, Ont.
Mueller Mfg. Co., H., Sarnia, Ont.

CEMENT HARDNER & WATERPROOFER
Beveridge Paper Co., Montreal, Que.

CEMENT, HIGH TEMPERATURE
Beveridge Paper Co., Montreal.
Gates, John W., St. James St., Montreal.
Green's Economiser, Ltd., Toronto.

CEMENT, PIPE JOINT
Wm. C. Wilson & Co., Toronto.

CEMENT MACHINERY
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Waterous Engine Works Co., Brantford, Ont.

CEMENT, INSULATING, REFRACTORY
Green's Economiser, Ltd., Toronto.

CHAIN DRIVES
Coventry Chain Co., Coventry, England.
Morse Chain Co., Ithaca, N.Y.

CHAIN WHEELS
Babbitt Steam Specialty Co., New Bedford, Mass.

CHIMNEYS, STEEL
Babcock & Wilcox, Ltd. Montreal
MacKinnon, Holmes & Co., Sherbrooke, Que.

CHUTES, COAL
Can. Allis-Chalmers, Ltd., Toronto, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.

CLEANERS, BOILER TUBE
Babcock & Wilcox, Ltd., Montreal.
Can. H. W. Johns-Manville Co., Toronto.
Cole Ltd., Geo. W., Toronto.
Beveridge Paper Co., Montreal, Que.
Garlock Packing Co., Hamilton, Ont.
Green's Economiser, Ltd., Toronto.
Liberty Mfg. Co., Pittsburgh, Pa.
Laurie & Lamb, Montreal, Que.
Pierce & Co., Wm. B., Buffalo, N.Y.
Pilley Packing & Flue Brush Mfg. Co., St. Louis, Mo.
Roto Co., Hartford, Conn.

CLOCKS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Foxboro Co., The, Foxboro, Mass.

CLOSETS
Mueller Mfg. Co., H., Sarnia, Ont.

CLUTCHES
Waterous Engine Works Co., Brantford, Ont.

COAL
Dom. Coal Co., Montreal

COAL AND ASH CONVEYORS
Babcock & Wilcox, Ltd. Montreal.
Jeffrey Manufacturing Co., Montreal.
Waterous Engine Works Co., Brantford, Ont.

COAL HANDLING MACHINERY
Babcock & Wilcox, Ltd. Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Jeffrey Manufacturing Co., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford, Ont.

COAL HOLE COVERS
Can. Allis-Chalmers, Ltd., Toronto, Ont.

COILS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

COLD STORAGE INSULATION
Armstrong Cork & Insulation Co., Montreal, Que.
[illegible]

COMMUTATOR TRUING DEVICES
[illegible] New York, N.Y.

CONDENSERS
[illegible] Buffalo, N.Y.
[illegible] Battle Creek, Mich.
[illegible]
Bellis & Morcom, Birmingham, Eng.
[illegible] Lindsay, Ont.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
[illegible]
Goldie & McCulloch Co., Galt.
[illegible]
[illegible] Montreal.
Waterous Engine Works Co., Brantford.

CONDENSERS, AMMONIA AND STEAM
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

COLLECTORS, PNEUMATIC
Sturtevant Co. of Canada., B. F., Galt, Ont.

CONSULTING ENGINEERS
[illegible]
Laurie & Lamb, Montreal.

COLD STORAGE DOORS AND WINDOWS
[illegible] Hagerstown, Md.

COMPRESSORS, AIR
American Steam Pump Co., Battle Creek, Mich.
[illegible]
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
[illegible]
Inglis Co., The John, Toronto, Ont.
Laurie & Lamb, Montreal.
MacKinnon Holmes & Co., Sherbrooke, Que.
Smart-Turner Machine Co., Ltd., Hamilton.
Taylor Instrument Co., Rochester, N.Y.

COMPRESSORS, GAS
Can. Allis-Chalmers, Ltd., Toronto, Ont.

CONDUITS
Can. H. W. Johns-Manville Co., Toronto, Ont.

CONDENSATION RECEIVER
Cole, Ltd., Geo. W., Toronto.
Davis Regulator Co, G. M., Chicago.

CONDENSER AND SMOKESTACK PAINTS
Beveridge Paper Co., Montreal, Que.

CONNECTIONS, FLANGED
[illegible] Lexington, Mass.
Dart Union Co., Ltd., Toronto, Ont.

CONTRACTORS' STRUCTURAL STEEL
Canadian Fairbanks-Morse Co., Ltd., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.

CONVEYOR MACHINERY
Babcock & Wilcox, Ltd. Montreal.
Ed Bennis & Co., Little Hulton, Bolton, Eng.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Jeffrey Manufacturing Co., Montreal.
[illegible] Toronto, Ont.
Waterous Engine Works Co., Brantford.
[illegible] Ottawa, Ont.

COOLER DOORS
[illegible] Hagerstown, Md.

CORK INSULATION
Armstrong Cork & Insulation Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.

COTTON HOSE
Garlock Packing Co., Hamilton, Ont.

COUNTERS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

COUNTERSHAFTS
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Victoria Foundry Co., Ottawa, Ont.

COUPLINGS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Beveridge Paper Co., Montreal, Que.
Jeffrey Manufacturing Co., Montreal.
McAvity & Sons, T., St. John, N.B.
Victoria Foundry Co., Ottawa, Ont.

COUPLINGS, BOILER, FLANGED PIPE, JOINT PIPE, UNION, STEAM PIPE
[illegible]
Dart Union Co., Ltd., Toronto, Ont.

COUPLINGS, SHAFT
Can. Bond Hanger & Coupling Co., Alexandria, Ont.

CRANES, ALL KINDS
Babcock & Wilcox, Ltd. Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

CRANES, ELECTRIC
[illegible]
Smart-Turner Machine Co., Ltd., Hamilton.

CRANES, HAND POWER
Babcock & Wilcox, Ltd., Montreal.
Boving Hydraulic & Eng., Co., Ltd., Lindsay, Ont.
[illegible]

CRANES, OVERHEAD TRAVELLING
Babcock & Wilcox, Ltd., Montreal.
Boving Hydraulic & Eng., Co., Ltd., Lindsay, Ont.
[illegible]

CRANES, POST JIB
Babcock & Wilcox, Ltd., Montreal

CRANES, SWING JIB
[illegible]

CRANES, WALL
[illegible]

CRANE MOTORS
Lancashire Dynamo & Motor Co., Toronto, Ont.

CRANK AND CROSSHEAD PIN OILERS
Lunkenheimer Co., Cincinnati, O.

CRIMPS, LEATHER
Graton & Knight Mfg. Co., Montreal.

CRUSHING MACHINERY
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Jeffrey Mfg. Co., Columbus, Ohio.

CYLINDER OIL
E. H. Kellogg & Co., New York.

DAMPER REGULATORS
Babcock & Wilcox, Ltd., Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Darling Bros., Ltd., Montreal, Que.
G. M. Davis Regulator Co., Chicago.
D'Este Co., Julian, Boston, Mass.
Elliott Co., Pittsburgh, Pa.
Mason Regulator Co., Boston, Mass.
Jas. Morrison Brass Mfg. Co., Toronto.

DISCS, FIBRE
Beveridge Paper Co., Ltd., Montreal, Que.
Johns-Pratt Co., The, Hartford, Conn.

DISCS, LEATHER
Graton & Knight Mfy. Co., Montreal.

DISTILLING APPARATUS
Canadian Griscom-Russell Co., Ltd., Montreal.
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

DOORS, COLD STORAGE AND FREEZER
Jamison Cold Storage Door Co., Hagerstown, Md.

DOUBLE PIPE CONDENSERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

DRAFT APPARATUS SYSTEMS, MECHANICAL
Green's Economiser, Ltd., Toronto

DRYING MACHINERY
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Sirocco Co., Windsor, Ont.

DUST SEPARATORS
Sturtevant Co. of Canada, B F., Galt, Ont.

DYNAMOS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Sturtevant Co. of Canada, B. F., Galt, Ont.

ECONOMIZERS
Babcock & Wilcox, Ltd., Montreal.
Green's Economiser, Ltd., Toronto.

EJECTORS
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.
Smart-Turner Machine Co., Ltd., Hamilton.

ELECTRICAL ACCESSORIES AND MACHINERY
Can. H. W. Johns-Manville Co., Toronto, Ont.
Beveridge Paper Co., Ltd., Montreal, Que.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Economy Fuse & Mfg. Co., Montreal, Que.
MacGovern & Co., Inc., New York.
Milton & Prentiss, Toronto, Ont.

ELECTRICAL SUPPLIES
Can. General Electric Co., Toronto, Ont.
Can. H. W. Johns-Manville Co., Toronto, Ont.

ELEVATORS
Beveridge Paper Co., Montreal, Que.
MacKinnon Holmes & Co., Sherbrooke, Ont.
John MacDougall Caledonian Iron Works, Montreal.

ELEVATING MACHINERY
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Beveridge Paper Co., Montreal, Que.
Goldie & McCulloch Co., Galt.
Hamilton Mfg. Co., Wm., Peterboro, Ont.
Jeffrey Mfg. Co., Montreal.
Waterous Engine Works Co., Brantford.

ENAMELWARE
H. Mueller Mfg. Co., Sarnia, Ont.

ENGINEERS' SUPPLIES
Beveridge Paper Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Ltd., Montreal, Que.
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.
Jas. Morrison Brass Mfg. Co., Toronto.

ENGINES, AUPTOMATIC AND DROP VALVE
Frick Co., Waynesboro, Franklin Co., Pa.
Waterous Engine Works Co., Brantford.

ENGINES, CORLISS AND ROCKING VALVE
[illegible] Toronto.
Frick Co., Waynesboro, Franklin Co., Pa.
Goldie & McCulloch Co., Galt.
Green's Economiser, Ltd., Toronto.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Waterous Engine Works Co., Brantford.

ENGINES, DIESEL
[illegible] Ltd., Toronto, Ont

ENGINES, GAS AND GASOLINE
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
[illegible] & Lamb, Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

ENGINES, STEAM
Bellis & Morcom, Birmingham, Eng.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Can. Sirocco Co., Windsor, Ont.
Goldie & McCulloch Co., Galt.
Hamilton Mfg. Co., Wm., Peterboro, Ont.
Inglis Co., The John, Toronto, Ont.
Laurie & Lamb, Montreal.
Leonard & Sons, E., London, Can.
John MacDougall Caledonian Iron Works, Montreal.
Waterous Engine Works Co., Brantford.

ENGINES, HOISTING, LOGGING, CABLE-WAY
Can. Allis-Chalmers, Ltd., Toronto, Ont.

ENGINES, MARINE
Canadian Fairbanks-Morse Co., Ltd., Montreal.
The John MacDougall Caledonian Iron Works Co., Ltd., Montreal.

ENGINES, SAW MILL
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Laurie & Lamb, Montreal.
Waterous Engine Works Co., Brantford.

ENGINES, SINGLE COMPOUND AND TRIPLE EXPANSION
Canadian Griscom-Russell Co., Ltd., Montreal.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
John MacDougall Caledonian Iron Works Co., Ltd., Montreal.
Kerr Engine Co., Walkerville.
Waterous Engine Works Co., Brantford.

ENGINES, VERTICAL
Laurie & Lamb, Montreal.

ENGINEERING BOOKS
MacLean Publishing Co., Toronto.

EXHAUSTERS
Green's Economiser, Ltd., Toronto.

EXHAUST HEADS
Can. Sirocco Co., Windsor, Ont.
Darling Bros., Ltd., Montreal, Que.
Direct Separator Co., Syracuse, N.Y.
Jas. Morrison Brass Mfg. Co., Toronto.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Franklin Williams Co., New York.
Watson & McDaniel Co., Philadelphia.

EXPANSION JOINTS
Alberger Heater Co., Buffalo, N.Y.
Direct Separator Co., Syracuse, N.Y.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.

FANS, VENTILATING
Can. Sirocco Co., Windsor, Ont.
C. T. Coe Co., 10 Johnson St., New York, N.J.
Coppus Engr. & Equip. Co., Worcester, Mass
Green's Economiser, Ltd., Toronto.
Sturtevant Co. of Canada, B. F., Galt, Ont.

FEED WATER HEATERS
Alberger Heater Co., Buffalo, N.Y.
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Ltd., Montreal, Que.
Elliott Co., Pittsburgh, Pa.
The John MacDougall Caledonian Iron Works Co., Ltd., Montreal.
Stewart Heater Co., Buffalo, N.Y.
Waterous Engine Works Co., Brantford.

FEED WATER PURIFIERS
Stewart Heater Co., Buffalo, N.Y.

FEED WATER REGULATORS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Chaplin, Fulton Mfg. Co., Pittsburgh, Pa.
Beveridge Paper Co., Montreal, Que.
Elliott Co., Pittsburgh, Pt.
Laurie & Lamb, Montreal.

FIBRE, VULCANIZED
Beveridge Paper Co., Montreal, Que.

FILTERS
Bowser & Co., Inc., S. F., Toronto, Ont.
The John MacDougall Caledonian Iron Works Co., Ltd., Montreal.
Laurie & Lamb, Montreal.

FILTERS, WATER
Canadian Griscom-Russell Co., Ltd., Montreal.
Darling Bros., Ltd., Montreal, Que.
Frick Co., Waynesboro, Franklin Co., Pa.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Scaife & Sons, Wm. B., Pittsburgh, Pa.
York Mfg. Co., York, Po.

FIREBRICK—JOINTLESS
Beveridge Paper Co., Montreal. Que.

FIRE BRICK, PLASTIC
Gates, John W., St. James St., Montreal.
Wenting, J. H., Toronto.

FIREPROOF COLD STORAE DOORS AND WINDOWS
Jamison Cold Storage Door Co., Hagerstown, Md.

FITTINGS, AIR, AUTOMOBILE, GAS, HYDRAULIC, PIPE, PIPE FLANGED, SCREWED PIPE, STEAM
Jefferson Union Co., Lexington, Mass.
Dart Union Co., Ltd., Toronto, Ont.
H. Mueller Mfg. Co., Sarnia, Ont.

FLANGED STEAM FITTINGS
Direct Separator Co., Syracuse, N.Y.
McAvity, T., & Sons, Ltd., St. John, N.B.

FLANGES
Dart Union Co., Ltd., Toronto, Ont.
Jefferson Union Co., Lexington, Mass.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.

FLOORING COMPOSITION
Armstrong Cork & Insulation Co., Montreal Que.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Can. H. W. Johns-Manville Co., Toronto, Ont.

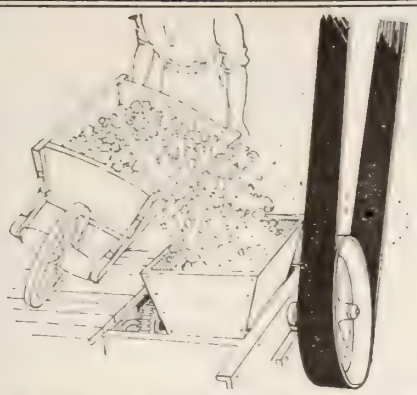
ELECTRICAL SAFETY AND ECONOMY

ECONOMY
Renewable
FUSES

Cut Annual Fuse Maintenance Cost 80%

Economy "Drop Out" Renewal Links are responsible for this saving.
A "Drop Out" Renewal Link restores a blown Economy Fuse to its original efficiency.
A sustained arc is impossible.
It's the work of a moment for even a novice to replace the link and renew the fuse.
First in its field—first in efficiency.
Order from your dealer.
Write for Catalogue 24.

Economy Fuse & Mfg. Co.
of Canada, Ltd.
Unity Bldg. - Montreal
Manufacturers in Canada of S.& C. High Potential Fuses—to 150,000 volts



SCANDINAVIA BELTING

Is a Good Belt for Dusty Places

In cement plants and brick plants where there is lots of dust, this belt is producing results that are very satisfactory for the mill operators.

You know how wearing grit is on a belt, and you want a belt that will not come apart when only partly worn through.

"Scandinavia" is this kind of a belt—there are no plies to come apart—it is solid woven. We have seen these belts still giving good service when the thickness was half worn through, and on the pulley side of the belt there were no frayed ends—the surface of the belt was smooth.

Mr. Plant Manager, you know what this means. If you require a belt for operating in a dusty place, let us ship you one, please. It will be a pleasure to us both.

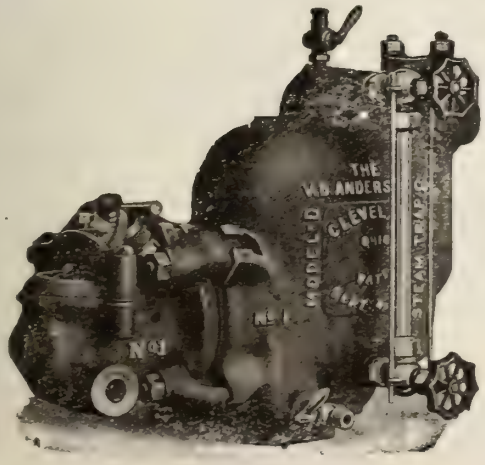
FEDERAL ENGINEERING CO., LIMITED,
172 John Street, Toronto

NOTE—Do not use "bar" or "stick" belt dressing on textile belts.

The Trap that Stays Tight

It means something to you in time, labor and expense to have a trap in your steam-room that will stay tight from the day you put it in. This dependability under high and low pressure is found in the

Anderson Model "D" Steam Trap



Features of this trap include simplicity of design, quick action and large capacity. It is operated by a counterbalanced LAKE SUPERIOR COPPER FLOAT. Has large air valve that will not wire draw and is always under deep water seal.

A self-contained strainer, an outside gauge glass, a self-contained by-pass and complete accessibility to all parts are other outstanding features of the Anderson Model "D" Steam Trap.

If you are troubled with condensation or any boiler room trouble, get in touch with us and secure our co-operation.

THE V. D. ANDERSON COMPANY
1935 West 96th Street, CLEVELAND, OHIO

FLUE CLEANERS
Babcock & Wilcox, Montreal.
Liberty Mfg. Co., Pittsburg, Pa.
[illegible] and Flue Brush Mfg. Co., St. [illegible]
William R. Pierce Co., Buffalo, N.Y.
[illegible]
Wm. C. Wilson & Co., Toronto.

FLUE GAS ANALYSIS INSTRUMENTS
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Uehling Instrument Co., New York.
[illegible] Detroit, Mich.
Penberthy Injector Co., Windsor, Ont.

FLUES, GAS AND SMOKE
Green's Economiser, Ltd., Toronto.

FLUMES, STEEL
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
[illegible] & Co., Sherbrooke, Que.

FREEZER DOORS
Jamison Cold Storage Door Co., Hagerstown, Md.

FRICTION LEATHERS
Graton & Knight Mfg. Co., Montreal.

FUEL AND OIL PUMPS AND MEASURING SYSTEMS
Imperial Oil, Ltd., Toronto.

FURNACES, BOILER
Gates, J. W., Montreal, P.Q.
[illegible]

FURNACES, SMOKELESS
Babcock & Wilcox, Montreal
Ed. Bennis & Co., Little Hulton, Bolton, Eng
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Detroit, Mich.

FURNACE GRATE BARS
[illegible] Montreal, Que

FUSES
Can. H. W. Johns-Manville Co., Toronto, Ont.
Economy Fuse & Mfg. Co. of Canada, Montreal.
Johns-Pratt Co., The, Hartford, Conn.

GAS ANALYSIS INSTRUMENTS, ETC.
Penberthy Injector Co., Windsor, Ont.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Uehling Instrument Co., New York, N.Y.

GASKETS, RUBBER, ASBESTOS
Can. H. W. Johns-Manville Co., Toronto, Ont.
[illegible] New York, N.Y.
Frick Co., Waynesboro, Franklin Co., Pa.
Garlock Packing Co., Hamilton, Ont.
Johns-Pratt Co., The, Hartford, Conn.
Peerless Rubber Mfg. Co., New York, N.Y.
Sarco Co., Inc., New York, N.Y.
Thomson-Gordon, Ltd., Hamilton, Ont.

GASKETS, LEAD, COPPER AND LEATHER
Graton & Knight Mfg. Co., Montreal, Que.
Shell Bar Boico Supply Co., Toronto, Ont.
Sarco Co., Inc., New York, N.Y.
Wm. C. Wilson & Co., Toronto, Ont.

GAS COLLECTORS
Precision Instrument Co., Detroit, Mich.

GAS PRODUCER PLANTS
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Laurie & Lamb, Montreal.

GASOLINE
[illegible]

GAUGE COCKS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Garlock Packing Co., Hamilton, Ont.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.
W. J. Wall, Montreal.

GAUGE GLASSES
Wm. C. Wilson & Co., Toronto.

GAUGES, AMMONIA, OIL, GAS, AIR
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y

GAUGES, PRESSURE, VACUUM, DRAFT AND RECORDING, AND MICROMETER
Babcock & Wilcox, Montreal.
[illegible] Foxboro, Mass.
Green's Economiser, Ltd., Toronto.
[illegible] Cincinnati, O.
Milton & Prentiss, Toronto.
Precision Instrument Co., Detroit, Mich.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.

GAUGES, WATER
[illegible] Montreal.
Jenkins Bros., Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
Penberthy Injector Co., Windsor, Ont.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

GEARS, FIBRE CUT
Beveridge Paper Co., Ltd., Montreal, Que.

GEARS, CUT, WORM, MORTISE
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
The John McDougall Caledonian Iron Works Co., [illegible] Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

GENERATORS, DIRECT CURRENT
[illegible] Toronto, Ont.

GENERATORS, STEAM TURBO
[illegible] Toronto, Ont.
[illegible] Montreal

GENERATORS AND CONVERTORS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. General Electric Co., Toronto, Ont.

GOVERNORS, ENGINE
[illegible] Montreal, Que.
McAvity, T., & Sons, Ltd., St. John, N.B.
Waterous Engine Works Co., Brantford.

GRAPHITE, BOILER
[illegible] Jersey City.
Wm. C. Wilson & Co., Toronto

GRATES, DUMPING, ROCKING, STATIONARY
Babcock & Wilcox, Montreal.
Boiler Repair & Grate Bar Co., Toronto, Ont.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
C. T. Coe Co., 10 Johnson St., Newark, N.J.
Can. Steam Boiler Equipment Co., Toronto, Ont.
Galt Foundry Co., Galt, Ont.
Mason Regulator & Engineering Co., Montreal.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Waterous Engine Works Co., Brantford.

GREASE CUPS
Albany Lubricating Co., New York City.
Detroit Lubricator Co., Walkerville.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

GREASE AND OIL EXTRACTORS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Canadian Griscom-Russell Co., Ltd., Montreal.
Elliott Co., Pittsburgh, Pa.
Laurie & Lamb, Montreal.

GREASES
Albany Lubricating Co., New York City.
Can. Economic Lubricant Co., Montreal, Que.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Jos. Dixon Crucible Co., Jersey City.
Wm. C. Wilson & Co., Toronto.

HAND LEATHERS OR PADS
Graton & Knight Mfg. Co., Montreal.

HANGERS
Can. General Electric Co., Toronto, Ont.
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Can. S K F Co., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Goldie & McCulloch Co., Galt.
Waterous Engine Works Co., Brantford.

HEATERS
Alberger Heater Co., Buffalo, N.Y.
Babcock & Wilcox, Ltd., Montreal.
Can. Sirocco Co., Windsor, Ont.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
Hamilton Mfg. Co., Wm., Peterboro, Ont.
Laurie & Lamb, Montreal.
McAvity & Sons, T., St. John, N.B.
Scaife & Sons, Wm. B., Pittsburgh, Pa.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Waterous Engine Works Co., Brantford.

HEATERS, EXHAUST STEAM
Can. Allis-Chalmers, Ltd., Toronto, Ont.

HEATERS, METERING
Can. Allis-Chalmers, Ltd., Toronto, Ont.

HEATING SYSTEMS, FANS
Can. Sirocco Co., Windsor, Ont.

HOISTS, GRIP
Jordan Bros., Inc., New York, N.Y.

HOISTING AND CONVEYING MACHINERY
Babcock & Wilcox, Ltd., Montreal.
Hamilton Mfg. Co., Wm., Peterboro, Ont.
Waterous Engine Works Co., Brantford.

HOSE, METALLIC
Pennsylvania Flexible Metallic Tubing Co., Boston, Mass.

HOSE, STEAM, SUCTION AND WATER
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Asbestos Co., Montreal.
Garlock Packing Co., Hamilton, Ont.
Goodyear Tire & Rubber Co., Toronto.
Peerless Rubber Mfg. Co., New York, N.Y.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

HYDRANTS
Wood & Co., R. D., Philadelphia, Pa.

HYDRAULIC ACCUMULATORS
Smart-Turner Machine Co., Ltd., Hamilton.

HYDRAULIC MACHINERY
Rawden Pump Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Hamilton Mfg. Co., Wm., Peterboro, Ont.
John McDougall Caledonian Iron Wks., Montreal.

HYDRAULIC PRESSES
Rawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

ICE MAKING MACHINERY
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Griscom-Russell Co., Ltd., Montreal.
Frick Co., Waynesboro, Franklin Co.
Linde Canadian Refrigeration Co., Montreal.
York Mfg. Co., York, Pa.

INDICATORS, ELECTRIC—ALL TYPES
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Uehling Instrument Co., New York, N.Y.

INDICATORS, STEAM AND GAS ENGINE
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Canadian Fairbanks-Morse Co., Montreal.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Green's Economiser, Ltd., Toronto.
Uehling Instrument Co., New York, N.Y.

INDICATORS—AMMONIA, HYDRAULIC
Can. Detroit Lubricator Co., Walkerville, Ont.

INDICATORS, SPEED
L. S. Starrett Co., Athol, Mass.

INJECTORS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

INSTRUMENTS, RECORDING
Green's Economiser, Ltd., Toronto.
Taylor Instrument Companies, Rochester, N.Y.

INSULATING BRICK
Armstrong Cork & Insulation Co., Montreal, Que.
Beveridge Paper Co., Ltd., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.

INSULATING COMPOUNDS
Johns-Pratt Co., The, Hartford, Conn.

INSULATORS
Ed. Bennis & Co., Little Fulton, Bolton, Eng.
Beveridge Paper Co., Ltd., Montreal, Que.
Johns-Pratt Co., The, Hartford, Conn.

IRON FILLER
Can. H. W. Johns-Manville Co., Toronto, Ont.

KILNS
Green's Economiser, Ltd., Toronto.

LACE LEATHERS
Graton & Knight Mfg. Co., Montreal.
Wm. C. Wilson & Co., Toronto.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Can. B. K. Morton Co., Toronto, Montreal.
Canuck Supply Co., Ltd., Montreal, Que.
Crane Packing Co., Chicago, Ill.

LAMPS, ARC
Canadian Fairbanks-Morse Co., Montreal.
Can. General Electric Co., Toronto, Ont.
Can. H. W. Johns-Manville Co., Toronto, Ont.

LAMPS, ELECTRIC
Wm. C. Wilson & Co., Toronto.

LAMPS, INCANDESCENT
Canadian Fairbanks-Morse Co., Montreal.
Can. General Electric Co., Toronto, Ont.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Can. Laco-Philips Co., Ltd., Toronto, Ont.

LAMPS, NITRO
Can. Laco-Philips Co., Ltd., Toronto, Ont.

LAMPS, TUNGSTEN AND NITRO
Can. General Electric Co., Toronto, Ont.
Can. Laco-Philips Co., Ltd., Toronto, Ont.

LEAD
Dominion Metal Co., Sherbrooke, Que.

LEATHER STRAPPING
Graton & Knight Mfg. Co., Montreal.

LININGS, FIRE BRICK, STEEL STACK
Green's Economiser, Ltd., Toronto.

LUBRICANTS
Albany Lubricating Co., New York City.
Canadian Economic Lubricant Co., Montreal.
Jos. Dixon Crucible Co., Jersey City.

CUTTING COMPOUNDS

LUBRICATORS, CYLINDER
Albany Lubricating Co., New York City.
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

LUBRICATORS, FORCE FEED
Can. Detroit Lubricator Co., Walkerville, Ont.
Darling Bros., Montreal.
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

LUBRICATORS, PLAIN
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

MACHINERY INSULATION
Armstrong Cork & Insulation Co., Montreal, Que.
Beveridge Paper Co., Ltd., Montreal, Que.

MANGENESITE PASTE
Wm. C. Wilson & Co., Toronto.

MASON CONTRACTOR
Wenting, J. H., 256 Lee Ave., Toronto.

MECHANICAL STOKERS
Babcock & Wilcox, Ltd., Montreal.
Green's Economiser, Ltd., Toronto.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Dertoit, Mich.

METERS, ELECTRIC
Can. H. W. Johns-Manville Co., Toronto, Ont.

METERS, STEAM
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Green's Economiser, Ltd., Toronto.

METERS, WATER
Allen General Supplies, Toronto, Ont.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Foxboro Company, Foxboro, Mass.
McAvity & Sons, T., St. John, N.B.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Precision Instrument Co., Detroit, Mich.

MIXING VALVES
Mueller Mfg. Co., H., Sarnia, Ont.

MILL AND MINING MACHINERY
Canadian Fairbanks-Morse Co., Montreal.
Engineering and Machine Works of Canada, Ltd. St. Catharines, Ont.
Goldie & McCulloch Co., Galt.
Hamilton Co., Wm., Peterboro, Ont.
Waterous Engine Works Co., Brantford.

METER TESTERS
Mueller Mfg. Co., H., Sarnia, Ont.

MOTORS
Canadian Fairbanks-Morse Co., Montreal.
Can. General Electric Co., Toronto, Ont.
Green's Economiser, Ltd., Toronto.
Milton & Prentiss, Toronto.

MOTORS, DIRECT CURRENT
Lancashire Dynamo & Motor Co., Toronto, Ont.

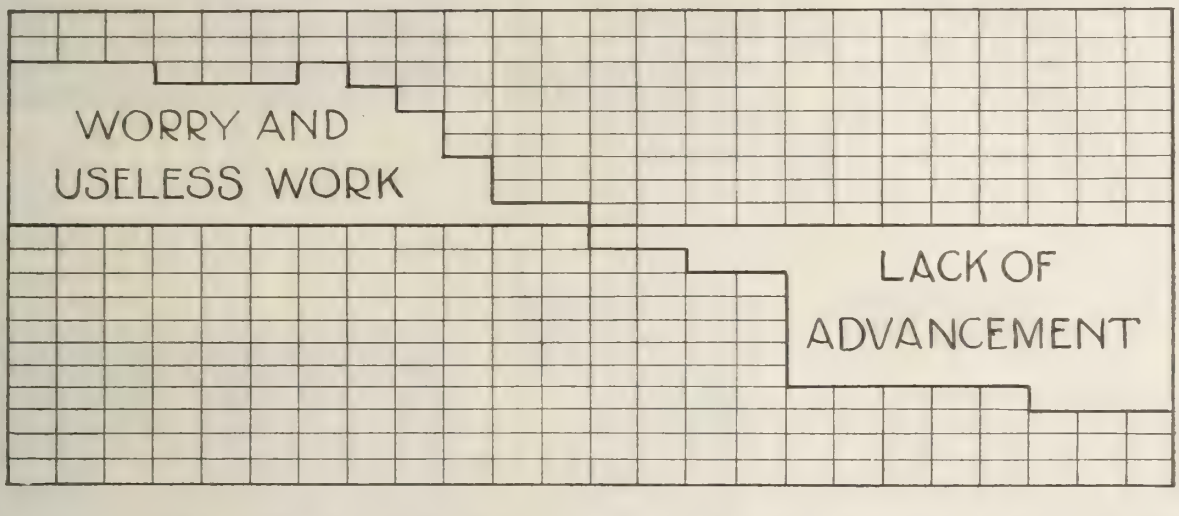
MOTORS, INDUCTION
Lancashire Dynamo & Motor Co., Toronto, Ont.

MOTORS, SYNCHRONOUS
Lancashire Dynamo & Motor Co., Toronto, Ont.

OAKUM
Wm. C. Wilson & Co., Toronto.

OFFICE RAILINGS
Jas. Morrison Brass Mfg. Co., Toronto.

Let the C.A.S.E. Smooth Out Your Load Curve



Remove The Peaks of Worry And Unproductive Labor And Build Up The Valleys By Working For Your Advancement

A man who is thoroughly grounded in the practice of his profession, who is free from personal worry and trouble, overcomes the many difficulties besetting the path of the operating engineer with little labor and in a manner ensuring his advancement.

The successful man owes his success to a wise appreciation of the advantages and mutual help offered by association with those in the same field of endeavor. To join an association having for its objectives the welfare of the engineer in things mental and material, his advancement in knowledge and skill, his protection by provision for sickness and distress is to take advantage of an opportunity indispensable to all who hope to better themselves.

If you are interested in such an organization and live where less than fifteen engineers are located, send for a copy of our constitution and application blanks for admission to nearest branch lodge. If there are more than fifteen engineers in your community, get together and send for particulars regarding formation of a branch lodge.

J. H. HALE, General Secretary,

Canadian Association of Stationary Engineers

230 Caroline Street Hamilton, Ont.

If any advertisement interests you, tear it out now and place with letters to be answered.

OIL CUPS
Albany Lubricating Co., New York City.
[illegible] Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

OILER, COMPOUND FEEDERS
Lunkenheimer Co., Cincinnati, O.

OILERS, GAUGE
Lunkenheimer Co., Cincinnati, O.

OILERS, MULTIPLE
Can. Detroit Lubricator Co., Walkerville, Ont.
[illegible] Cincinnati, O.

OIL FILTERS AND CIRCULATING SYSTEMS
Bowser & Co., Inc., S. F., Toronto, Ont.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
Jas. Morrison Brass Mfg. Co., Toronto.

OIL SEPARATORS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
Direc. Separator Co., Syracuse, N.Y.
Elliott Co., Pittsburgh, Pa.
Leitch Co., Arthur S., Toronto, Ont.
Liberty Mfg. Co., Pittsburgh.
Jas. Morrison Brass Mfg. Co., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.

OILS, QUENCHING
Imperial Oil, Ltd., Toronto.

OILING SYSTEMS
Albany Lubricating Co., New York City.
Bowser & Co., Inc., S. F., Toronto, Ont.
Lunkenheimer Co., Cincinnati, O.

OILS, CYLINDER
Imperial Oil, Ltd., Toronto.

OILS, LUBRICATING
Albany Lubricating Co., New York City.
Can. Economic Lubricant Co., Montreal, Que.
Kellogg & Co., E. H., New York, N.Y.
Wm. C. Wilson & Co., Toronto.

OILS, ENGINE
Imperial Oil, Ltd., Toronto.

PACKING, ASBESTOS
Johns-Pratt Co., The, Hartford, Conn.

PACKING ENGINE
Can. Asbestos Co., Montreal, Que.
Garlock Packing Co., Hamilton, Ont.
Johns-Pratt Co., The, Hartford, Conn.
Peerless Rubber Mfg. Co., New York, N.Y.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING FIBRE
Beveridge Paper Co., Ltd., Montreal, Que.
Can. B. K. Morton Co., Montreal, Que.
Johns-Pratt Co., The, Hartford, Conn.
Wm. C. Wilson & Co., Toronto.

PACKING, HYDRAULIC
Can. Asbestos Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Can. B. K. Morton Co., Toronto, Montreal.
Crane Packing Co., Chicago, Ill.
Durabla Manufacturing Co., New York.
Garlock Packing Co., Hamilton, Ont.
Goodyear Tire & Rubber Co., Toronto.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, METALLIC
Can. B. K. Morton Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Crane Packing Co., Chicago, Ill.
Greene, Tweed & Co., New York.
Holmes Metallic Packing Co., Wilkesbarre, Pa.
Milton & Prentiss, Toronto.
Steel Mill Packing Co., Windsor, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, ROD
Can. Asbestos Co., Montreal, Que.
Can. B. K. Morton Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Crane Packing Co., Chicago, Ill.
Garlock Packing Co., Hamilton, Ont.
Canuck Supply Co., Ltd., Montreal, Que.
Steel Mill Packing Co., Windsor, Ont.
Peerless Rubber Mfg. Co., New York, N.Y.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, SHEET
Can. Asbestos Co., Montreal, Que.
Can. B. K. Morton Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Canuck Supply Co., Ltd., Montreal, Que.
Durabla Manufacturing Co., New York.
Garlock Packing Co., Hamilton, Ont.
Jenkins Bros., Ltd., Montreal.
Johns-Pratt Co., The, Hartford, Conn.
Peerless Rubber Mfg. Co., New York, N.Y.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, AMMONIA, STEAM AND WATER
Can. Asbestos Co., Montreal, Que.
Can. B. K. Morton Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Canuck Supply Co., Ltd., Montreal, Que.
Crane Packing Co., Chicago, Ill.
Garlock Packing Co., Hamilton, Ont.
Greene, Tweed & Co., New York.
Goodyear Tire & Rubber Co., Toronto.
Johns-Pratt Co., The, Hartford, Conn.
Steel Mill Packing Co., Windsor, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, LEATHER
Can. B. K. Morton Co., Toronto, Montreal.
Canuck Supply Co., Ltd., Montreal, Que.
Garlock Packing Co., Hamilton, Ont.
Graton & Knight Mfg. Co., Montreal.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING PISTON
Crane Packing Co., Chicago, Ill.

PACKING, VALVE STEM
Crane Packing Co., Chicago, Ill.
Johns-Pratt Co., The, Hartford, Conn.

PAINTS
Wm. C. Wilson & Co., Toronto.

PAINT, DAMP RESISTING
Toch Bros., Toronto, Ont.

PAPER, INSULATING, ETC.
Beveridge Paper Co., Montreal, Que.

PATTERNS
Victoria Foundry Co., Ottawa, Ont.

PENSTOCKS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
MacKinnon, Holmes & Co., Sherbrooke, Que.

PILLOW BLOCKS
Can. Bond Hanger & Coupling Co., Alexandria Ont.
Waterous Engine Works Co., Brantford.

PIPE COILS
Frick Co., Waynesboro, Pa.
York Mfg. Co., York, Pa.

PIPE COVERINGS, STEAM, BRINE, AMMONIA AND ICE WATER
Armstrong Cork & Insulation Co., Montreal, Que.

PIPE, CAST IRON
Wood & Co., R. D., Philadelphia, Pa.

PIPE STEEL
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

PIPE VISES AND CUTTERS
Armstrong Mfg. Co., Bridgeport, Conn.

PIPE, GAS
Can. Allis-Chalmers, Ltd., Toronto, Ont.

PIPES, WATER
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

PIPING AND FITTINGS
Frick Co., Waynesboro, Franklin Co., Pa.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
York Mfg. Co., York, Pa.

PIPING, STEAM
Babcock & Wilcox, Ltd., Montreal.

PLATE WORK
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd. St. Catharines, Ont.
Hamilton Co., Wm., Peterboro, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

PLUG COCKS
Homestead Valve Mfg. Co., Pittsburgh, Pa.

PLUMBING SUPPLIES
Mueller Mfg. Co., H., Sarnia, Ont.
Wm. C. Wilson & Co., Toronto.

POWER PUMPS
American Steam Pump Co., Battle Creek, Mich
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
Waterous Engine Works Co., Brantford.
Garlock Packing Co., Hamilton, Ont.
Laurie & Lamb, Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.

POWER, TRANSMISSION MACHINERY
American Pulley Co., Philadelphia, Pa.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Goldie & McCulloch Co., Galt.
Hamilton Co., Wm., Peterboro, Ont.
Jeffrey Manufacturing Co., Montreal.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
MacGovern & Co., New York.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Morse Chain Co., Ithaca, N.Y.
Waterous Engine Works Co., Brantford.

PRESSES
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont

PRESSURE, BLOWERS, CENTRIFUGAL
Can. Sirocco Co., Windsor, Ont.

PULLEYS
American Pulley Co., Philadelphia, Pa.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Can. Bond Hanger & Coupling Co., Alexandria, Ont
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Wm. Hamilton Co., Ltd., Peterboro.
Jeffrey Manufacturing Co., Montreal.
Victoria Foundry Co., Ottawa, Ont.
Waterous Engine Works Co., Brantford.

PULP MILL MACHINERY
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Hamilton Co., Wm., Peterboro, Ont.
Jeffrey Manufacturing Co., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

PUMPING MACHINERY
American Steam Pump Co., Battle Creek, Mich.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Bawden Machine Co., Toronto.
Beveridge Paper Co., Montreal, Que.
Laurie & Lamb, Montreal.
McAvity & Sons, T., St. John, N.B.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.
Waterous Engine Works Co., Brantford.

PUMPING MACHINERY, ELECTRICAL
Bawden Machine Co., Toronto.
Beveridge Paper Co., Montreal, Que.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Jeffrey Manufacturing Co., Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.

PUMPS, AIR
American Steam Pump Co., Battle Creek, Mich
Bawden Machine Co., Ltd., Toronto.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Montreal.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co. Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
Storey Pump & Equipment Co., Ltd., Toronto

PUMPS, ACID
Bawden Pump Co, Toronto.
Beveridge Paper Co., Montreal, Que.

PUMPS, CONTRACTORS'
Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Beveridge Paper Co., Montreal, Que.
McAvity & Sons, T., St. John, N.B.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, ELECTRICAL
American Steam Pump Co., Battle Creek, Mich
Beveridge Paper Co., Montreal, Que.

PUMPS, FEED WATER
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Beveridge Paper Co., Montreal, Que.

PUMP GOVERNORS AND REGULATORS
Bawden Machine Co., Ltd., Toronto.
Darling Bros., Montreal.
G. M. Davis Regulator Co., Chicago.
D'Este Co., Julian, Boston, Mass.
Elliott Co., Pittsburgh, Pa.
Mason Regulator Co., Boston, Mass.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.
Watson & McDaniel Co., Philadelphia.

PUMP STRAINERS
Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Darling Bros., Ltd., Montreal.
Liberty Mfg. Co., Pittsburgh, Pa.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, HAND AND POWER
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Darling Bros., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, BOILER FEED
Bawden Pump Co, Toronto.

PUMPS, CENTRIFUGAL
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Darling Bros., Montreal
Hamilton Co., Wm., Peterboro, Ont.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Pulsometer Engineering Co., Ltd., London, Eng.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Victoria Foundry Co., Ottawa, Ont.
Waterous Engine Works Co., Brantford.

PUMPS, DUPLEX
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Beveridge Paper Co., Montreal, Que.

PUMPS, GEARED, COMPOUND
American Steam Pump Co., Battle Creek, Mich
Bawden Machine Co., Ltd., Toronto.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Montreal.
Inglis Co., The John, Toronto, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, ELECTRICAL
Bawden Pump Co, Toronto.

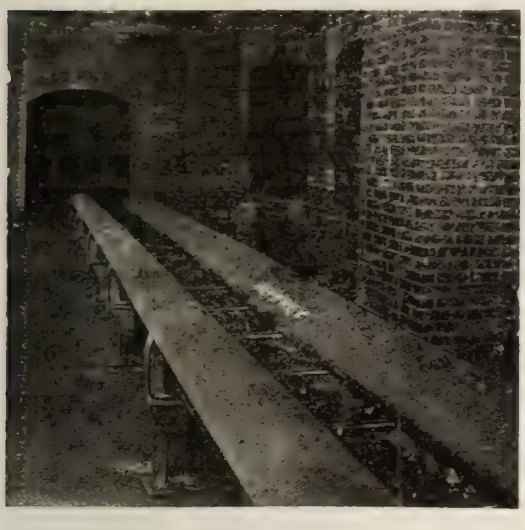
PUMPS, HYDRAULIC, PRESSURE
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Darling Bros., Montreal.
Inglis Co., The John, Toronto, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.

PUMP LEATHERS
Beveridge Paper Co., Ltd., Montreal, Que.
Can. B. K. Morton Co., Toronto, Montreal.
Graton & Knight Mfg. Co., Montreal.

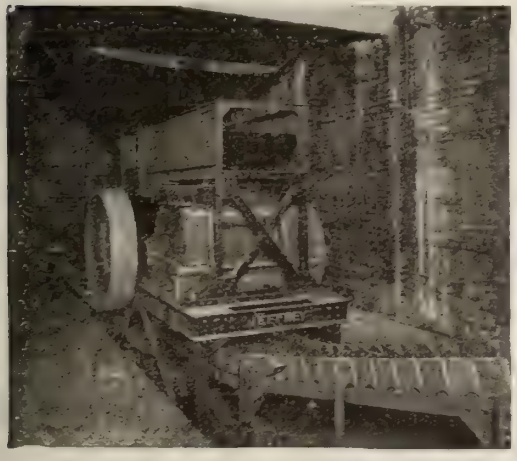
PUMPS, OIL
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Ltd., Toronto.
Bowser & Co., Inc., S. F., Toronto, Ont.
Can. Detroit Lubricator Co., Walkerville, Ont.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, STEAM TURBO
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Darling Bros., Montreal.
Escher Wyss & Co., Montreal, Que.
Pulsometer Engineering Co., Ltd., London, Eng.

165 ft. upper run of Jeffrey Carrier over coal and ashes storage bins of the Transue Williams Steel Forging Power Plant, Alliance, Ohio. 50 tons of Crushed Coal per hour is dumped by the traveling tripper shown.



Another view of the Jeffrey Carrier shown above. Note the curved steel skirt boards, which not only form a continuous trough for loading the conveyer, but serve as a protection for the Chain against dirt and grit.



Jeffrey 30-in. x 30-in. Single Roll Crusher installed with Coal and Ashes Handling System at this plant. This Crusher in one operation reduces Run-of-Mine or Lump Coal to the proper size for maximum heat efficiency in stokers.

First of All
Character

Defined by Webster, CHARACTER means DISTINCTIVE FEATURES—and all things that have Character abound in Quality.

The Distinctive Features of

THE JEFFREY
IMPROVED CARRIER

have been gained from the knowledge of nearly 20 years of actual experience in the installation of successful pivoted bucket outfits.

"Reliability" and "Durability"

are the first considerations in its design and construction—absolute reliability under all conditions of service—coupled with that material strength, quality and hardness of wearing parts throughout, which insures long and satisfactory service.

Write for our new Bulletin No. 237-4. It fully describes the Jeffrey Carrier and its many points of refinement, and pictures interesting installations.

The Jeffrey Mfg. Co.
Canadian Branch and Warerooms
MONTREAL

PUMP TANK, RECEIVER
American Steam Pump Co., Battle Creek, Mich.
Beveridge Paper Co., Montreal, Que.
Smart-Turner Machine Co., Hamilton, Ont.

PUMPS, STEAM
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Ltd., Toronto.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
Inglis Co., The John, Toronto, Ont.
Laurie & Lamb, Montreal.
Leitch Co., Arthur S., Toronto, Ont.
McAvity & Sons, T., St. John, N.B.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, TRIPLEX
Smart-Turner Machine Co., Hamilton, Ont.

PUMPS, VACUUM
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Ltd., Toronto.
Beveridge Paper Co., Montreal, Que.
Laurie & Lamb, Montreal.
Leitch Co., Arthur S., Toronto, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PYROMETERS
Foxboro Co., The, Foxboro, Mass.
Goldie & McCulloch Co., Ltd., Toronto.
Jas. Morrison Brass Mfg. Co., Toronto.
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.

RADIATOR TRAPS
Beveridge Paper Co., Montreal, Que.
Sarco Co., Inc., New York, N.Y.

RADIATOR AIR VENTS
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

RAGS
Wm. C. Wilson & Co., Toronto.

REBOILERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

RECEIVERS, AIR
Can. Allis-Chalmers, Ltd., Toronto, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.

RECORDING INSTRUMENTS
Can. H. W. Johns-Manville Co., Toronto, Ont.
Foxboro Co., The, Foxboro, Mass.
Green's Economiser, Ltd., Toronto.
Precision Instrument Co., Detroit, Mich.
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.

REFRIGERATOR DOORS, WINDOWS, ETC.
Jamison Cold Storage Door Co., Hagerstown, Md.

REFRIGERATING MACHINERY
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Griscom-Russell Co., Ltd., Montreal.
Frick Co., Waynesboro, Franklin Co., Pa.
Linde Canadian Refrigeration Co., Montreal.
Vilter Mfg. Co., Milwaukee, Wis.
York Mfg. Co., York, Pa.

REFUSE DESTRUCTOR
Canadian Griscom-Russell Co., Ltd., Montreal.
Laurie & Lamb, Montreal.

REGULATORS, PRESSURE
Chaplin-Fulton Mfg. Co., Pittsburgh, Pa.
D'Este Co., Julian, Boston, Mass.
Jas. Morrison Brass Mfg. Co., Toronto.
Taylor Instrument Co., Rochester, N.Y.

REGULATORS, TEMPERATURE
Sarco Co., Inc., New York, N.Y.
Taylor Instrument Co., Rochester, N.Y.

RETORTS
MacKinnon, Holmes & Co., Sherbrooke, Que.

REVOVLING DOORS FOR HARDENING ROOMS
Jamison Cold Storage Door Co., Hagerstown, Md.

ROOFING
Wm. C. Wilson & Co., Toronto.

ROOFINGS—RUBBER, PLASTIC, LIQUID
Beveridge Paper Co., Montreal, Que.

ROPE
Wm. C. Wilson & Co., Toronto.

ROPE PRESERVATIVE
Cling Surface Co., Buffalo.

ROTARY CONVERTERS
Canadian Fairbanks-Morse Co., Montreal.

RUBBER HOSE
Can. H. W. Johns-Manville Co., Toronto, Ont.
Garlock Packing Co., Hamilton, Ont.
Liberty Mfg. Co., Pittsburg, Pa.
Thomson-Gordon, Ltd., Hamilton, Ont.

RUBBER MOLDS
Bawden Machine Co., Ltd., Toronto.

SAFES
Canadian Fairbanks-Morse Co., Montreal.
Goldie & McCulloch Co., Galt.

SCALE REMOVERS
Babcock & Wilcox, Ltd., Montreal.
Beveridge Paper Co., Ltd., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Roto Co., Hartford, Conn.
William B. Pierce Co., Buffalo, N.Y.
Snowdon, C. C., Calgary, Alta.

SEAM PROTECTORS, GIRTH
National Boiler Protector Co. of Canada, Montreal, Que.

SHAFTING
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Hamilton Co., Wm., Peterboro, Ont.
Waterous Engine Works Co., Brantford.

SHAKING AND DUMPING GRATES
Babcock & Wilcox, Ltd., Montreal.
Galt Foundry Co., Galt, Ont.
Waterous Engine Works Co., Brantford.

SMELTER LININGS
Beveridge Paper Co., Montreal, Que.

SMOKE BOXES, STACKS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Green's Economiser, Ltd., Toronto.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

SMOOTH-ON
Wm. C. Wilson & Co., Toronto.

SPECIAL MACHINERY
Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Hamilton Co., Wm., Peterboro, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Waterous Engine Works Co., Brantford.

SPEED INDICATORS
Foxboro Co., The, Foxboro, Mass.
Schaeffer & Budenburg Mfg. Co., Brooklyn, N.Y.
L. S. Starrett Co., Athol, Mass.

SPLICE PROTECTORS
Jordan Bros., Inc., New York, N.Y.

SPROCKET CHAIN ATTACHMENTS
Waterous Engine Works Co., Brantford.

SPROCKET RIMS
Babbitt Steam Specialty Co., New Bedford, Mass.

SPUR WHEELS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Canadian Fairbanks-Morse Co., Montreal.
Hamilton Co., Wm., Peterboro, Ont.
Waterous Engine Works Co., Brantford.

STACKS, STEEL
Babcock & Wilcox, Ltd., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.

STAND PIPES, STEEL
MacKinnon, Holmes & Co., Sherbrooke, Que.

STAYBOLTS, FLEXIBLE
Can. Allis-Chalmers, Ltd., Toronto, Ont.

STEAM SEPARATORS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Darling Bros., Montreal.
Direct Separator Co., Syracuse, N.Y.
D'Este Co., Julian, Boston, Mass.
Elliott Co., Pittsburgh, Pa.
Leitch Co., Arthur S., Toronto, Ont.
Penberthy Injector Co., Windsor, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Watson & McDaniel Co., Philadelphia.

STEAM SPECIALTIES
Alberger Heater Co., Buffalo, N.Y.
Canadian Fairbanks-Morse Co., Montreal.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
D'Este Co., Julian, Boston, Mass.
Liberty Mfg. Co., Pittsburg, Pa.
Lunkenheimer Co., Cincinnati, O.
Mason Regulator & Engineering Co., Montreal.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor.
Watson & McDaniel Co., Philadelphia.

STEAM TRAPS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Anderson Co., Y. D., Cleveland, O.
Canadian Fairbanks-Morse Co., Montreal.
Can. Sirocco Co., Windsor, Ont.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
Davis Regulator Co., G. M., Chicago.
D'Este Co., Julian, Boston, Mass.
Dunham Co., Ltd., C. A., Toronto, Ont.
Elliott Co., Pittsburgh, Pa.
J. T. Long, 84 Adam St., Montreal, Que.
Can. Morehead Mfg. Co., Woodstock.
Mason Regulator & Engineering Co., Montreal
Nashua Mach. Co., Boston, Mass.
Sarco Co., Inc., New York, N.Y.
Sturtevant Co. of Canada, B. F., Galt, Ont.
Watson & McDaniel Co., Philadelphia.

STEEL BARRELS
Smart-Turner Machine Co., Hamilton, Ont.

STEEL DRUMS
Smart-Turner Machine Co., Hamilton, Ont.

STEEL TANKS
Babcock & Wilcox, Ltd., Montreal.
Hamilton Co., Wm., Peterboro, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works, Brantford, Ont.

STOKERS
Babcock & Wilcox, Ltd., Montreal.
Ed. Bennis & Co., Little Fulton, Bolton, Eng.
Detroit Stoker Co., Detroit, Mich.
Galt Foundry Co., Galt, Ont.
Green's Economiser, Ltd., Toronto.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Dertoit, Mich.

STRAINERS
Babcock & Wilcox, Ltd., Montreal.
Bawden Machine Co., Ltd., Toronto.
Beveridge Paper Co., Montreal, Que.
Elliott Co., Pittsburgh, Pa.
Self-Cleansing Strainer Co., Chicago.

STRUCTURAL STEEL WORK
Babcock & Wilcox, Ltd., Montreal.
Hamilton Co., Wm., Peterboro, Ont.
MacKinnon, Holmes & Co., Ltd., Sherbrooke, Que.

SUPERHEATERS, STEAM
Babcock & Wilcox, Ltd., Montreal.
Green's Economiser, Ltd., Toronto.

SWING JOINTS
Franklin Williams Co., New York.

SWITCHBOARDS
Can. General Electric Co., Toronto, Ont.

SWITCHES AND SWITCH BOXES
Can. H. W. Johns-Manville Co., Toronto, Ont.

TACHOMETERS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Can. H. W. Johns-Manville Co., Toronto, Ont.
Foxboro Co., The, Foxboro, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

TANKS, BLOW-OFF
Darling Bros., Montreal.
John McDougall Caledonian Iron Works, Montreal
Waterous Engine Works Co., Brantford.

TANKS, FREEZING, STORAGE AND WATER COOLING
Frick Co., Waynesboro, Franklin Co., Pa.

TANKS, OIL
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Bowser & Co., Inc., S. F., Toronto, Ont.
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Hamilton Co., Wm., Peterboro, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

TANKS, WATER
Inglis Co., The John, Toronto, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

TAPPING MACHINES
Mueller Mfg. Co., H., Sarnia, Ont.

TECHNICAL BOOKS
MacLean Publishing Co., Toronto.

THERMOMETERS
Foxboro Co., The, Foxboro, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Milton & Prentiss, Toronto.
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.

THERMOSTATS
Sarco Co., Inc., New York, N.Y.

TIN
Dominion Metal Co., Sherbrooke, Que.

TOOLS
Mueller Mfg. Co., H., Sarnia, Ont.

TRANSFORMERS
Can. General Electric Co., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.

TRANSMISSION MACHINERY
American Pulley Co., Philadelphia, Pa.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Goldie & McCulloch Co., Galt, Ont.
Hamilton Co., Wm., Peterboro, Ont.
Jeffrey Manufacturing Co., Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Waterous Engine Works Co., Brantford.

TRAPS, STEAM AND WATER-LINE
Beveridge Paper Co., Montreal, Que.
D'Este Co., Julian, Boston, Mass.

TRUCKS, FACTORY
Beveridge Paper Co., Ltd., Montreal, Que.
Canadian Fairbanks-Morse Co., Montreal.

TUBE CLEANERS
Babcock & Wilcox, Ltd., Montreal.

WATER
WE-FU-GO AND SCAIFE
PURIFICATION SYSTEMS
SOFTENING & FILTRATION
FOR BOILER FEED AND
ALL INDUSTRIAL USES
WM. B. SCAIFE & SONS CO. PITTSBURGH, PA.

Don't buy that New Electrical Apparatus Just Yet

WE can supply you with high-grade apparatus that has been slightly used and discarded through no fault of its own, at an **immense saving in cost.** For instance, in many cases we take over entire plants simply because of changed conditions such as increased capacity, change of system, etc.

EVERYTHING IS OVERHAULED AND REFINISHED BY US AND **GUARANTEED** AS GOOD AS NEW, BOTH ELECTRICALLY AND MECHANICALLY.

Our catalogs of offerings should be in the hands of every power plant superintendent each time they are gotten out, and it will be worth while for anyone interested in this class of power plant equipment to be on our mailing list to receive all offerings.

Nearly all of the principal power, lighting and street railway plants in the United States are our customers.

WRITE FOR OUR LATEST CATALOG of **Power House Equipment, Street Cars, Motors, Hoists, Compressors, etc.**

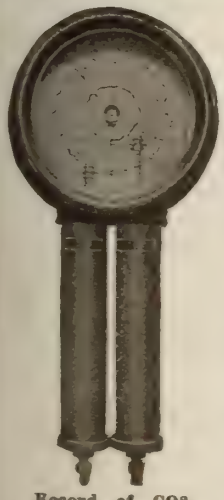
MACGOVERN & COMPANY, Inc.

114 Liberty St., New York City

UEHLING WASTE METER

COMBINED

CO_2 AND TEMPERATURE RECORDER

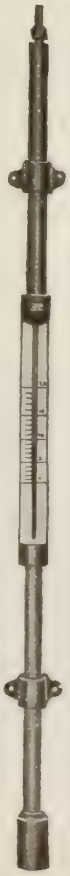


Record of CO2 and stack temperature on one chart.

Does your fireman know how much fuel he is wasting? Do you know?

The **Uehling CO_2 Recorder** makes a complete 24 hr. record of your combustion efficiency and the **CO2 indicator at the Boiler Front** holds the fireman responsible.

Get more **Steam** per pound of **Coal** and reduce your annual fuel consumption.



CO2 Indicator for Boiler Front

Let us know the number and size of your boilers and coal consumed per year, upon receipt of which information we will be glad to send you full particulars.

Let us hear from you. We are pioneers in the manufacture of Indicators and Recorders for Power Plant purposes.

Send for our Bulletin No. 110.

Uehling Instrument Company

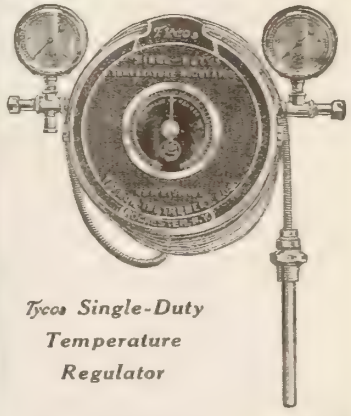
2008 Empire Building **New York City**

Tycos

TEMPERATURE INSTRUMENTS

Indicating Recording Controlling

Mercurial, Recording and Index Thermometers for all industrial and laboratory applications.
Electric Contact Thermometers.
Temperature, Pressure and Time Regulators.
Mercury Column Vacuum Pressure and U Gauges.
Base Metal, Rare Metal and Radiation Pyrometers.
Fery Radiation Pyrometers.
Hygrometers.
Hydrometers.
Mineral Oil Testing Instruments.
Aneroid Barometers.
Mercurial Barometers.
Recording Barometers.
Pocket Compasses.
Surveying Compasses.
Rain Gauges.
Anemometers.
Air Meters.
Thermographs.
Hand Levels.
Aviation Barometers.
Inclinometers.
Sphygmomanometers
Fever Thermometers.
Urinary Glassware.
Thermometers of all kinds for home and general use.



Tycos Single-Duty Temperature Regulator

An instrument absolutely essential in industries where temperature control is a determining factor in production.

Our catalogue gladly sent if requested

Taylor Instrument Companies

ROCHESTER, N.Y.

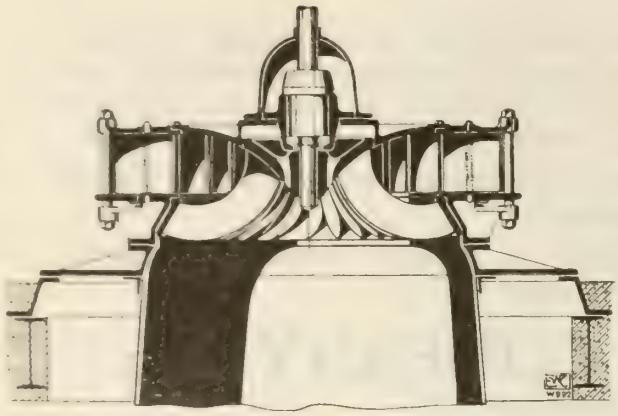
201 Royal Bank Bldg., Toronto, Ont.

If any advertisement interests you, tear it out now and place with letters to be answered.

Escher Wyss & Co. S.A. Zurich (Switzerland)

Montreal Office: 112 Coristine Building

Water Turbines



Governors

Pipelines

Turbopumps

15/18

ADVERTISING INDEX

A

[illegible] 72
Alberger Heater Co. 62
American Steam Gauge & Valve Mfg. Co. 60
American Steam Pump Co..... 65
Anderson Co., V. D..... 89
Armstrong Cork & Insulation Co. 11

B

Babbitt Steam Specialty Co.... 66
Babcock & Wilcox 86
Beveridge Paper Co..... 74
Boiler Inspection Dept. 78
Boving Hydraulic & Eng. Co... 84
Bowser, S. F., & Co..... 80

C

Can. Allis-Chalmers Co. 83
Can. Assoc. Stationary Engrs. 91
Can. Bond Hanger & Coupling Co. 72
Can. Detroit Lubricator Co.... 8
Can. Economic Lubricator Co.. 56
Can. Fairbanks-Morse 57
Can. General Electric Co..... 83
Can. H. W. Johns-Manville Co. 67
Can. Laco-Philips Co., Ltd.... 69
Can. Morehead Mfg. Co..... 85
Can. S K F Co. 63
Can. Steam Boiler Equipment Co. 4
Canuck Supply Co., Ltd..... —
Chaplin-Fulton Mfg. Co. 12
Cling-Surface Co. 72
Cole Ltd., Geo. W. 52
Coppus Engr. & Equip. Co.... 9
Coventry Chain Co. 68
Crane Packing Co. 51

D

[illegible] ..... —
Dart Union Co. 53
[illegible] ..... —
D'Este Co., Julian 74
Direct Separator Co. 58
Dominion Belting Co. 82
Dominion Coal Co. 84
Dunham & Co., C. A. 55
Durabla Mfg. Co. 60

E

Economy Fuse & Mfg. Co. of Canada 89
Elliott Co. 47
Engineering & Mach. Works of Canada, Ltd. 2
Escher Wyss & Co..... 96

F

Federal Engineering Co. 89
Francis & Co., Walter J. 51
Frick Co. 11

G

Galt Foundry Co. ..... —
Garlock Packing Co. 77
Garth Co. 84
Gates, John W. 52
Goldie & McCulloch Co. 16
Goodyear Tire & Rubber Co.... —
Graton & Knight Mfg. Co.... 59
Greene, Tweed & Co. 61
Green's Economizer, Ltd. 76

H

Holmes Metallic Packing Co.. 84
Homestead Valve Mfg. Co..... 68
Hoyt Metal Co. 2

I

Imperial Oil Co. 3
Inglis Co., John...Inside back cover

J

Jamison Cold Storage Door Co. 85
Jefferson Union Co. 81
Jeffrey Mfg. Co. 93
Jenkins Bros. 75
Johns-Pratt Co., The 66
Jones Underfeed Stoker Co.... 4
Jordon Bros., Inc. 6

K

Kellogg & Co., E. H..... 52
Kerr Engine Co. 74

L

Ladd Co., The Geo. T..... 85
Laurie & Lamb 13
Leitch Co., The Arthur S..... 6
Liberty Mfg. Co..... 47
Linde Canadian Refrigeration Works Co. 10
Long & Co., J. T. 51
Lunkenheimer Co. 70

M

MacGovern & Co. 95
MacKinnon Steel Co. 51
MacLean's Magazine 64
Magnolia Metal Co. 82
Mason Regulator Co. 6
Mason Regulator & Engr. Co... 7
McAvity & Sons, T. 70
McDougall Caledonian Iron Works Co. 14
McGhie, W. C. 84
McLaren Ltd., D. K. 73
Metlskin Co., Inc. 58
Morrison Brass Mfg. Co., Jas. Outside back cover
Morse Chain Co. 79
Mueller Mfg. Co. 71
Murphy Iron Works 5
National Boiler Seam Protector Co. 84

P

Penberthy Injector Co...Front cover
Pennsylvania Flexible Metallic Tubing Co. 58
Pierce Mfg. Co., Wm. B..... Inside front cover
Pilley Packing & Flue Bush Mfg. Co. 85
Power Plant Equipment Co... 56
Pratt & Cady Co., Inc. 60

R

Roto Co. 55

S

Sarco Co., Inc. 50
Scaife & Sons Co., Wm. B.... 94
Schaffer & Budenberg Mfg. Co. 6
Shell-Bar, Boico Supply, Ltd... 5
Smart-Turner Mach. Co. 85
Snowdon, C. C. 78
Starrett, L. S., Co. 86
Steel Mill Packing Co. 55

T

Taylor Instrument Co. 95
Thomson-Gordon, Ltd. 78
Trimont Manufacturing Co.... 86

U

Uehling Instrument Co..... 95

V

Vilter Mfg. Co. 10

W

Wall, W. J. 52
Waterous Engine Works Co. 1
Watson & McDaniel Co..... 84
Wenting, J. H. 85
Williams & Co., J. H. 68
Williams Co., Franklin 62
Wood & Co., R. D..... 52

Y

Yarnall-Waring Co. 66
York Mfg. Co. 12

INGLIS BOILERS

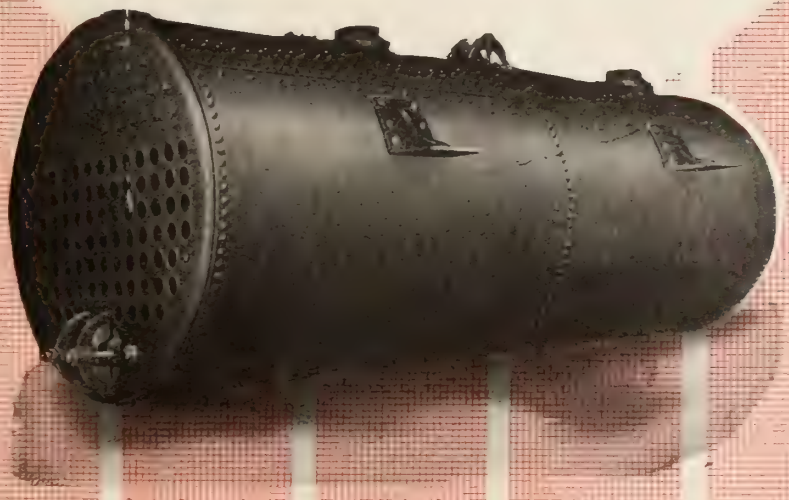
Boilers for all Services

Inglis boilers are used in Power Houses in every part of Canada. They have set the standard for years in efficiency, and are noted for their long service. Strongly built—require minimum repairs.

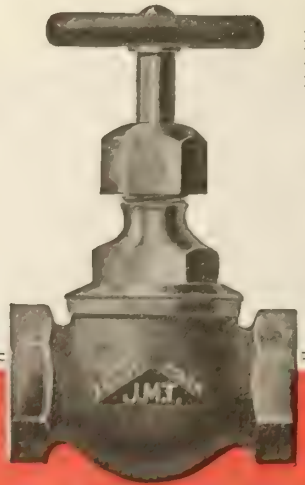
Sole Canadian makers of Erie City Water Tube Boilers, Vertical and Horizontal.

Write for prices and specifications, or have our representative call upon you.

The John Inglis Company
Limited
ENGINEERS AND BOILER MAKERS
14 Strachan Avenue Toronto, Canada



Morrison's STEAM GOODS and Specialties



Morrison's quality is what quality should be from the user's standpoint. It represents skill and knowledge of the highest order drawn from forty years' varied experience.

Morrison's Steam Goods and Specialties are approved by the Provincial Boiler Inspection Departments.

SOME OF OUR LINES

Stop Valves	Steam Gauges
Check Valves	Vacuum Gauges
Gate Valves	Ammonia Gauges
Safety Valves	General Boiler Mountings
Relief Valves	Gauge Board Outfits
Reducing Valves	Lubricators
Steam Traps	Pipe Fittings
Injectors	Steam Whistles
Ejectors	Engine Indicators
Inspirators	Pipes, Tools, etc.
Jet Pumps	

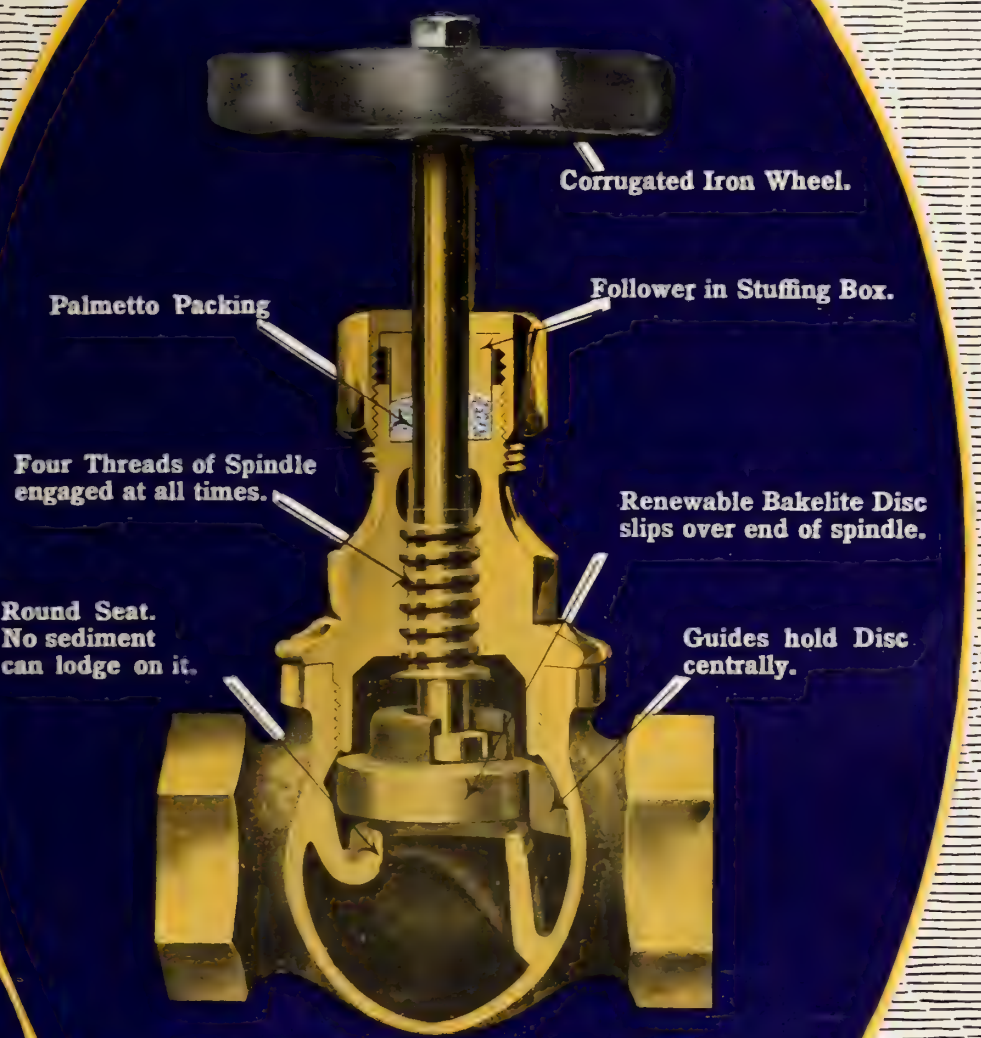
Do not hesitate to write us for full information on any lines or line in which you are interested.

The James Morrison Brass Mfg. Co., Ltd.

93-97 Adelaide Street, W.
TORONTO

POWER HOUSE

Published by The MacLean Publishing Co. Limited, Toronto, Ont.


Corrugated Iron Wheel.
Follower in Stuffing Box.
Palmetto Packing
Four Threads of Spindle engaged at all times.
Renewable Bakelite Disc slips over end of spindle.
Round Seat. No sediment can lodge on it.
Guides hold Disc centrally.

The Fairbanks Renewable Disc can be replaced in less than one minute with only one tool—a wrench to remove the bonnet.

FAIRBANKS VALVES

The Canadian Fairbanks-Morse Company, Limited

If there's scale on your boiler tubes---

It lies within your power to greatly Reduce Fuel Consumption

Examine your boilers now and prepare for the coming winter and an acute fuel shortage.

Get a Dean Boiler Tube Cleaner and put it to work at once. **It will reduce coal bills from 9% to 35%** depending upon the amount of scale in your boiler tubes.

The secret of the success of the Dean lies in its vibratory action—a controlled and localized vibration loosens the scale in large chunks. In a return tubular boiler the loosened scale falls to the bottom of the boiler. In a water tube boiler the pieces are ejected from the tube by the cleaner exhaust.

The Dean cleans boiler tubes clean. It gets all the scale. The Dean, because of its few and simple parts, takes out scale faster and more thoroughly than any other known methods; and its sturdy simplicity means long life, low upkeep cost and ease of operation.

Dean

Reg. U.S. Pat. Off.

Boiler Tube Cleaner

Mr. Smith

chief engineer of Macdonald Mfg. Co., Toronto, Canada, manufacturers of biscuit boxes, paint cans, etc.,

Says---

"In five years we haven't had to want for power five minutes. Never any trouble. Horsepower developed (250).

He uses the "Dean"

Try the Dean Cleaner Free of Charge

Write a letter: "Send us a Dean on trial, with the understanding that we are under no obligation to purchase it," and state type of boilers and exact outside diameter of tubes.

The Wm. B. Pierce Company

153 Ellicott Street, Buffalo, N.Y.

BOILERS

FOR POWER AND HEATING PURPOSES

You will find Waterous Horizontal Return Tubular Boilers in the largest industrial and municipal power plants in the country. There are reasons for this. They are economical of fuel, carry a big reserve steam pressure for use in emergencies, can be used with hard and dirty water, and are readily cleaned and easily taken care of. They cost little new; their upkeep and maintenance expense is negligible.

Waterous Horizontal Return Tubular Boilers are built in all sizes from 40 inches by 10 feet to 72 inches by 18 feet. Most standard sizes are carried in stock. If we cannot supply you at once from our yards we can turn out your order for you in quick time. On the next boiler you need let us quote you prices and delivery.

Boilers in Stock

HORIZONTAL

2—48 inches by 14 inches.
3—54 inches by 14 inches.
4—60 inches by 14 inches.
3—72 inches by 18 inches.

VERTICAL

2—15 H. P.
2—18 H. P.

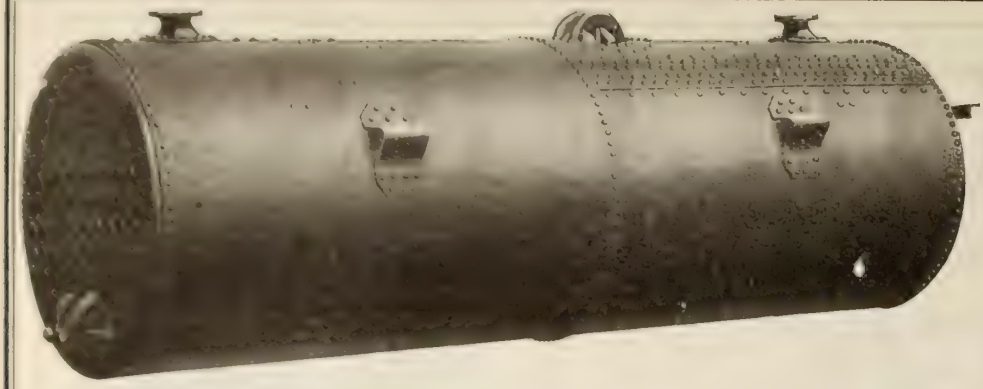
LOCOMOTIVE

1—30 H. P.
3—40 H. P.
3—60 H. P.

Waterous

BRANTFORD, ONTARIO, CANADA

If any advertisement interests you, tear it out now and place with letters to be answered.



BOILERS

Horizontal Tubular
Locomotive Types
Vertical Tubular

We Have Registered Designs to Conform With Various Provincial Codes

Our BOILERS Are Installed in the Largest Industrial Plants---There Must Be A Reason

Write Us for Boiler Information and Prices.

Engineering & Machine Works of Canada, Limited

FORMERLY
St. Catharines Works of
The Jenckes Machine Co., Ltd.

HEAD OFFICE AND WORKS:
St. Catharines, Ont.

SALES OFFICES:
St. Catharines, Ont.
Hall Machinery Co., Sherbrooke, Que.

Every Barrel of **BOICO** The Quick Remover and Positive Preventive of Boiler Scale

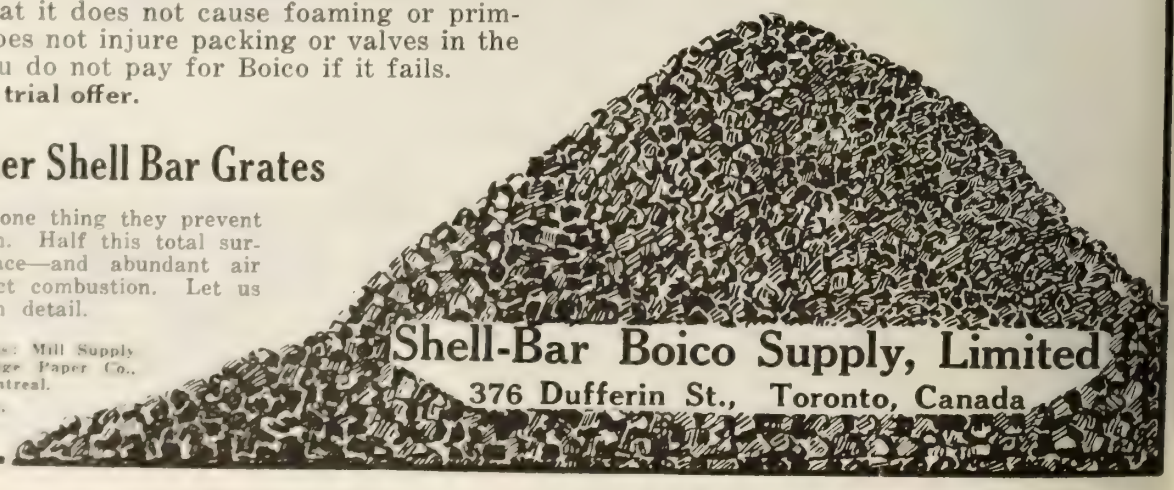
SAVES A PILE OF COAL

It's such a heartless job trying to keep a boiler clean with ordinary compounds that comparatively few are always wholly clean. Consequently a good deal more fuel than need be is turned up on the grates. We claim for Boico that it removes absolutely all scale; that it positively prevents further formation of scale; that it does not carry over in the steam; that it does not cause foaming or priming; that it does not injure packing or valves in the slightest. You do not pay for Boico if it fails.
Write for our trial offer.

Anti-Clinker Shell Bar Grates

save coal. For one thing they prevent clinker formation. Half this total surface is air space—and abundant air commands perfect combustion. Let us tell you more in detail.

Eastern Sales Agents: Mill Supply Department, Beveridge Paper Co., Ltd., Montreal.
Adolphe Huot & Sons, Quebec.



Shell-Bar Boico Supply, Limited
376 Dufferin St., Toronto, Canada

CORRECT LUBRICATION OF VITAL IMPORTANCE

Success in milling, manufacturing or mining—success in almost every line—is largely dependent upon power. The power-plant is the heart of your works. Efficient power-plant operation depends upon correct lubrication more than upon any other one thing. Correct lubrication is assured by the use of Imperial Lubricants.

Good mechanical engineers know that by using Imperial Lubricants, more dependable, as well as more economical power, is secured. They know that by their use more years of service may be secured from power units, factory output increased and overhead costs decreased.

Good mechanical engineers know, too, that the price is not nearly so important as the quality of lubricants. They realize that poor lubricants are not cheap at any price. They know that our line gives more hours of lubrication, dollar for dollar, than any other and that power-plants can more easily be kept in perfect running order if our line is used. That is why good mechanical engineers are so ready to recommend Imperial Lubricants.

Our Lubrication Engineers will gladly assist your own engineer or mechanical superintendent to determine the most economical and efficient lubrication for your power-plant. Their services are free.

Imperial Lubricants

For Manufacturing, Mining and Milling

Atlantic Red Engine Oil
Bayonne Engine Oil
Standard Gas Engine Oil
Kearsarge Engine Oil
Renown Engine and Dynamo Oil
Solar Red Engine Oil
Junior Red Engine Oil
Eldorado Engine Oil

Capitol Cylinder Oil
Beaver Cylinder Oil
Imperial Cylinder Oil
Shield Cylinder Oil
Ebony Cylinder Oil
Acme Cylinder Oil
Disc Cylinder Oil
Dominion Cylinder Oil

Write to our home office at 56 Church Street, Toronto, or to any of our branches.

IMPERIAL OIL LIMITED

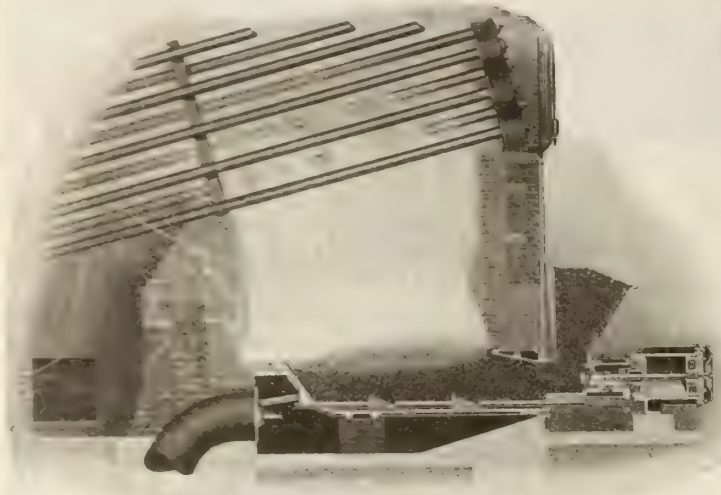
Power Heat Light Lubrication

Branches in all cities

If any advertisement interests you, tear it out now and place with letters to be answered.

JONES UNDERFEED STOKER

With the Jones Automatic Underfeed Stoker you have steady steam pressure all the time—and a smokeless stack. For the feed and air supply are so regulated as to make combustion almost perfect.



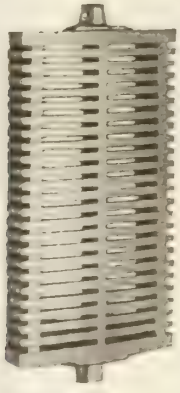
85 Tons

Go as far as 100 Hand Fired

With coal so high-priced, so scarce, so essential to the winning of this war—why not install a Jones stoker and do what you can to save it?

Jones Underfeed Stoker Company, Limited

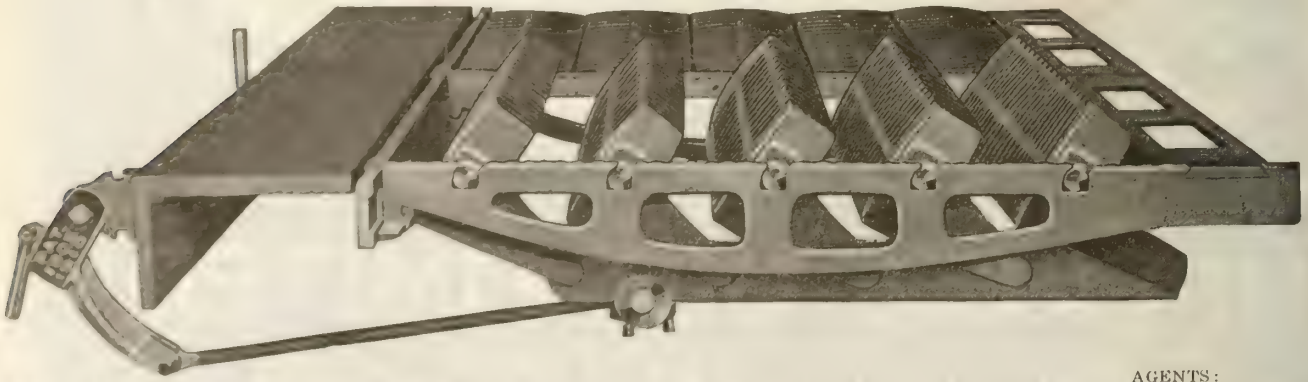
37-41 Britain Street - - TORONTO



Hard coal, all grades of soft coal, and screenings surrender every atom of heat energy—if combustion is perfect.

Cyclone Grates

make combustion perfect, because of their 60% air space and 90% underdraught. Not a clinker can form nor can good fuel get into the ash pit. You want proof? Very well—just give us your name.



The Canadian Steam Boiler Equipment Co., Ltd.

Sole Makers for Canada

26 McGee Street Phone G. 3660 Toronto, Ontario

AGENTS:

ST. JOHN, N.B., F. W. Blizard, 329 Charlotte St. MONTREAL, Mason Regulator Co., Ltd., St. James St. HAMILTON, Robt. Fitzsimmons, 8 Grove St. WINNIPEG, Vulcan Iron Works.

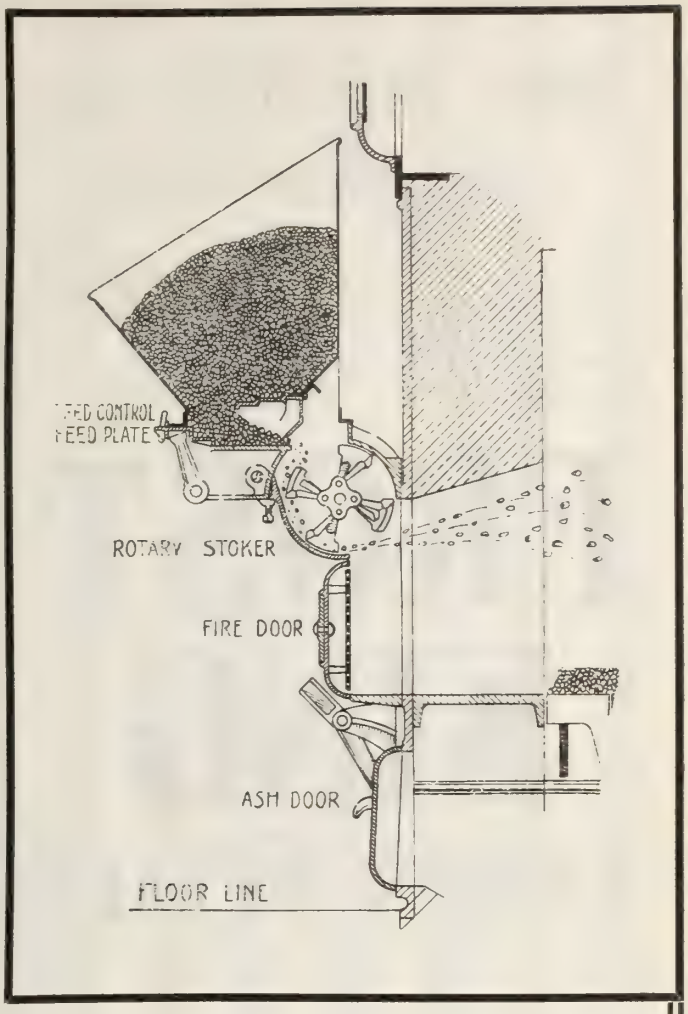
If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

Not a pretty picture but—

It Solved the Coal Question for Another 10 Plants Last Month

And it freed 20 expert firemen for production work in the "profit-making" departments of these plants.

All because it shows the operating principles of the



Galt Sprinkler Stoker

and the logic of these principles appealed to the common-sense of the men who own the "20 plants" referred to in the caption of this advertisement.

Therefore will you please study this drawing.

Note the Rotary Stoker. In a light, continuous stream it automatically feeds to the furnace cheap anthracite dust to 3-in. lump. As it feeds, it so uniformly spreads the fuel as to give a level fire 3 to 4 inches thick.

Note the **closed** fire door. No in-rushing draft of cold air here to upset perfect combustion or to act as a drag on the efficiency of your boiler.

Also the Feed Control and Feed Plate. Not one part in contact with the furnace flame. No complicated mechanism that lump or low-grade fuels can clog.

The Galt Sprinkler Stoker operates with natural draft and with forced or induced draft equally well. It gives practically smokeless combustion.

Illustrated catalog tells how the Galt Stoker, with 10 to 20% less coal, makes more steam. Write for copy.

GALT FOUNDRY COMPANY, LTD.

GALT :: :: ONTARIO

If any advertisement interests you, tear it out now and place with letters to be answered.

Better Babbitt Service and Lower Costs

Phenomenal growth in popularity has attended Hoyt Babbitt Metals in the power houses of the world. This growth is attributed to the fact that Hoyt Metals give the best service and prove the most economical.

FROST KING

BABBITT METALS

have no equal for general babbitting purposes. Continued use of FROST KING always results in minimum babbitting costs.

Nickel Genuine, Another famous Hoyt Metal. It is specially mixed for dynamo and motor service. If you have not tried it, do it now and watch the results.

There is forty years' of experience in metal mixing behind Hoyt Metals. Made for all babbitting purposes, and you can depend upon any of them.

HOYT METAL CO.

Eastern Ave. and Lewis St., Toronto, Can.
New York, N.Y. London, Eng.
St. Louis, Mo., U.S.A.

MASON

Reducing Valves

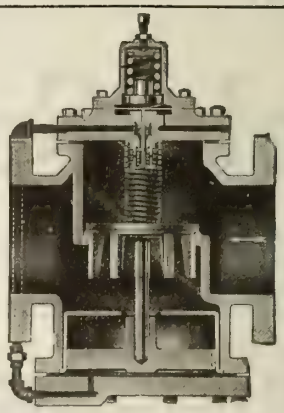
Pump Regulator
Balanced Valves
Damper Regulators

If you order a Mason you will get absolute satisfaction. This we guarantee you. You simply cannot make a mistake.
Dependable regulation under every possible condition.

Our complete catalog tells you WHY. Let us mail you a copy.

Mason Regulator Company
BOSTON, MASS.

TORONTO REPRESENTATIVES:
The Arthur S. Leitch Co.,
506 Kent Bldg., Toronto.



Kieley & Mueller Specialties

Regulating Valves
Back Pressure Valves
Pump Governors
Separators
Traps

FOR EVERY SERVICE
SALES ENGINEERS
THE ARTHUR S. LEITCH CO.
TORONTO

New Bundy Return Trap

Mason Standard Bronze Reducing Valve

SAVE COAL

SAVE STEAM

STOP LEAKS

There are mighty few steam plants where Fuel Economies of a very appreciable value cannot be effected at relatively small cost by simply stopping existing leaks and waste.

Our specialty is stopping leaks.

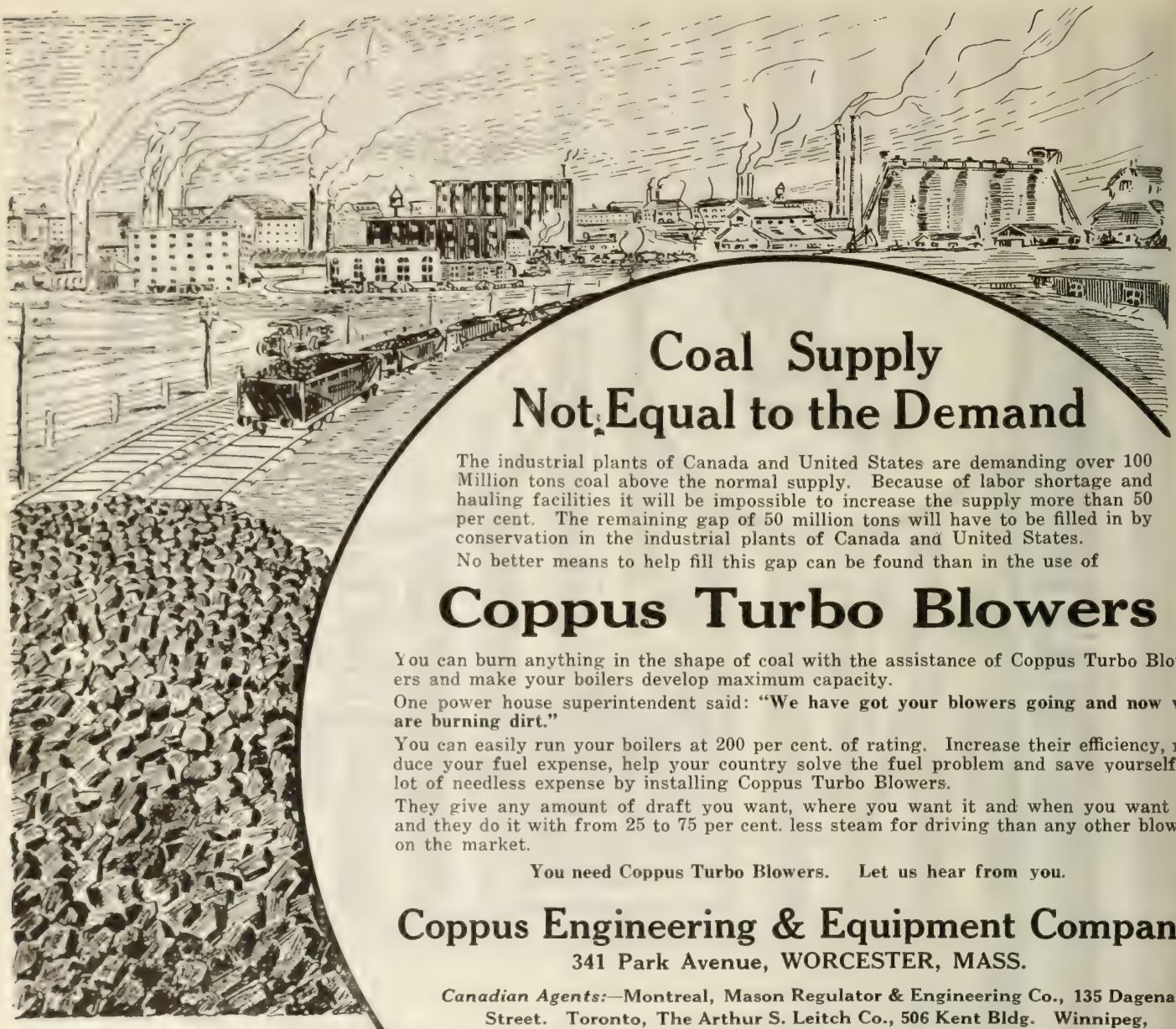
It costs you nothing to have your plant surveyed—our advice is based on practical experience to obtain maximum results at least first cost.

THIS IS
MASON SERVICE

The Mason Regulator & Engineering Co., Ltd.
Successors to H. L. PEILER & COMPANY
Montreal, Office and Factory: 135 Dagenais Street

Toronto Representative: The Arthur S. Leitch Co., 506 Kent Bldg., TORONTO

If any advertisement interests you, tear it out now and place with letters to be answered.



Coal Supply Not Equal to the Demand

The industrial plants of Canada and United States are demanding over 100 Million tons coal above the normal supply. Because of labor shortage and hauling facilities it will be impossible to increase the supply more than 50 per cent. The remaining gap of 50 million tons will have to be filled in by conservation in the industrial plants of Canada and United States.

No better means to help fill this gap can be found than in the use of

Coppus Turbo Blowers

You can burn anything in the shape of coal with the assistance of Coppus Turbo Blowers and make your boilers develop maximum capacity.

One power house superintendent said: **"We have got your blowers going and now we are burning dirt."**

You can easily run your boilers at 200 per cent. of rating. Increase their efficiency, reduce your fuel expense, help your country solve the fuel problem and save yourself a lot of needless expense by installing Coppus Turbo Blowers.

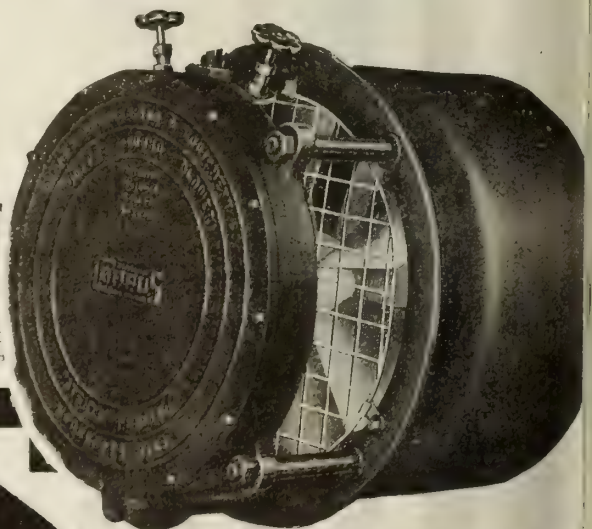
They give any amount of draft you want, where you want it and when you want it, and they do it with from 25 to 75 per cent. less steam for driving than any other blower on the market.

You need Coppus Turbo Blowers. Let us hear from you.

Coppus Engineering & Equipment Company

341 Park Avenue, WORCESTER, MASS.

Canadian Agents:—**Montreal, Mason Regulator & Engineering Co., 135 Dagenais Street. Toronto, The Arthur S. Leitch Co., 506 Kent Bldg. Winnipeg, Wm. Carter, 817 Union Bank Bldg.**



COPPUS TURBO BLOWERS

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

Murphy AUTOMATIC Furnace

Murphy Stokers

A few longtime constant users, and there are others!

Lockport Paper Co.,	Lockport, N.Y.	33 years constant use
Hartje Paper Co.,	Steubenville, Ohio	24 years constant use
Sherwin-Williams Co. 12 contracts 20 Stokers	Montreal, P.Q. Cleveland, Ohio Kensington, Ill.	16 years constant use
Laurentide Co., Ltd.,	Grand Mere, P.Q.	13 years constant use
Ford Motor Co.,	Detroit, Mich.	
" " "	Des Moines, Iowa	18 years constant use
" " "	New York, N.Y.	
Ohio Traction Co., 16 Repeat Orders	Cincinnati, Ohio	28 years constant use 74 Murphy Stokers

For printed matter address

MURPHY IRON WORKS

DETROIT, MICH. BUFFALO, N.Y.

Having Commutator Troubles?

The Jordan Commutator Truing Device will true your commutators without a shut-down.

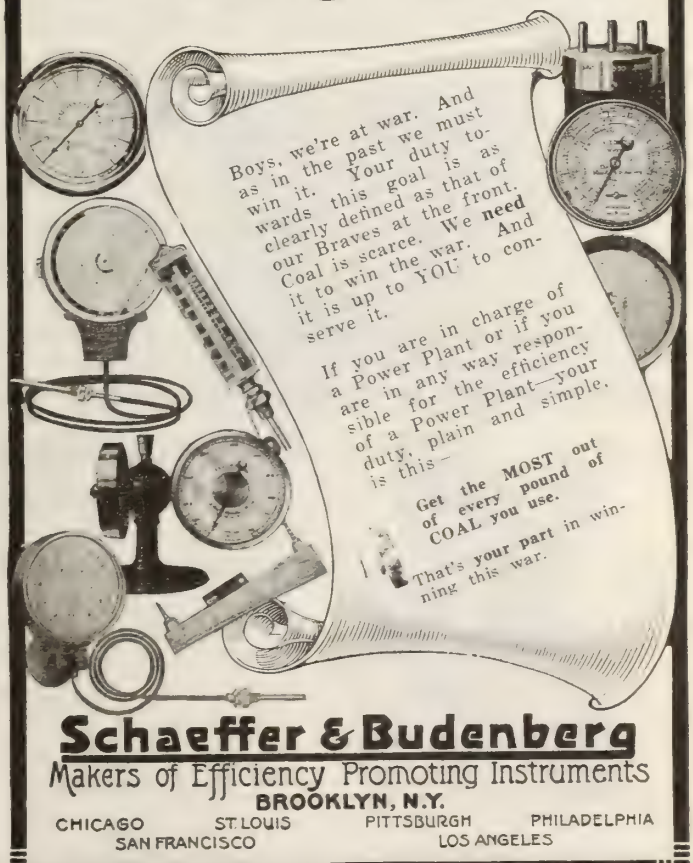
Jordan Bros., Inc.

82 Beekman St. New York City, N.Y.

Canadian Representative :

CANADA SALES CO., 183 Church Street, Toronto, Canada

A Message to YOU


Boys, we're at war. And as in the past we must win it. Your duty towards this goal is as clearly defined as that of our Braves at the front. Coal is scarce. We need it to win the war. And it is up to YOU to conserve it.
If you are in charge of a Power Plant or if you are in any way responsible for the efficiency of a Power Plant—your duty, plain and simple, is this—
Get the MOST out of every pound of COAL you use.
That's your part in winning this war.

Schaeffer & Budenberg

Makers of Efficiency Promoting Instruments

BROOKLYN, N.Y.

CHICAGO ST. LOUIS PITTSBURGH PHILADELPHIA SAN FRANCISCO LOS ANGELES

Linde Canadian

THE powers of the organization are devoted to high quality instead of high output.

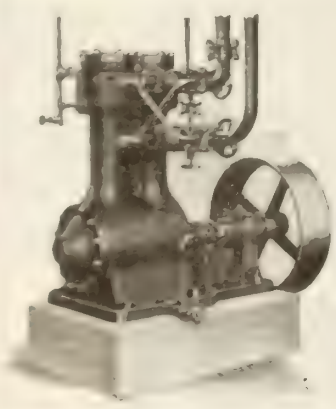
The long-established policy of building a few machines and building them well, constantly guarantees the character of the Linde.

The Linde Canadian Refrigeration Company, Ltd.

37 St. Peter St., Montreal

MAKERS OF QUALITY REFRIGERATING MACHINERY

Established and Manufacturing in Canada Since 1896



Ice-making and Refrigerating Machinery

Built in any capacity that you desire. HORIZONTAL OR VERTICAL

Our SMALL MACHINES have the same "regularity of Operation," "Reliability" and "Efficiency" as our large ones.

AMMONIA FITTINGS, CONDENSERS, BRINE COOLERS, ETC.

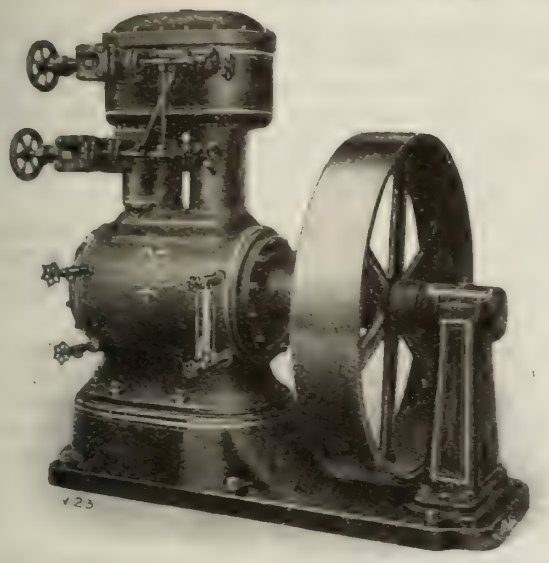
Our Machines are in daily operation in Canada

CORLISS and POPPET VALVE ENGINES

The Vilter Manufacturing Company

242 Beecher St. - - - Milwaukee, Wisconsin

"Install the FRICK Machine"



Recommendations frequently made by Engineers and Owners who have installed and operated various makes of Refrigerating Machines and Equipment, plainly state, "Install the FRICK Machine."

Why?—Because they exceed the guarantees made for them. In the Refrigerating field the FRICK Machine is like a Yankee on the battlefield—prepared and ready for extra duty.

Ask for Ice and Frost No. 5—It explains details.

36 YEARS OF SUCCESSFUL REFRIGERATING ENGINEERING EXPERIENCE.

Ask for a copy of our list of users covering 48 pages of satisfied customers—also your copy of "Ice and Frost."

Frick Company
WAYNESBORO, PA. U.S.A.
ICE MACHINERY SUPERIOR SINCE 1862

Canadian Representatives:
FRICK ICE & REFRIGERATING COMPANY
MONTREAL, CANADA

There is a FRICK Machine for every refrigerating purpose—all types—Vertical — Horizontal — Absorption.

Why the Fire Underwriters Approve Nonpareil Corkboard for Cold Storage Rooms

Here are the results of a fire in the International Provision Company's Packing Plant, Brooklyn, N.Y., which happened June 24, 1913. Here, as in many other cases, Nonpareil Corkboard definitely proved its fire-retarding qualities. Ignited cork will not support combustion itself, and the solid, compact construction possible with Nonpareil Corkboard leaves no concealed air-spaces in the walls to act as flues and assist in the spread of the fire once under way.

Interior view of one of the cold storage rooms practically undamaged. The cement finish was cracked just a little, due to the intense heat getting into the rooms through the open doorway.

A solid Nonpareil Corkboard partition, four inches thick, at the end of a cold storage room. The fire destroyed the Portland cement finish, but the corkboard was damaged very little. The interior of the room remained intact.

Is it surprising that the National Board of Fire Underwriters have approved Nonpareil Corkboard? Their approval has resulted in reduced insurance rates in many sections of the country, not only on the buildings insulated with Nonpareil, but on their contents as well.

Armstrong Cork & Insulation Company

504 McGILL BUILDING MONTREAL, QUEBEC, CANADA

Also manufacturers of Nonpareil Cork Covering for brine, ammonia and ice water lines; Nonpareil Insulating Brick for boiler settings, etc.; Nonpareil High Pressure Covering for steam lines; and Circle A Cork Brick for floors of cold storage rooms.

Refrigeration—A National Demand

The nation-wide appeals for the conservation of food products is greatly increasing the demands for mechanical refrigeration. Ice-making and Refrigerating Plants all over the country are overhauling and improving their equipment so that they may supply this demand and reap the increased profits.

Quality in refrigerating machinery, under present conditions, is more to be valued than ever before. An interruption of operation will mean a definite loss.

York Ice-making and Refrigerating Machinery is known universally as the Standard. There's a York Machine to meet every practical condition of mechanical refrigeration, and we are always ready to advise with prospective customers concerning their requirements and then to furnish the plant best suited to meet his conditions.

Let Our Engineers Help You. Write us about your problem.

York Manufacturing Company

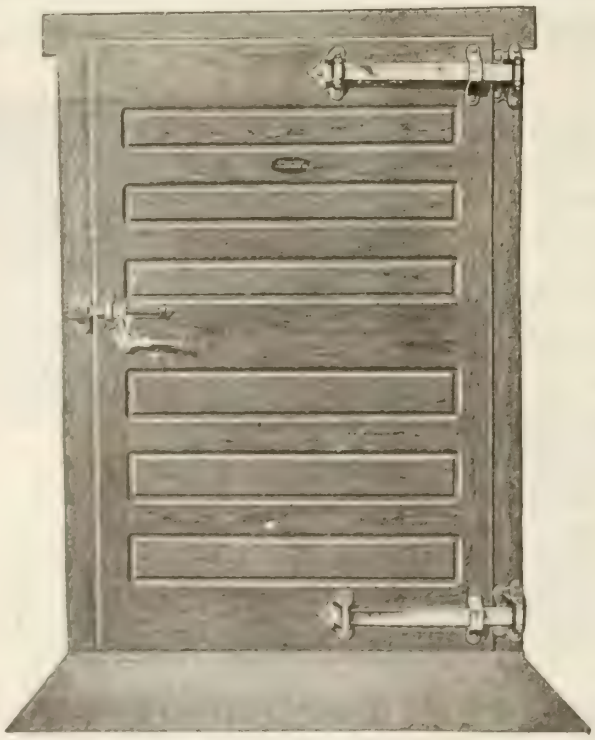
(Ice-Making and Refrigerating Machinery Exclusively)

YORK, PA.

Canadian Representatives:

Canadian Ice Machine Company

WINNIPEG 85 Lombard St. | TORONTO 82 Chestnut St. | MONTREAL 626 Coristine Bldg. | CALGARY 605 Second St.



DOORS

For Cold Storage and Freezer Purposes Either Standard or Fireproof

JAMISON'S "JONES" and "NOEQUAL" doors are SUPERIOR because:

1st—Only the best materials are used in their construction.
2nd—We use heavier materials. Result: Longer life and increased efficiency.

3rd—Our doors are built with double and triple seals of contact—others have but one.

4th—Our Automatic Self-Tightening Fastener is the only truly AUTOMATIC and SELF-TIGHTENING Fastener on the market.

5th—Our ADJUSTABLE SPRING Hinges mean the door is always properly seated in the frame, making sagging impossible.

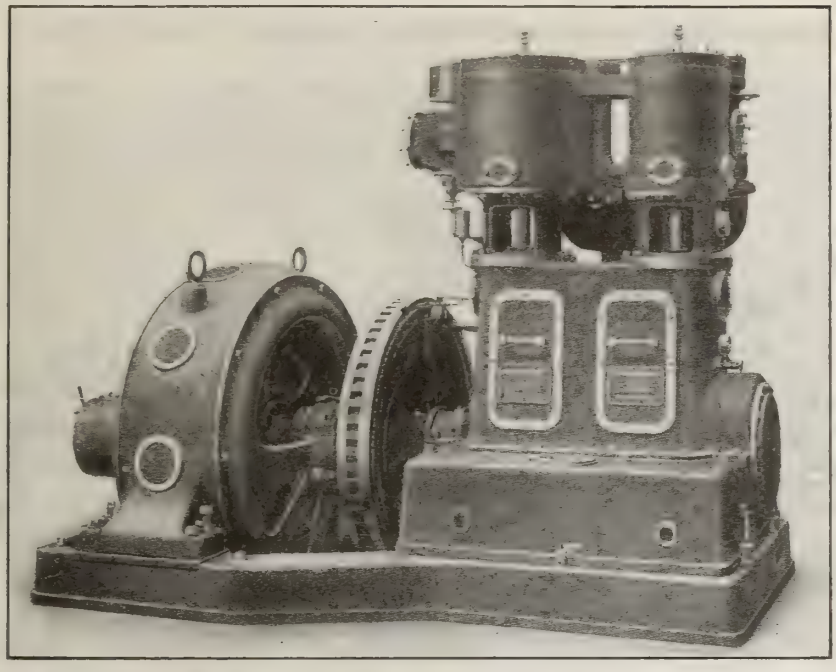
Write for General Catalog No. 7, illustrating and describing both "Jones" and "Noequal" doors, windows, ice doors and chutes, etc.

Jamison Cold Storage Door Company

Formerly Jones Cold Store Door Co.

HAGERSTOWN, MD., U.S.A.

BELLISS & MORCOM, LTD.
Engines and Air Compressors



Belliss & Morcom Motor-Driven Air Compressor.

Belliss Steam Engines, Steam Turbines, Diesel Engines,
Air Compressors, Condensing Plants

Heenan Refuse Destructors, Air Coolers, Water Coolers,
Oil Coolers, Dynamometers

Paterson Water Softening Plants and Filters

Centrifugal Pumps

We can make good delivery for War Service.

LAURIE & LAMB

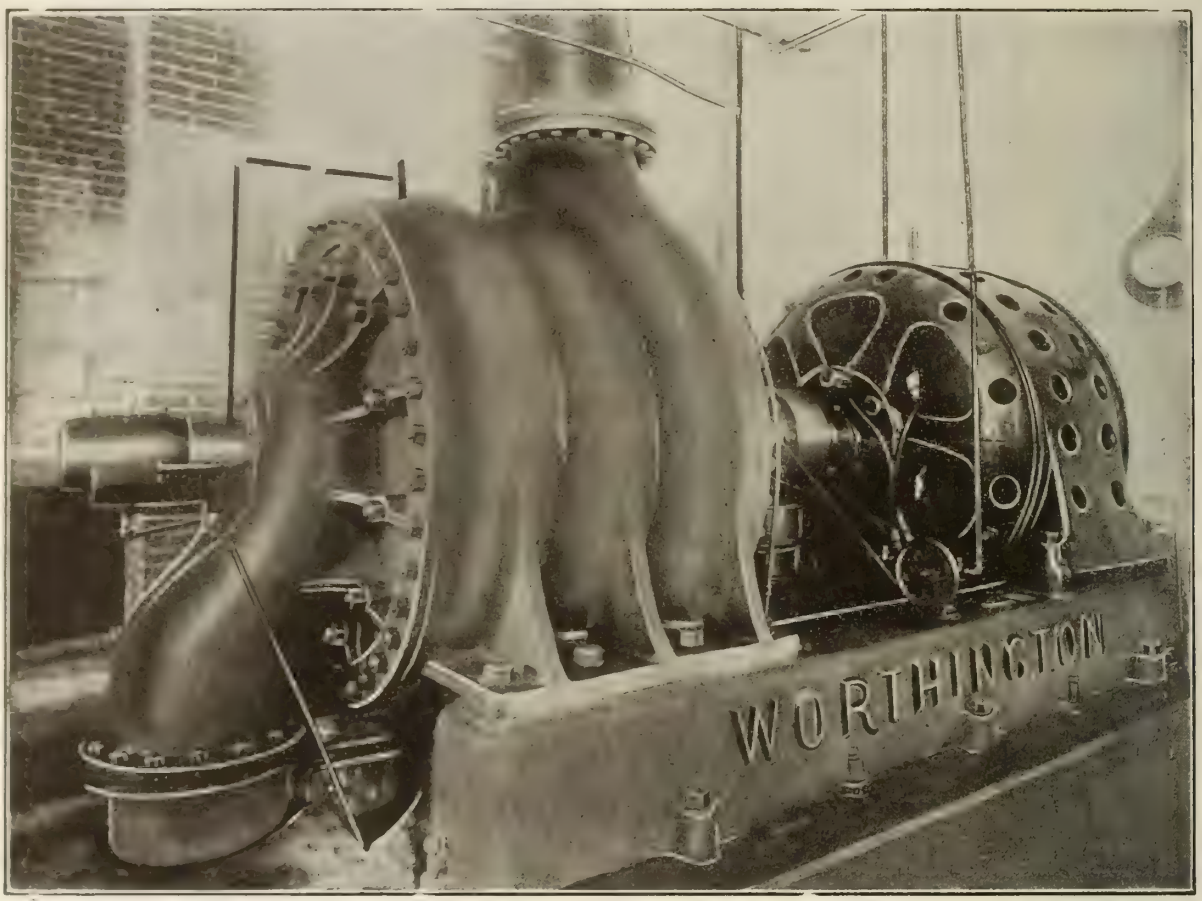
Engineers

211 Board of Trade Bldg. - - MONTREAL

THE JOHN McDOUGALL CALEDONIAN IRON WORKS CO., Limited

Manufacturers of Boilers, Castings, Condensers, Elevators, Engines, Filters, Forgings, Hydraulic Machinery, Pumps — centrifugal and reciprocating, Steam Turbines, Tanks, Water Wheels, Water Works Plants

Works: Seigneurs and William Streets, MONTREAL



5,000,000 gallons daily—Montreal Water Works—Driven by 400 H.P. Induction Motor.

Our Engineers have spent many years developing Centrifugal Pumps and we are now able to offer you perfected designs in any size pump from inch and a half and up for any service you may desire, and to be driven either with motor, engine or belt.

Write us for Engineering information, or prices, any time.

Sole Canadian Agents for H. R. Worthington Co.

Keeping in Stock at Montreal a large assortment of their Boiler, Feed and General Service Pumps

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

The Publisher's Page

TORONTO OCTOBER, 1918

The Clean, Straight Road

NO one knows better than an advertiser that all the investment he has made in the years of building his business through advertising can be knocked into a cocked hat by a few pieces of unsatisfactory product.

No one knows better than he that ONE proved instance of departure from square dealing will instantly bar him from the pages of every reputable publication—his marketing medium.

There is no secret diplomacy in advertising in legitimate publications. There never can be.

There is no commercial bribery in orders placed through the open claims of consistent advertisers.

The advertiser cannot afford to profiteer or to cut quality. Only the firm that has discontinued advertising and is planning to go out of business can do so.

Remember the odium that is bound to attach to the man who has recommended the purchase of goods which fall down—whether their failure is through intentional scrimping or blundering lack of knowledge.

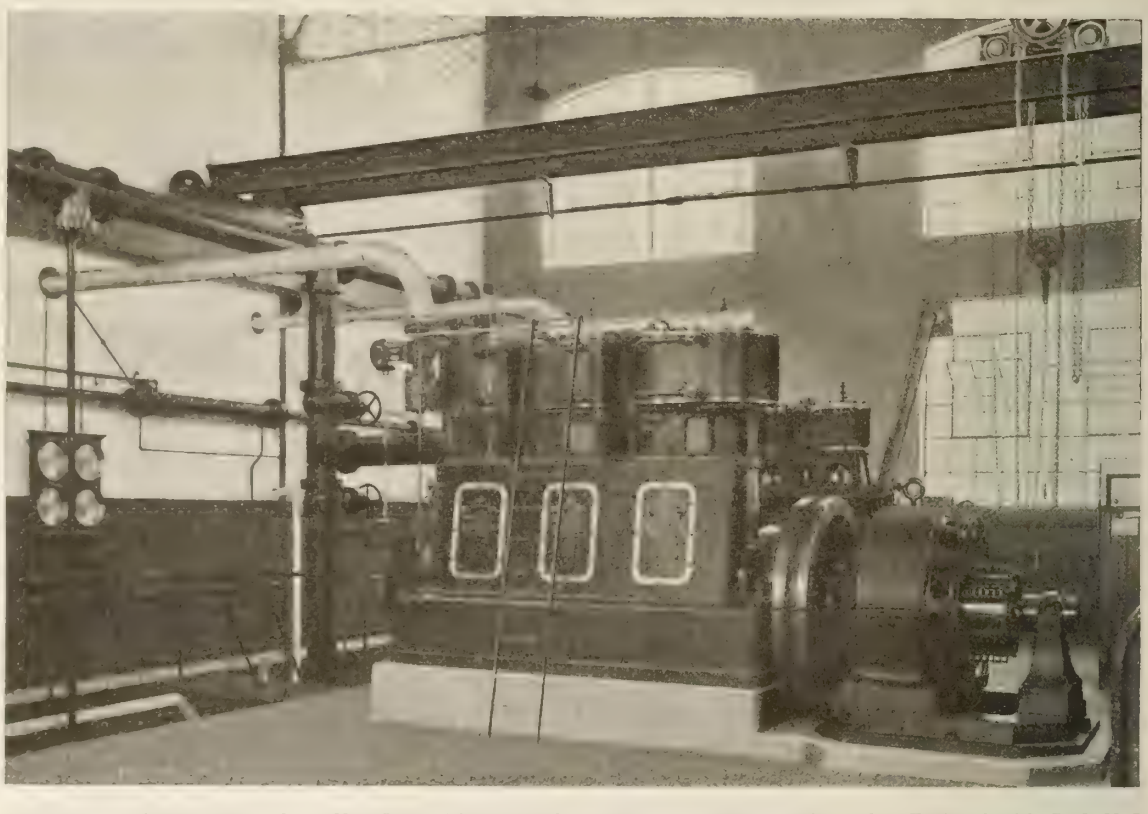
Remember the loss in time and production, as well as the cost of replacing, when equipment fails to fulfill the claims made for it by some irresponsible salesman. Whether his firm authorized such claims or not, the loss is on you, if that firm is not a business builder—an advertiser backing his claims with a "make-good" policy.

Think these facts over, Mr. Engineer, when you are making out your next requisition for supplies, or when you make that recommendation for equipment.

Think them over, Mr. Owner, when you are about to put your O.K. on your engineer's requirements.

POWER EQUIPMENT

Built to Meet Your Own Requirements



A corner in the Engine Room of our New Power Plant recently erected at our Main South Works. Equipped with G. & McC. Co. Three-Cylinder Compound and Two-Cylinder Compound Vertical Forced Lubrication Steam Engines.

G. & McC. CO. ENGINES and BOILERS

will provide your plant with

A Continuous and Economical Service

WE BUILD

Horizontal and Vertical Steam Engines; Steam Turbines; Return Tubular and Water Tube Boilers; Heaters; Tanks; Pumps and Condensers; Transmission Machinery; Safes, Vaults and Vault Doors.

The advice of our Engineering Experts, our Catalogues, Specifications, Photographs, etc., will be cheerfully supplied to interested parties.

The GOLDIE & McCULLOCH CO., Limited

Head Office and Works: GALT, Ontario, Canada

TORONTO OFFICE:	WESTERN BRANCH:	QUEBEC AGENTS:	BRITISH COLUMBIA AGENTS:
Suite 1101-2,	248 McDermott Ave.,	Ross & Greig, 412 St. James St.	Robt. Hamilton & Co.,
Traders Bank Bldg.	Winnipeg, Man.	Montreal, Que.	Vancouver, B.C.

POWER HOUSE

Conservation and Its Relation to the Power Plant

Cause of Fuel Shortage—U.S. Government Measures—Hydro-Electric Power—Use of Factory Refuse

By T. H. FENNER, Associate Editor

THE war has brought many trials and hardships in its wake, but it has also been instrumental in awakening keen public interest in a subject that formerly held only academic interest to the majority of people. The subject is that of conservation of the great natural resources of the North American continent, and particularly the conservation of coal. Coal has always been so easily obtainable, at a moderate price, that any attempt on the part of the engineering profession to arouse interest in promoting means to ensure its more efficient use, have met with but slight encouragement from those to whom the matter should have appealed the most. Fuel costs have been such a relatively small portion of the general manufacturing costs, that managers of industrial plants paid but little attention to them, in proportion to other items of producing expense, and looked on them as a sort of necessary evil, to be made the best of. However, the conditions arising out of war time demands, aroused all kinds of coal consumers to the necessity of a change in methods, and that speedily.

The Fundamental Cause of the Shortage

The main cause of the great falling off in quality of coal being distributed and the difficulty of obtaining it, was the largely increased demand by the many new factories established for manufacturing war material, and a marked decrease of production at the mines, due to the shortage of labor and the relatively low production of the labor employed. Wages were high, and the men could earn a higher wage than ever before in a shorter time. As the production was falling short of the demand, far less care was employed in the inspecting and screening of coal at the mines, and grades of coal were shipped which had hitherto been considered unmarketable. As a great many of the plants were burning coal very inefficiently even when getting a suitable grade, the loss with the lower qualities was enormously increased, and in a great many cases, difficulty was experienced in keeping the plant running. This attracted the attention of many factory executives who had never before considered operations in the power house to any extent, and when the railway congestion of last winter resulted in conditions that caused the compulsory closing down of the greater portion of the industrial and commercial life of both Canada and the United States on a certain number of days, fuel conservation had become a real live consideration. However, the real object of the heatless days was to relieve the railways of the congestion under which they were handicapped, more than to actually save coal.

Earlier Movement For Conservation

Before the critical situation of last winter had been reached, the representative men of the manufacturing, mining, and power industries had been called into conference with the government in both countries, with the object of fixing on ways and means of reducing consumption of coal without dislocating the essential industries of the countries, and to make these measures permanent, and not merely for the time of stress they were undergoing. There are two main sources of waste of fuel, one being that due to the waste of culm, silt, and small sized coal at the mines themselves, and the second the waste due to imperfect combustion of the coal under the boilers and in the furnaces of the consumers. That a considerable proportion of the small size of anthracite, and also culm and silt, now being allowed to go on the refuse pile can be used to advantage at the mines for supplying light, heat and power, has been proved beyond question, and is actually being done at a number of the mines, thereby releasing a corresponding amount of the steam sizes for distribution to the consumers.

Amount Of Waste At The Mines

It has been estimated by competent authorities in the United States that about one ton of anthracite is consumed at the mines for each eight or nine tons produced. It is estimated that the production of anthracite for the current year, that is from April 1st, 1918 to March 31st, 1919, will be in the neighbourhood of 80,000 000 tons. If the waste products could be reclaimed, and used for power production at the source, it would mean adding an additional 8,000,000 tons to the industrial users supply for the year. There are two kinds of waste in the production of anthracite, the first being the culm, or sizes smaller than 3/32 of an inch, and secondly the rock refuse. The average production of culm to tonnage mined runs about 15%, so that taking the statistics of anthracite produced from 1830 to Jan. 1st, 1918, the culm production in that time amounted to approximately 350,000,000 tons. All this is not available, as probably 50% of it has been taken into the mines for roof support, etc., leaving in the whole anthracite field about 175,000,000, available for use. The heat value of this culm is high, under proper conditions of burning, by the installation of proper preparing plants at the mines, where this culm can be pulverized with a predetermined amount of bituminous coking coal, it can be used successfully in locomotive boilers, while in stationary boilers it can be used without the addition of any mixture. The result of various tests with the fine sizes of anthracite coal have demonstrated that by using a mixture of about 30% fine anthracite with 70% bituminous coking coal, evaporative results equal to those given by a straight butuminous coal can be obtained, even with hand firing. The writer has personal knowledge of one Canadian plant burning a low grade anthracite consisting of about 40% No. 2 Buckwheat, 40% No. 3, and the remainder No. 4 and smaller, with an ash content of from 17% to 22%, with hand firing, and getting fairly good results, without the addition of any bituminous. With a proper mechanical stoker outfit, the same grade of coal would probably give from 15% to 20% better results. In the Canadian bituminous mines most of the small coal is used at the mine, in some cases used in coke ovens, and in others pulverized and burned under the boilers in a central power house, from which power is delivered to the various underground workings.

The Least Excusable Waste

It is in the boiler rooms and factories of the industrial plants that the greatest amount of preventable waste occurs. In

the United States where there are a much greater number of high powered plants than is the case in Canada, the average efficiency is higher, but at that it is doubtful if it exceeds 60%, while in Canada it is probably 10% lower than that. The large majority of plants in Canada are of the one boiler variety, where little or no attention is paid to means of promoting efficiency. When it is considered that 40% of the total coal mined, is burnt under the boilers of manufacturing and electric generating plants, the amount of saving possible by an increase in average efficiency of even 10% can be readily imagined. On the ways and means of achieving this desirable result, articles without number have been written in the past two years and manufacturers of coal saving appliances have contributed to the general knowledge on the subject through their advertising matter. However, these means have evidently not been sufficient to get the power users interested, so the U. S. government have taken more drastic steps to ensure the co-operation of the consumers.

U. S. Government Measures

The United States government have approached this matter of fuel conservation as they have all matters connected with the prosecution of the war, and even to those little enough inclined to find cause for praise in anything done by the U. S. the effectiveness of the measures taken is apparent. What they have done in effect is to put a premium on efficient steam production. Realizing to the full the probable effects of the continuation of present wasteful methods the fuel controller of the U. S. government has presented the power plant owners with the alternative of producing their power economically, as regards fuel consumption, or being put in the position of not having any fuel to consume. They have not done this in any spirit of antagonism to manufacturers, or in a manner to suggest discrimination between the different interests, but in a way that clearly shows they wish to help those who will help themselves.

A power plant efficiencey campaign has been inaugurated, which will embrace every State in the Union, and every power house in each State. An administrative committee has been formed, and under their jurisdiction a field force has been mobilized, whose duty it will be to personally visit every one of the 250,000 steam power plants in the country, and investigate their working conditions right on the spot, offering their help where necessary. As a preliminary to this a questionnaire has been drawn up, and sent to each plant in the country. The questions set embrace all the fundamental points of economical working in the plant, and to each question a certain value has been given. The plants will be rated according to the number of points given to their answers, and those gaining the highest number of marks, or in other words, showing the greatest efficiency, will have the first call on whatever coal is available. The fuel control board has power to shut down completely any plant which in their opinion is excessively wasteful in its operation. The questionaire is produced below. This is the best and fairest means which have yet been designed, to deal with the allotment of coal to the different plants, and gets down to the bed rock of the situation, and if the system is followed up and worked out as it has been designed, many million tons of coal will be saved per year. The plan deserves the earnest co-operation of the consumer, as by following out the suggestions of the questionnaire, he will not only be relieving the coal situation generally, but saving himself money into the bargain.

QUESTIONAIRE

Date of report.....
Name of company, concern or owner.....
Address of Central Office.....
Name and location of plant inspected.....
Character of product or service.....

Stationary Boilers

WATER-TUBE BOILERS

Number	Hp	Kind of Draft: Nat'l	Forced	Induced	How Fired: Stoker	Hand	Total Hp	Remarks

FIRE-TUBE BOILERS

Number	Hp	Kind of Draft: Nat'l	Forced	Induced	How Fired: Stoker	Hand	Total Hp	Remarks

MOVABLE BOILERS*

Number	Hp	Type	Remarks

* In the rating of the plant movable boilers will be considered separately. The questionnaire does not call for information regarding movable boilers except as per above table. The influence of movable boilers on the rating of the plant will be left to the judgment of the Administrative Engineer.

Kind of coal ..... Bituminous ..... Semibituminous ..... Anthracite
Size .....

Tons of coal of 2,000 pounds used during twelve months ending May 1, 1918.....
Months of operation of plant during the same year .....
Approximately what percentage of live steam is used for:

	Winter Per Cent.	Summer Per Cent.
(a) Making power		
(b) Heating building		
(c) Process work		

Is purchased electric power used?.....
If so, how many kilowatt-hours consumed during twelve months ending May 1, 1918?

Records

Are records kept to show any of the following information? Answer "Yes" or "No" in table.

	By Shift	Daily	Weekly	Mont
Water evaporated by boilers				
Coal consumption by boilers				
Flue gas analysis				
Feed-water temperature				
Steam pressure				

ENGINE EQUIPMENT

STEAM UNITS—ENGINES, TURBINES, PUMPS

Type	No.	Rating: Initial Pressure	Hp.	Kw. or Cu. Ft. Per Min.	Condensing	Noncondensing	Type of Valve Gear
Simple							
Compound							
Turbine							
Steam Pumps							

What changes have you in progress which are expected to reduce your fuel consumption?
.....
When will they be in effect?
.....
Further remarks by owner:
.....

Note to Owner: If sufficient space is not available in the questionnaire, please attach an extra sheet with the additional information.

Recommendations by the Fuel Administration

That provision be made for weighing and recording of the fuel used each shift or day.

That feed water be heated and measured.

That provision be made for an adequate supply of air to the fuel and convenient means provided for the measurement and control of the draft.

That provision be made to keep boiler surfaces clean inside and out.

That the grates be in good repair, that settings, breeching and access doors be free from air leakage, and that boiler surfaces wasting heat be covered with insulation.

That the surfaces of steam piping, drums and feed-water heaters which waste heat or steam by radiation be properly covered with insulating material.

That exhaust steam be utilized wherever possible, to the exclusion of direct steam from the boilers. The plant should be so designed that no more exhaust steam will be produced than can be efficiently utilized in heating or process work.

That a competent man in the plant be detailed for the work of fuel conservation in the boiler and engine rooms.

That a competent man or committe be detailed for the work of fuel conservation in the building or shop outside of the power plant.

(a) FUEL: Value of question, 9. Mark received . . ..
Question 1. What provision is made for weighing fuel used each shift or day?
Question 2. What records are made of fuel used each shift or day?
Question 3. What grate surface is in use each shift, exclusive of banked fires?
Question 4. Total coal used each shift exshift exclusive of banked fires?

(b) WATER: Value of question, 15. Mark received . . ..
Question 1. What provision is made for heating and continuous measuring of feed water (check answer in table below)?

Heating.	Means Used for Measuring.
Open feed-water heater ..	.....
Closed feed-water heater..	.....
Exhaust steam	.....
Direct steam	.....
Waste heat economizer...	.....

(c) AIR SUPPLY: Value of question, 12. Mark received .....
Question 1. Are means provided for measuring the draft over the fire?
Question 2. Are means provided for determining the excess air by fluegas analysis?
Question 3. Are dampers provided for equalizing the draft in the furnaces?
Question 4. Is there a convenient means for regulating the draft by main or uptake damper?
Question 5. Is there an automatic damper regulator in working order?

(d) CLEAN HEATING SURFACES: Value of question, 12. Mark received.....
Question 1. What provision is made for keeping soot and ashes from boiler-heating surfaces (mark answer in table below)?

Steam lance for blowing soot by hand.....	
Mechanical soot blower.....	
Brushes or scrapers.....	

Question 2. How often are the soot and ash cleaned from the boiler-heating surface?
Question 3. What provision is made for keeping scale and sediment out of the boiler (check answer in table below)?

Chemical treatment of feed water in the boiler...
Chemical treatment of feed water outside of boiler
Filtration of feed water in open iced-water heater
Filtration by means of feed-water pressure filter
Other means ....
Water is free from scale or sediment without treatment . .

Question 4. What means are used for removing scale from the boilers?
Hand..... Mechanical.....

(e) BOILER AND FURNACE SETTING: Value of question, 20. Mark received....

Question 1. Are the grates warped, broken or otherwise defective?

Question 2. Check air leaks observed, as follows:
Leaks in boiler setting.....
Openings between boiler and setting.....
Badly warped fire-doors.....
Badly warped cleaning or access doors.....
Leaks around blowoff piping.....

(f) INSULATION: Value of question, 7. Mark received . . .

Check any of the following items where saving could be made by covering surfaces with insulation:
Exposed drums of boilers.....
Exposed shells of boilers.....
Steam piping in boiler room.....
Steam piping in engine rom.....
Feed-water heater .....
Exhaust-steam piping where fuel could be conserved by covering .....
Feed lines .....

(g) ENGINE-ROOM AND HEATING SYSTEMS: Value of question, 15. Mark received . . .

Question 1. Is exhaust steam used: Entirely..... partly.....not used?.....

Question 2. State service for which this steam is employed: Heating.....Cooking.....Dry room .....Tank heating .....
Low-pressure turbines .....
Other purposes.....

Question 3. Is there an excess of exhaust over requiremnts?

	Day	Night
Winter . .	.....	.....
Summer . .	.....	.....

Question 4. Is there any low-pressure live steam used in the plant?.....
At what pressure?...lb. gauge.
For what purpose?.....
Heating..... Cooking.....
Dry room.....Tank heating .....Other purposes.....

(h) SUPERVISION: Value of question, 10. Mark recived .....

Question 1. Has the owner detailed a competent employee to supervise the work of fuel conservation in the boiler and engine plants with directions to report weekly on measures for economy and progress in conservation of fuel?
Name and title of this employee
.....
.....
.....

Question 2. Has the owner appointed a man in charge of the work of fuel conservation outside of the boiler and engine rooms described under Recommendations?
Name and title of this employee
.....
.....
.....

What Canada Is Doing

When we turn to the means adopted in Canada towards effective conservation of fuel, we do not find evidence of a very strong effort having been made. In so far as the utilization of the inferior coals of the western fields are concerned, active steps have been taken to ascertain how they can be used in the best manner. Experiments have been carried out in burning lignite in gas producers, and also under steam boilers and good results have been achieved in both cases. The Canadian government has very recently appointed a board of prominent engineers to thoroughly investigate the properties of the lignite coal of the prairie provinces, but considerable experimental work had already been carried out by provincial governments. It has been demonstrated that lignite containing a high amount of moisture can be successfully handled by the use of a special design of furnace, which can be built at but slight expense. If these fields could be fully utilized, it would release not only higher grade coal, but a large amount of rolling stock, to the eastern part of Canada. However, in this direction at least, the government seems to be awake. It is in the direction of securing more efficient consumption of coal in steam power plants that the government appears to have exerted itself only half heartedly. No positive measures seem to have been adopted, the only tangible evidence of interest in the matter, having come indirectly by way of the Manufacturers' Association. This came about in the following way. The government invited the Manufacturers' Association to consider the question of fuel conservation, and in conjunction with representative engineers, to draw up a form to be distributed to all power plants in the country, which could be used as a guide to fuel conservation. The form here reproduced was drawn up by Mr. J. O. B. Latour chief engineer of the General Accident Assurance Co., of Toronto, and adopted for distribution. The advice contained in this circular is excellent, and if it was followed out conscientiously, would result in great savings, but there is the "if." These circulars were supposed to be hung up in the boiler rooms, and engine rooms of every power plant, and the advice therein contained carefully assimilated and acted on. Will anybody acquainted with the average fireman believe for one moment he will give that circular more than a passing glance. How many of those excellent circulars were hung up and carefully studied, and how many were looked at and then thrown in the furnace? The men who were most in need of the advice would be the ones to throw it in the fire. with the explanation that they "knew all that before." Many of them do know it, but don't act on it. That is not the way to get efficiency methods introduced into the boiler and engine rooms. It needs a definite spur such as the U. S. government has applied to get things moving in the right direction. This fuel conservation question is too big a thing to be handled by one or two men. It requires the services of trained men preferably experienced power house operators with a special knowledge of combustion problems, to visit the plants with the authority of the government behind them, to see that the best available means are being used and to instruct the staff where necessary along the proper lines. It is not a question of forcing manufacturers to put in expensive mechanical plants, but merely of bringing the existing apparatus up to its best condition.

Hydro Electric Power

There seems to be an inclination on the part of the Fuel Controller's office, to strongly recommend the use of electric power, wherever available, as a substitute for steam power. Now, there are many cases where small manufacturers can buy power cheaper than they can produce it with their own plant, and save coal, if power production takes the larger part of their consumption. In the majority of cases in eastern Canada, at least, the percentage of coal consumed for power production alone is a very small part of the total consumption. It is a safe thing to say that in plants that heat with exhaust steam, and use steam for process work, the consumption of coal for power purposes only, does not average more than 20% of the total. In this case the introduction of outside electrical power would affect an actual fuel saving of 20% in the summer months only, while in the winter the fuel consumption would be the same as before, while the electric company's charges would still be going on. Some of the smaller companies selling electric power have tried hard to get business by the fuel conservation lever, and it is to be hoped that the office of the Fuel Controller will not be used as an assistant to securing business for these companies, unless definite savings can be shown, without a prohibitive investment by the manufacturer.

Co-operation Between Factory and Power House

There are ways and means of cutting out waste in factory steam plant operation, outside of the points usually dwelt on. The subject of air leaks in boiler settings has been preached, and written on continuously for the last two years, as have flue gas analyses, clean fire and water surfaces, and steam pipe insulation. However, there are some smaller points which are productive of much waste, and do not seem to ever be mentioned in the various contributions to the subject.

A great many processes involve the use of hot water, frequently in open tanks, as the dipping tanks for nickel plating work, washing water, etc. It is a common thing to see the steam valves on these tanks set so as to keep the water in the tank violently boiling the whole day long, whether in use or not. This could be checked if anyone in the department took sufficient interest but very rarely they do. The fitting of thermostatic valves to control the supply of steam to these tanks, keeping them at the required temperature, would result in a considerable saving at small cost. When exhaust steam is available the water supply can be heated to say 200° before being sent to the tanks thus further cutting down the live

steam requirement. Small details such as keeping washers in hot water taps tight, do not look as though they would affect steam consumption a great deal, but all the hot water wasted has to be replaced with cold, and this cold water has to be re-heated. If all the hot water wasted in even a moderately sized factory were to be measured, the results would furnish a surprise. In drying work such as Japan baking, lumber drying and kindred processes, the initial heating could well be performed with exhaust steam, and live steam turned on only when the limit of temperature from exhaust had been reached. When exposed lumber drying kilns are operated in winter, it would frequently be practicable to use exhaust steam to keep the temperature high enough to prevent freezing while loading and discharging in winter, and to eliminate the surface moisture, making a further saving in live steam.

Factory Refuse

An operation which usually causes much hard feeling and incidentally, lowered efficiency, is the manner in which factory refuse is delivered to the boiler room for burning, and the manner it is burnt after it gets there. Factory refuse means a variety of things, depending on the product, and some of it has relatively good heating value, while others is just plain dirt. As a rule it is delivered to the boiler room just as it is collected, scraps of paper being mixed up with pieces of old boxes, sanding belts, old nails, pieces of leather belts. This makes an uninviting and awkward heap for the fireman to handle and he usually does it by means of a pitchfork to lift it up with, ramming it into the fire with his hands, feet and body. After introducing one pitchfork load, he leaves the fire door open while he collects another load, and shoves it in in the same manner. This goes on in the same way till the front of the fire is full, when he shoves it back as far as he can with his rake, and then goes ahead again. The furnace door is open for 15 or 20 minutes continuously and the state of the fire when he is finished is usually such that all that can be done is to pull it out. The pieces of hoop iron, nails, etc., in the refuse form a slag which effectually blocks the air passage through the coal bed, which in turn forms into a mass of hard clinker. Now, a little co-operation here would make it possible for incombustible rubbish to be separated out, and the remaining refuse delivered at a time when it could be burned to the best avantage. Generally speaking, it can be better burned at night, when the load is light. In any case, it should be burnt only on a fire that has been burnt down ready for what is meant as a saving. In plants where there are more boilers than required, it is worth while to fit one up with a Dutch oven, and reserve it only for refuse destruction. Another point the factory staff can help in is to see that aircocks on machines where air is used for blowing such as moulding machines in the foundry, are not left partly open when not required. All these may appear to be minor points, but collectively they mean a whole lot to any plant, and when they are multiplied by the total number of plants in the country, they form an item well worth considering.

Necessity of Making a Real Effort

Canada depends so largely on the United States for her coal supply, that it behoves her to make a strong and concerted effort to improve conditions. If power users in the States are to be allowed coal only in so far as they can show they are not wasting it, it can hardly be expected that they will cheerfully submit to coal being shipped to Canada to other inefficient users. Increased efficiency is largely a matter of effort, and if the consumers cannot make the effort, then it is up to a paternal government to do it for them, taking care to play no favorites, but being absolutely firm and impartial, and in this Canada might well follow the lead of her big neighbour.

FUEL SAVING "DON'TS"

by
J. O. B. Latour, Chief Engineer,
GENERAL ACCIDENT ASSURANCE CO. OF CANADA.

1. DON'T fill the furnace with the intention that there will be no necessity for any additional fuel for the next two to four hours. This is quite a common practice with heating boilers, and with bituminous fuel results in very great waste.
2. DON'T regulate the draft by closing the ash pit door, but regulate it with a damper in the smoke flue or pipe between the boiler and the chimney. This also applies to any kind of furance.
3. DON'T allow any cracks in the brick setting of the boilers, because cold air will enter through these cracks and absorb the heat that should have been transferred to the boiler.
4. DON'T permit the use of grates of any kind which are in bad condition. This will permit the unconsumed fuel to fall through to the ash pit and be shovelled out as ashes or waste.
5. DON'T use a grate that is larger than will permit the burning of at least 12 lbs. of coal per sq. ft. of grate per hour.
6. DON'T permit any pipes or boiler surface to remain uncovered, unless it is necessary to transmit the heat through the surface of that pipe to the room in which it is located.
7. DON'T permit any point in the boiler or any pipe connected thereto to leak.
8. DON'T permit any valve to leak which is located on a pipe supplied by the boiler. This is a very common source of loss. All valves should be positively tight when closed.
9. DON'T attempt to control the quantity of condensation to be collected from any pipe or other apparatus by hand control. There are a large quantity of good serviceable traps to collect these returns of condensation and they should be returned from these traps to the boiler.
10. DON'T permit any surface on the boiler exposed to the furnace heat to become covered with soot or ashes. The tubes should be cleaned at the very least daily.
11. DON'T use live steam for heating rooms, liquids, or other substance when there is exhaust steam from engines or pumps available. If the exhaust steam is not of sufficient temperature to heat the room, the liquids, or other substance to the required temperature, arrange your heating to be done in two stages; for instance, water could be heated to nearly 212 degrees by exhaust steam, then passed through to another vessel to be heated to the desired temperature with live steam.
12. DON'T feed a boiler with cold water when there is exhaust steam available to heat it. Every eleven degrees in temperature that feed water is raised by heating by exhaust steam there is a saving of 1 per cent. in fuel, and in winter time especially feed water is very seldom any warmer than 42 degrees. If this water is heated 212 degrees it will then effect a saving of 15 to 16 per cent.
13. DON'T allow the main steam valve on any engine or pump to leak. This is a very common fault, due to the fact that the leak is not seen.
14. DON'T allow the piston of any engine or pump to leak. This is also a very common defect permitted to go on day after day simply because the leak is not seen.
15. DON'T take it for granted that pipes that lead to sewers, blow-off tanks, or other places of discharge, are tight. If the pipe is warm between the stop valve and the source of discharge it will generally pay to investigate a little closer, because it generally is a sure sign of leakage, with great waste.

Courtesy of
CANADIAN MANUFACTURERS' ASSOCIATION
Toronto, Ont.

Power Plant Management; The Use of Instruments

Why it Pays to Keep Your Finger on the Pulse of Your Power Plant—Poorly Operated Plant a Direct Aid to Germany in View of Coal Shortage

By ROBERT JUNE

YOU wouldn't knowingly and willingly help Germany—would you? Of course you wouldn't—not in any apparent and direct manner. But what about indirect aid and comfort?

You don't want to give that any more than you do open assistance to the enemy's cause. Yet you are deliberately doing this very thing, when in view of the existing coal shortage, you fail to maintain the highest possible operating efficiency in your boiler room. The fact that the power you generate may go directly into the manufacture of supplies for our war machine, makes no difference. It is your patriotic obligation to conserve coal wherever practicable, in order that more war supplies may be made.

Now, how are you to know whether you are at all times maintaining the highest practicable operating efficiencies in your boilers? Well, how does your physician determine the operating efficiency of your body? Through the use of guaging and recording instruments, doesn't he? And just as the medical man needs his watch, thermometer, stethoscope, blood count apparatus, and blood pressure machine, so does the power plant operator need his clock, draft guage, Orsat, CO_2 recorder, steam flow meter, and flue gas temperature recorder.

How one Power Plant Operator Utilizes the Clock.

I have mentioned the clock first. It isn't the most important instrument, but it belongs in every boiler-room, and can be put to unsuspected uses. One power plant operator of my acquaintance has had a great deal of difficulty, due to general industrial conditions in his vicinity, in getting labor of any sort, experienced or inexperienced, for his boiler-room. He sometimes has had a complete labor turnover in two weeks. Green hands have not only not known how, they have not known when to fire, and they have resented the forman's constant admonition to fire up, or to withhold firing and give combustion a chance. As a result, firing has been exceedingly erratic, and boiler efficiency something to dream about.

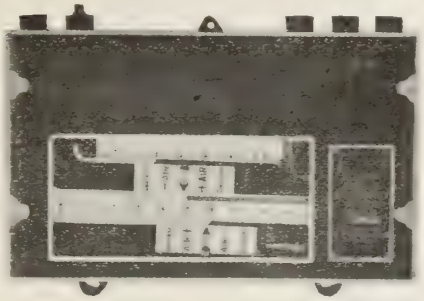
The irregular firing phase of the problem has been solved by connecting up the clock with an electric bell. Every five or six minutes the alarm sounds, and promptly on the dot, the fiire doors are opened in unison, the fires are sliced (if required) and a standard number of shovels of coal thrown in the furnaces.

This standardization of time of firing, has produced a marked increase in the efficiency of this plant. The boiler room foreman has noy only to devote his attention to condition of combustion. Contrary to expection, the firemen have taken kindly to the innovation. They receive a bonus for high CO_2 and have found their pay checks increased about 10 per cent. In addition they are actually shovelling less coal and have more frequent rest periods.

Changes in load involving the cutting out or in of boilers at stated times, should always be scheduled on a bulletin board, arranged with a clock in close proximity.

I make this statement with due consideration of all the factors entering into successful boiler operation. It enables the fireman to produce the largest amount of steam with the least amount of coal handling.

The draft required to effect a given rate of combustion depends upon the kind and condition of fuel, the thickness of fire, type of grade and efficiency of combustion, and can only be found accurately by experiment. For every kind of fuel and rate of combustion, there is a certain draft with which the best results are obtained. The curves in Fig. 1 give the furnace draft necessary to burn various kinds of coal at the indicated rate of combustion for average conditions. These curves allow a safe margin for economically burning coals of the characters noted. Specific figures for the various types of stokers may be obtained from the manufacturers.



THE BLONCK DIFFERENTIAL DRAFT GAGE OR EFFICIENCY METER

When combustion is progressing properly, the quantity of gases will be in direct proportion to the load. The boiler through which the gasses pass has a constant resistance (constant, that is, for the individual boiler—different sizes and makes of boilers have different resistances.) The function of the draft guage is to indicate the difference in pressure between the point or points with which it is connected and the atmosphere. A simple draft guage is connected to one point, a differential to two.

A draft gauge, connected to show the pressure drop through the fuel bed, in connection with one showing the drop through the boiler, will indicate any change in the fuel conditions. A relative increase in the fuel bed drop will indicate that the bed is becoming thicker, or that it is coming clogged with clinker, etc. If the pressure drop becomes less, it indicates that there are holes in the fire, or that the fuel bed is too thin.

There are a number of good draft guages on the market. One of the best is the Hays.

The Ellison consists of multiple differential guages, and a simple U-guage. This latter indicates the blast, while the upper inclined guage shows the furnace draft, and the lower inclined gauge the drop between the flue and furnace (boiler resistance.)

The Blonck efficiency meter consists of two differential guages, one indicating pressure drop through the fuel bed, the other through the boiler.

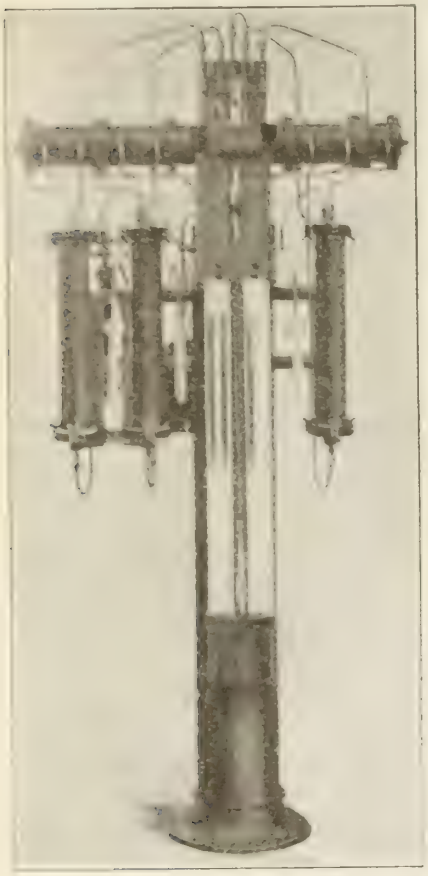
The Bailey boiler meter combines the differential guages of the efficiency meter, with a steam flow meter. The two draft guages, etc., are of the recording type, and are enclosed in the same case with the steam flow meter, recording on one circular chart. The pressure drop in the boiler gas passages is an indication of the quantity of air passing through the boiler, and the pen recording this pressure is set to record just ahead of the steam flow pen. When the two lines practically coincide, the air is in the proper proportion for the load on the boiler. A pen controlled by two different pressure meters of the inverted bucket type, attached to the arms of a balance, called the furnace indicator, records on the outer portion of the chart. The steam record is made as a percentage of the rated capacity of the boiler.

The pressure drop across the fire varies with the resistance of the fuel bed, and also with the rate of flow of air through the fuel bed. The furnace indicator compares the pressure drop across the boiler, eliminating effects due to the rate of flow of air, and thus obtains a net result which varies only with the resistance of the fuel bed. While this type of apparatus indicates what is going on in the furnace boiler, the operator must have sufficient intelligence and skill to be able to interpret its indications and adjust conditions.

In concluding this discussion of draft, and draft guages, I cannot do better than quote a statement once made by that master engineer of boiler-room operation, Joseph W. Hays: "Visit your boiler-

Editor's Note—This is the fourth in a series of articles by Mr. June on Power Plant problems. Succeeding articles deal with principles of heat absorption, mechanical stokers, influence of furnace design, coal and ash handling equipment, storage of coal, abuse of steam, etc. Later articles sum up the best current practice in the business management of the Power Plant. The series is timely and should prove of value to our readers.

room to-day and note how your firemen manage the drafts. If there are draft gauges on your boilers you will first be interested to note what a variety of drafts you have. You will also be interested to see whether the firemen are paying any attention to the guages. If they do not, it is the fault of somebody about the plant—not the firemen. It is a waste of time and money to equip your plant with anything that is not going to be used. Now watch the firemen.



THE UEHLING CONTINUOUS CO RECORDER

"The boiler dampers are wide open. The damper in the main breeching, if there is one, is wide open also. The firemen act upon the theory that draft is made to be used and that if some draft is a good thing, all of the draft that can be obtained must be better. They take the whole box of pills at one dose.

"The rule, when designing a power plant, is to provide for an excess of draft. Dampers are furnished in order that the draft may be under control. The better damper has the same relation to the furnace that the throttle bears to the steam engine. The firemen should set the dampers to give the draft that is called for—no more and no less. The dampers should never be wide open except under the most extreme conditions of use.

"You will notice, most likely, that the firemen use the ash-pit doors to check the draft when the steam approaches the popping point. They have discovered that this is a very effective way to quiet the enthusiasm of the boiler. They do not know that it is the wasteful and improper way. If there are draft gages on your furnaces you will observe that the vacuum is greatly increased when the ash-pit doors are closed. This multiplies the inflow of air at all of the cracks, crevices, holes and other openings about the boiler. The uptake temperature raises. Steam is being checked all right, but heat energy is being wasted.

"It is just as easy to close the boiler dampers as it is to close the ash-pit doors, provided the dampers are furnished with the proper means for exercising manual control. If they are not so furnished, somebody's foot slipped. The boiler damper controls should be so arranged that they may be worked, and worked easily from the fronts of the furnaces. The firemen should be compelled to use the dampers in preference to the ash-pit doors. The latter should be removed, if necessary, to get the firemen in the way of using the dampers."

The Why of Flue Gas Analysis

The products of combustion, resulting from complete oxidation of coal, with theoretical air supply, consist chiefly of nitrogen and carbon dioxide, with lesser amounts of water vapor and sulphur dioxide. With deficient air supply the flue gases are found to contain carbon monoxide and carying amounts of hydrocarbon. Excess air results in the presence of free oxygen in the gases. Evidently an analysis of the flue gases offers a basis for judging the efficiency of combustion.

The following are the things to be studied and adjusted:

1. The firing and handling of the fire.

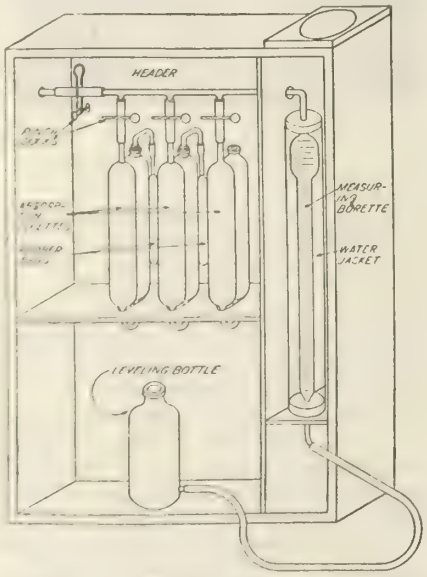
(a) Selection of proper firing method for the coal in use (cooking or spreading methods).

(b) The proper leveling of the fire to keep it free from air holes.

(c) The proper depth of fire.

2. The draft for the thickness of the fire and the load.

3. The setting, which should be free from cracks.



ORSAT APPARATUS FOR DETERMINING PER CENT. CO_2 IN INDIVIDUAL SAMPLE OF FLUE GAS

4. The secondary air supply, which must be provided to complete combustion.

If the gas analysis is to have any value, the sample on which it is based must be as nearly an average as it is possible to obtain. There is a diversity of opinion as to the best method of obtaining the sample. The Bureau of Mines recommends water cooled tube, or a quartz tube, as preferable to a metal

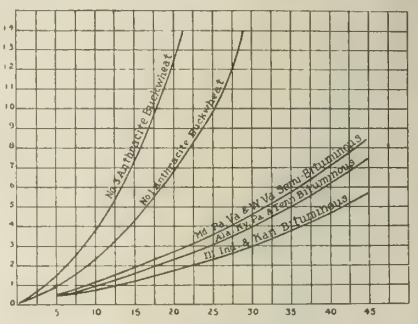

No 1 Anthracite Buckwheat
No 1 Anthracite Birdseye
Me Pa Va Ky W Va Semi-Bituminous
Pa Ky Va Kan Mo Bituminous
Ill Ind & Mont Bituminous

FIG. 1. DRAFT REQUIRED AT DIFFERENT COMBUSTION RATES FOR VARIOUS FUELS

tube. The A.S.M.E. test code recommend a plain perforated ¼-inch gas pipe. As between the two, the Bureau of Mines recommendation would seem preferable.

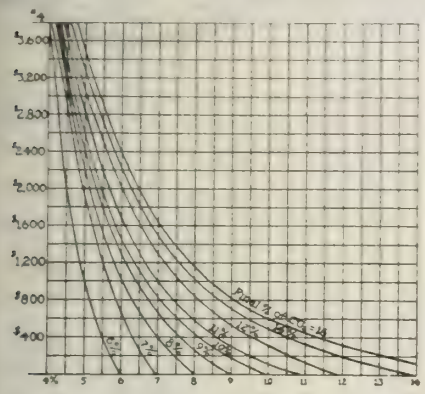
The use to be made of a gas analysis determines the location of the sampling tube. If the total heat losses are the desired data, the sample should include all air leakage into the setting. If this information is to be used in controlling the fire, the sample should be taken at some point before the gases are diluted by leakage through the setting.

Remember the boiler damper in placing the sampling tube so that the tube is not placed in a gas pocket. Particular attention must be paid to preventing air leakage around the sampling pipe, which might give a false indication of the composition of the gases. In a B. & W. boiler the sampling pipes can be thrust through the top blow-role at the last pass. In a Heine boiler the pipes can be run through one of the hollow stay bolts. In a return tubular boiler the top handle can be removed from the boiler doors. Place the tube six inches from the boiler head and above the top row of tubes. If it is put in too far it may come into a dead space. Be sure to get none of the air leakage around the doors. If air leaks in at the rear arch most of it will find its way through the upper arches.

The Orsat apparatus recommended by the Bureau of Mines for C O_2 determination is shown in Fig. It can be purchased either in the form shown or in a modified form from a number of reliable manufacturers. Full directions for its operation are given in the Bureau of Mines bulletins, or may be obtained from the manufacturers.

While hand indicators, such as the Orsat, can be used as a means of studying air supply conditions or for occasional tests, they do not answer the purposes of daily plant operatin, ince

the CO_2 content of the flue gases may, and does, vary widely, rapidly and continuously, due to the fact that the proportions of the air supply, which comes through the fire and in above the fire, are easily upset by throwing on of fresh coal, the burning through of thin spots, accumulations of clinker and ash, manipulation of dampers and fire-doors, etc. It can hardly be said that CO_2 re-



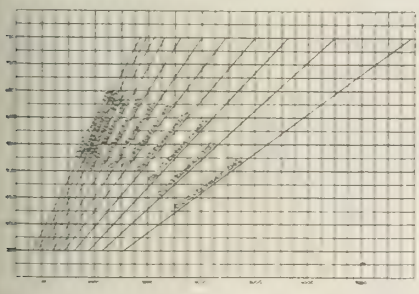
SAVING IN DOLLARS PER YEAR PER 100 H.P. BY INCREASING THE PER CENT. CO IN THE FLUE GASES.

corders act promptly enough to follow the variations in CO_2 from minute to minute, but they do, on the other hand, produce a chart showing an average, which serves as a warning to the fireman, who is careless or incompetent in his management of the fire and draft.

Remember that while high CO_2 indicates a small amount of excess air, it does not necessarily mean correspondingly good combustion.

Low CO_2 may be caused by excess air, insufficient air (high CO), or improper mixtures of the air and gases, but a surplus of air is the cause in almost every instance. The difference between the CO_2 percentages in the last and first passes indicates the air leakage in the setting.

CO_2 is affected by the character of the fuel. The more hydrogen in the



LOSS DUE TO HEAT CARRIED AWAY BY CHIMNEY GASES FOR VARYING PERCENTAGES OF CO

coal, the less CO_2 in the flue gases. If the fuel were all carbon there would be 21 per cent. CO_2 in the setting.

We must not attempt, however, to secure high CO_2 by cutting down the draft only. High CO_2 can be obtained with any draft in reason, either high or low, provided the draft and the fuel resistance are in proper relation. CO_2 percentage indicates the ratio of air used to the air that has not been used. It is sometimes feared that 8 or 10 per cent. CO_2 cannot be obtained without CO in considerable quantities. This is not in accordance with general experience. There is little danger from CO until 15 per cent. CO_2 is reached.

The percentage of CO_2 is the index of the amount of heat being wasted up the stack. It is little realized how large a return will result from a small increase of average per cent. of CO_2. The chart of Fig. shows, for instance, the dollars saved per 100 boiler h.p. operating 365 days per year, 24 hours per day, for various prices of coal, and corresponding to an increase in CO_2 from any original figure to any final figure. Suppose, for instance, that the original per cent. of CO_2 is 7 and that after equipment with CO_2 recorder, the average CO_2 is increased to only 8 per cent. Starting at the 7 per cent. mark of the horizontal line of this chart and rising to the 8 per cent. curve and then running over horizontally to the left, we find that with coal at $4.00, this increase of CO_2 means a yearly saving of $375.00. This, of course, is for 100 boiler h.p. operating continuously. If the load factor instead of being 100 per cent. were only 25 per cent. the saving would be one-quarter of $375.00 or $94.00 per 100 boiler h.p. and for a 500 boiler h.p. 5x94 equals $470.000.

The CO_2 indication answers most practical purposes. If greater certainty is desired after the CO_2 has been brought up to the desired per cent. the CO determination can be made. The formation of CO is due to:

1. Furnaces of poor design.
2. Improper methods of firing.
3. Character of fuel, particularly with reference to the equipment with which it is burned.
4. Improper mixing of combustible gases with the air.
5. Low furnace temperature, so that the gases are cooled below the ignition point.
6. Deficient air supply.

The formation of CO is usually due to insufficient air supply, which, as pointed out by the Bureau of Mines, may be either local or general. Either the local or general causes may be from the composition of the coal. The coal may be fusible, in which case the surface of the fuel forms one solid layer of semi-liquid fuel, which effectively stops the passage of air. At the same time, a large excess of air may be fed into the furnace elsewhere. The same local excess or insufficient air supply may be caused by the fusion of ash on the grates. The volatile matter may be driven off so rapidly after a fresh charge of coal that the average air supply is not sufficient, whereas a couple of minutes after firing it is too large.

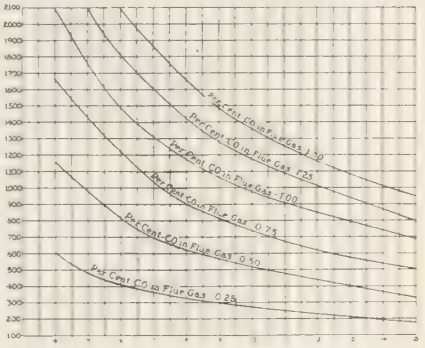
The occurrence of CO in the waste gases is a decided danger of signal, not so much on account of the loss which it represents, but because it is usually accompanied by unconsumed hydrogen and hydro-carbons.

Flue Gas Temperatures and Efficiency

Flue gas temperatures should be taken with a continuous instrument. They serve a number of useful purposes.

1. Call attention to leaks in boiler setting. In case air is allowed to leak into the flues, and mingle with the gases after they have left the heating surfaces, the temperatures may be brought down to almost any point above that of the atmosphere, but without any reduction in the amount of heat wasted.
2. Indicate condition of furnace and boiler, such as:
   (a) Dirty fire.
   (b) Holes in fire.
   (c) Presence of scale on water surfaces.
   (d) Presence of soot on fire surfaces.
   (e) Faulty condition of baffles.

Of the conditions just mentioned, unclean heating surfaces are most important, since they are most prevalent and constant. Many cases are on record where continuous soot removal, such as is obtained by the use of mechanical soot blowers, has affected a



LOSS DUE TO UNCONSUMED CARBON CONTAINED IN THE CO IN THE FLUE GASES

continued reduction in average flue gas temperatures of 80 degrees.

In conclusion, there is no more reason why you should ask or permit your boiler-room crew to work without the instruments we have discussed than to permit them to work without a pressure gauge. Instruments tell your men where they are at. Given knowledge and good intention they will soon improve operating conditions. At present the state insists upon the pressure gauge. The time is rapidly approaching when it will insist upon the other instruments. Forewarned is forearmed. Give your men the needed appliances.

A wise man is never less alone than when he is alone.—Swift.

A negative thought is a poison as deadly as arsenic.—H. L. Fogleman.

He who does not advance recedes.—Latin.

I have often wanted Fortune, but oftener Enterprise.—Montaigne.

When you begin to feel sorry for yourself, you have a right to be.—Logging.

Nothing is impossible to industry.—Periander of Corinth.

PRINCIPLES AND OPERATION OF MODERN ELECTRICAL EQUIPMENT VIII.

BY A. M. PERE.

IN last month's course an explanation of the operation of generators when changed to motors was given. This subject is interesting in itself and also serves to clearly show the various types of windings used and their relations to each other.

Fig. 1 shows an ordinary shunt wound generator of simple type. The armature is revolving in the direction shown and the simple armature coil has currents induced in it as shown in the small circles to the right and left of the commutator, that is it flowing away from the observer in the left hand conductor and towards him in the right hand conductor. This must be the case for the direction in which the armature is revolved as may be shown by referring to a previous section where currents induced by magnetism were discussed and the right and left hand rules for generators and motors given. A portion of the current generated will flow through the shunt windings and will energize the fields.

If now the shunt generator be supplied with current from an outside source and run as a motor the direction of current flow in the fields will be reversed while the direction of current flow in the armature will remain the same, supposing the current to be supplied in the same direction as that generated or as shown. This will change the polarity of the field magnets as shown but since current is being supplied and not generated the armature conductors will have a tendency move by reason of magnetic drag in an opposite direction to that in which they were driven when the machine was used as a generator. The resultant direction of rotation will therefore remain the same as before. Altering the direction in which the current is supplied will have no effect, as regards direction of rotation because the field current and armature currents will both change in direction and the rotation will be the same as before.

Series Generator and Motor

The only method of changing the direction of rotation of any direct current motor, is to transpose the field connections where they connect with the armature leads.

The series wound machine offers a different problem as will be seen from an inspection of the diagrams Figs. 3 and 4. The generator rotating as shown in Fig. 3 and with connections arranged as shown will generate current as shown by the arrows. The fields consisting of a few turns of heavy wire are energized by all the armature current.

If this machine be changed over into a motor and current supplied, the field current and the armature current will remain the same relative to one another, but the armature conductors will tend to move in a direction opposed to that of a generator under the same polarity. Since there is no change of polarity such as occurred in the shunt dynamo the motor will revolve in the opposite direction to a generator.

Here again the only way to reverse a motor is to transpose the field connections since by a little study of the

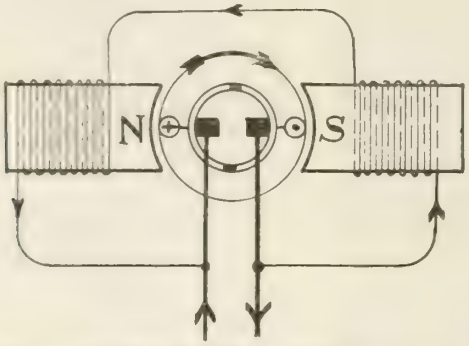


FIG. 1. DIAGRAM SHOWING CURRENT RELATIONS IN SHUNT WOUND DYNAMO

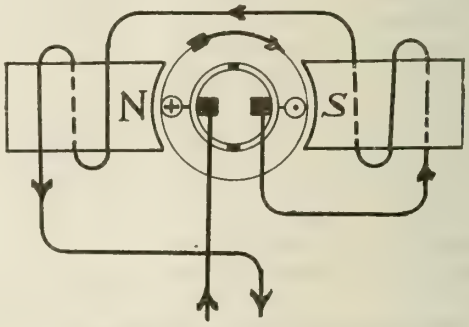


FIG. 2. DIAGRAM SHOWING CURRENT RELATIONS IN SERIES WOUND DYNAMO

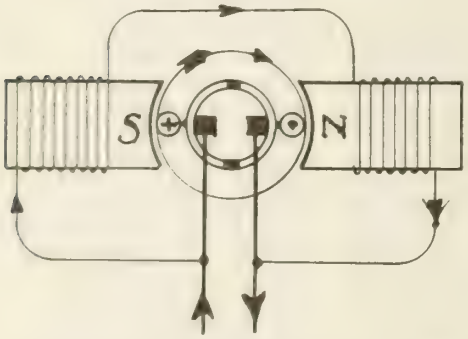


FIG. 3. THE SAME MACHINE AS THAT SHOWN IN FIG. 1, CHANGED OVER AND RUNNING AS A MOTOR. THE DIRRECTION OF ROTATION IS UNCHANGED FOR A SHUNT WOUND MACHINE

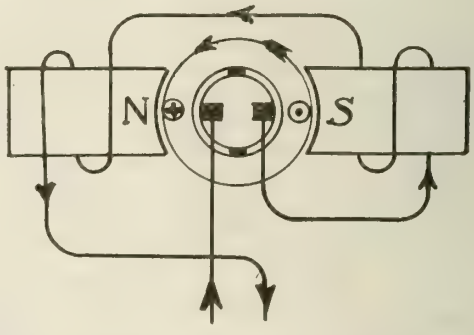


FIG. 4. THE SAME MACHINE AS THAT SHOWN IN FIG. 2 CHANGED OVER AND RUNNING AS A MOTOR. THE DIRECTION OF ROTATION IS REVERSED FOR A SERIES WOUND MACHINE

diagram, it is apparent that changing the direction of current flow into the motor will have no effect just as in the shunt motor.

It should be stated here that a series generator is never used except for very special conditions as series generator is shown mainly for descriptive purposes.

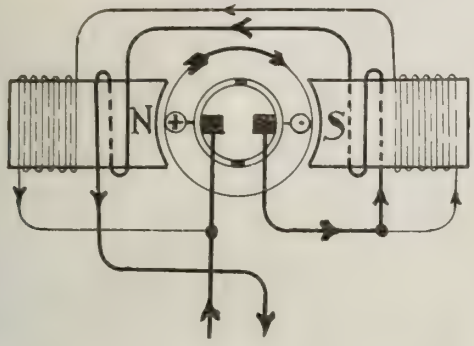


FIG. 5. DIAGRAM SHOWING CONNECTIONS FOR A CUMULATIVE WOUND COMPOUND ENERATOR. BOTH FIELD COILS ACT IN AREEMENT AND EACH SUPPLIES PART OF THE MAGNETISM NECESSARY

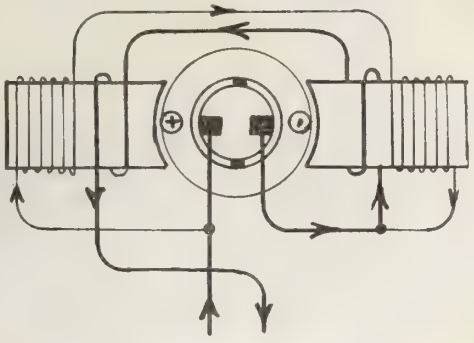


FIG. 6. THE CUMULATIVE WOUND GENERATOR OF FIG. 5 BECOMES A DIFFERENTIAL WOUND MOTOR WHOSE DIRECTION OF ROTATION DEPENDS ON THE RELATIVE STRENGTH OF THE TWO FIELDS

Compound Wound Machines

It was stated in last month's section that a differential compound wound generator will become a cumulative wound motor and vice-versa. As before stated the differential machine is one in which the magnetising effects of the shunt and series windings are opposed while the cumulative wound machine is one in which they assist each other.

Fig. 5 shows a cumulative wound generator, and from an inspection of the windings and their arrangement it is seen that the two field windings assist each other. When this machine is supplied with current and run as a motor it is seen that the current through the armature in Fig. 6 remains the same, the current through the series field coils remains the same but that through the shunt coils is reversed in direction and thus the magnetising effect of the shunt windings opposes that of the series windings. This effect remains the same even if the direction of current flow through the whole machine is changed the two sets of fields opposing one another. It is seen that the cumulative wound generator changes to a differential wound motor and by a similar process the differential wound generator changes to a cumulative wound motor.

To change a differential wound motor into a cumulative wound machine it is only necessary to change one set of field connections, either the series or shunt. To change the direction of rotation of a compound wound motor of either type both sets of field connections must be changed.

In a compound wound dynamo the shunt winding provides the initial excitation sufficient to generate full voltage at no load. The excitation due to the shunt winding is very nearly constant while the series windings supply an increasing amount of excitation as the load increases.

Compound motors are used where the load varies considerably, where the extreme speed variations of series motors would be objectionable, and where sudden increases in the load require increased torque that shunt motors could not give.

Answers to Last Month's Problems

1. Shunt, series and compound.
2. See last month's section and also this month's drawings.
3. No. Because the field excitation drops off with increasing load, and finally reaches a point where no voltage is generated or only that due to residual magnetism.
4. Yes.
5. No, it reverses its direction of rotation.

SYNTHETIC RUBBER

A very instructive communication on the difficulties with which Germany has to contend owing to the dearth of the most important raw materials for the war industries was made by Dr. Duisberg, one of the leading chemists of the Elberfeld Farbenfabriken, in the meeting of the Bunsen Gesellschaft, held at Berlin in April last. It will be remembered that in the years 1910 to 1912 Fritz Hoffmann, of that firm, had succeeded in preparing isoprene and dimethylbutadiene, hydrocarbons somewhat resembling benzene, which on long-continued boiling (for weeks or months, it is now admitted) turned into a substance which showed the chemical reactions and some of the properties of caoutchouc. This synthetic product was used as a rubber substitute or as addition to rubber, and the process seemed commercially possible in those days when rubber was in Germany 30 marks per kilogramme. When the price went down to 4 marks, the Leverkusen works of the firm gave the new process up. There was another process, tried and afterwards abandoned, in these works: reduction of acetone by means of aluminum to pinakone, which is closely related to methylbutadiene. The war once more forced attention on these processes. Meanwhile, however, aluminum and acetone had become equally rare and precious. As regards aluminum the manufacture of the metal was taken up in Germany, which has now three works. With respect to acetone, potatoes had been a raw material, but they could not be spared any longer. Bottinger found that with the aid of the bacillus macerans he could make acetone from putrid potatoes, the fermentation yielding a mixture of about two parts of alcohol and one part of acetone; but the bacillus proved very sensitive, and the process was not a success on a large scale. Calcium carbide was then utilised to a larger extent than before the war; it yields, with water, acetylene which in the presence of a contact substance (mercury salts) is converted into acetaldehyde; the aldehyde can be oxidised to acetic acid; blown over another contact substance the acid loses the elements of CO_2, turning into acetone. This process is worked at Leverkusen, at Hochst and at Burghausen on the Alz. The rubber manufacture was then resumed. The rubber industry was not favourably disposed to the new methyl caoutchouc, however, which was not real rubber, absorbed oxygen from the air, and gave trouble in the vulcanisers. This trouble was overcome by the aid of piperidin and other ingredients. The new hard rubber (ebonite) so improved was equal to the old product and dielectrically even stronger; the accumulator boxes of the U-boats are made of this ebonite. The soft rubber, however, was not perfect yet; at ordinary temperature it resembled leather more than rubber, and became elastic only when warm. The addition of dimethylaniline and of toluidine—both valuable products, it need not be pointed out—cured these defects. In the improved condition the rubber is used for making the tyres for heavy motor vehicles and also for artificial teeth. The Leverkusen works can now supply 2,000 tons of rubber per year, which is about one-eighth of the amount of rubber wanted. Meanwhile Merling has prepared isoprene from acetylene and acetone, and that process, though still in the experimental stage, is also regarded as promising. As to the outlook for these synthetic rubbers in normal times Dr. Duisberg was guarded.—"Engineering."

Description of Some of Europe's Water Powers

Water Powers of Europe of Considerable Value—Description of One of the Italian Plants Developing Power From Water Under High Head

By F. C. PERKINS

THE great utility of the Hydro-Electric power plants in Europe has been wonderfully demonstrated during this great war. The "white coal" is indispensable and those countries which have developed their water power resources appreciate their value as never before in the world. The accompanying illustrations, Figs. 1, 2, 3 and 4, show the Cedegola Hydro Electric Power Station and the reinforced concrete double roof and hydraulic installation, as constructed by Ingegnevi Fratelli Damioli, of Milan, Italy. The hydraulic turbines in this plant were installed by Escher Wyss & Cie of Zurich, Switzerland, as well as those of the Pataras Hyro Electric Plant noted in photograph Fig. 5 and the Kubelwerk Power Plant seen in Fig. 6. The hydraulic turbines of the Arniberg Hydro-Electric Power Station, the general design and details of construction which may be noted in drawings Figs. 7, 8 and 9, were built by Theodore Bell & Co., of Kriens-Lucerne, Switzerland.

The Pataras turbines shown in Fig. 5 operate under a head of 236 meters, utilizing 420 litres per second and developing 1,000 horsepower each, operating at a speed of 375 revolutions per minute. At the Kubelwerk the Escher, Wyss turbines seen in photograph Fig. 6 developed 1,200 horsepower each at a speed of 375 revolutions per minute, the hydraulic head varying from 82 to 92 meters.

It is of interest to note that the Arniberg Hydro-Electric Power Station was built at Arniberg, near Amsteg, on the St. Gothard Railway, ten miles or so above the upper end of the Lake of Lucerene, the head at this station being 2,800 feet. Besides supplying electrical energy to this district, which is thinly populated, and of a non-industrial character, the station serves as a feeder to Altdorf, seven miles further down the valley, and to Rathhausen, on the outskirts of Lucerne. To the former city the Arniberg Station supplies three-phase current at 48 periods and to the latter three-phase current of periods, by a thirty-mile transmission line.

The water power is obtained from two glacier-fed streams and from some springs. The water after being collected in an artificial lake situated 4,500 feet above sea level is led through two parallel pipe lines, each 6,850 feet long, and varying in internal diameter from about two feet to about 18 inches.

The two pipe lines are connected by a cast steel double bend securely anchored to a heavy concrete block and the end thrust on the bend amounts to something like 320 tons. Should repairs be found necessary either pipe line may be shut off without closing down the whole plant. Each pipe line is provided with a waste-water pipe which discharges into the tail race. These waste-water pipes, shown in the drawing on page 6, a plan and elevation of the power-house, are controlled by a sluice valve at the main pipe line and by a regulating valve at the tail race end. The latter valve is of the nozzle type and is used to relieve the sluice valve of excessive pressure when being closed. A section of the regulating valve is shown in Fig. 10.

The station was designed for four turbine units, three of 3,000 horsepower each and one of 1,300 horsepower. Each turbine is connected to the main pipe line nearest the wall of the powerhouse by a wrought iron branch pipe 12 inches in diameter in the case of the larger units and 8 inches in the case of the smaller unit. The tee-piece uniting the branch pipes with the main pipe is provided with a valve whereby each unit can separately be shut off from the source of power. They are provided with balancing pistons to relieve the pressure of 1,200 pounds per square inch under which they have to act and are controlled by spur gear and chain drive from the turbine room. To ensure

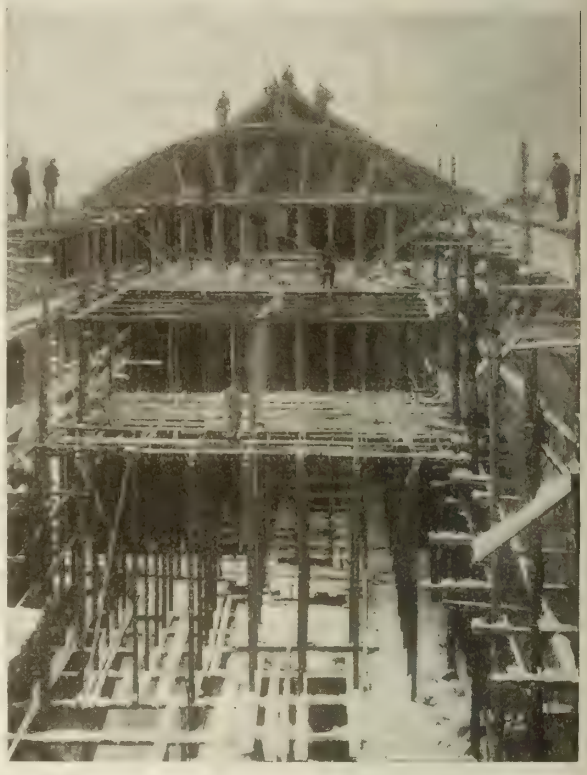


FIG. 2.—REINFORCED CONCRETE FORMWORK TO ROOF

FIG. 1.—THE CEDEGOLO POWER PLANT, MILAN, ITALY

FIG. 3—THE REINFORCED CONCRETE RESERVOIR OF THE CEDEGOLO POWER STATION

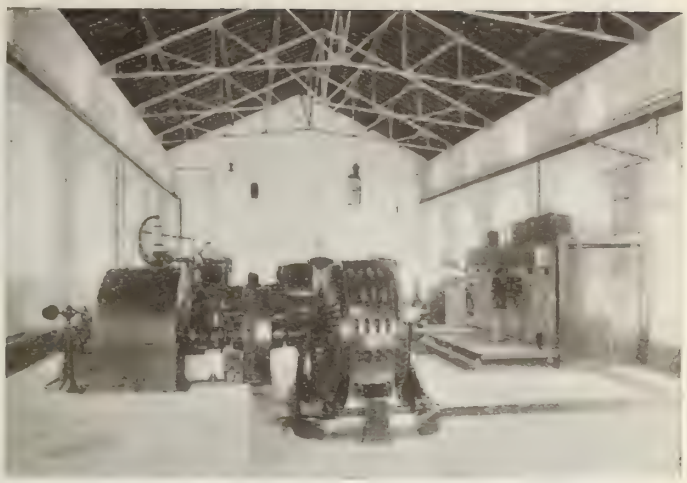


FIG. 5 PATARAS HYDRO-ELECTRIC PLANT.

an absolutely tight closing of these valves they are fitted with leather rings protected by bronze liners against the wearing action of the quickly moving water.

The turbines are of the Pelton wheel type. The smaller wheel has a mean diameter of about 5 feet 5 inches and is that employed in the 3,000 horsepower turbine. The larger Pelton wheel has a mean diameter of about 9 feet 6 inches and is used in the 1,300 horsepower unit.

The generator attached to the larger powered unit has an output of 2,080 kilovolt-amperes at 42 periods. In the case of the smaller powered unit there is a 1,000-kilovolt-ampere 42 period generator at one end and a 500-kilovolt-ampere 48-period generator at the other.

The 3,000 horsepower unit runs at 630 revolutions per minute, the other at 360. The load on the station is fairly even and is not liable to large and sudden changes. This fact and the installation of a particularly accurate regulating mechanism, to be described shortly, has enabled the turbine makers to dispense with fly-wheels in the design of the Pelton wheels. Such fly-wheels would in ordinary circumstances be more or less essential for good regulation with pipe lines more than one and a quarter miles in length.

In the case of the 3,000 horsepower unit it has thus been possible to fix the Pelton wheel direct to the end of the generator shaft, which for this reason is provided with an extra large bearing on the turbine side. At the Lontsch Power Station 6,800 horsepower units are in use. The advantages of it are said to be considerable. For example, not only is space saved but there are only two bearings to be kept in alignment instead of four.

In the case of the 3,000 horsepower unit a disc of forged steel carrying the buckets at its periphery is bolted to the flanged end of the generator shaft. The buckets are of a special steel and are highly polished over their concave faces.

FIG. 4—REINFORCED CONCRETE HYDRAULIC INSTALLATION OF THE CEDEGOLO POWER STATION

The housing of the Pelton wheel and its governor is bolted to the bed-plate of the generator. At its lower part it is arched and splayed out so that the water after discharge from the buckets may be guided in a gentle curve into the tail race. A short shaft coupled to the outer face of the wheel disc and carried in a bearing on the housing drives the pendulum governor through two pairs of bevels. The water is led to the wheel through a cast steel bend securely fixed to the foundations. The nozzle at the end of this bend is made detachable for renewal or repairs, and when full open gives a horizontal jet about 2⅜ inches in diameter.

The area of the nozzle is adjusted by a knob and needle in the usual way, the movement being effected by oil pressure under the control of the governor. As the head utilized is 2,800 feet and the pipe line is over one and a quarter miles in length, special attention has been devoted to the design of the governing arrangements. The governor to be effective must answer quickly and must keep the speed constant or very nearly so, even when the load changes suddenly and by a large amount. The contract condition on this matter was that the throwing off of the whole load, as would occur, for example, in the event of a short circuit, should not cause the speed to increase by more than 8 per cent. above the normal.

The main difficulties to be overcome were two in number as any sudden partial or complete closing of the nozzle would create an excess of pressure which would react on the regulating means with a tendency to increase the speed rather than diminish it. Again, the same sudden closing of the nozzle would lay the pipe lines open to the dangers arising from water hammer. The deflecting nozzle arrangement so frequently adopted whereby part or the whole of the jet is, on the occurrence of a sudden and great change of load, turned temporarily to one side of the wheel was not thought to be a good solution in the present instance.

It was pointed out that if no arrangements were made simultaneously to close the nozzle the method would be wasteful. Further, the mechanism required would

FIG. 6

soon become leaky and require frequent repairing. The impingement of the jet, at a wrong angle on the buckets, causes rapid wear to take place at their tips. The pressure regulator which automatically opens and by-passes some of the water as soon as the turbine speed increases was regarded as favorable, but was not considered farther, on the ground that under high pressures especially it is difficult to keep the device water-tight.

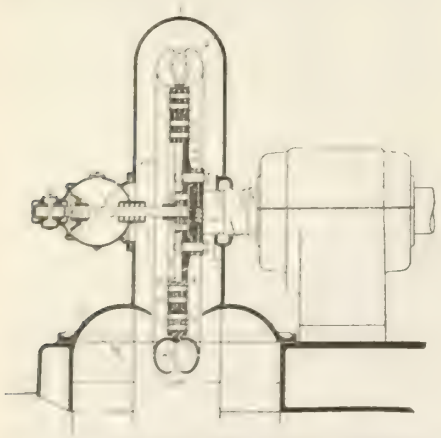


FIG. ARMBERG HYDRAULIC TURBINE. CROSS SECTION.

The arrangement adopted is illustrated in drawing Fig. 11. It consists of a double spring pendulum governor A B acting on two levers C D fulcrumed at E and F respectively. The fulcrum E is carried by a bar G joined at one end to an eccentric H and at the other to a vertical rod J. The fulcrum F is carried by the rod J. The lever D is connected to an oil brake or dashpot K which prevents it moving otherwise than slowly The levers C and D control the regulating valves L M respectively. The valve L operates the servo-motor N which servo-motor controls the position of a deflector P working in conjunction with a fixed bend Q down which water can pass to the tail race. The valve M operates the servo-motor R controlling the position of the needle valve S. When the turbine for any reason changes its speed slowly the levers C and D are moved by the governors in unison as the dashpot K under these circumstances exerts no restraint on the lever D.

The needle valve S and the deflector P are thus moved simultaneously, the proportion of the parts being such that the movement of the deflector always brings it finally into a position tangential to the jet. In other words, if the needle valve increase or decrease the area of the jet the deflector will move simultaneously into such a position that its upper tip is almost, but not quite, cutting into the lower surface of the jet. If, now, the speed of the turbine increases quickly, the levers C and D move in a different ratio, for the dashpot K prevents the lever D from moving other than slowly. The result is that the deflector P cuts into the jet and spills a portion of it down the pipe Q to the tail race.

The needle valve S is meanwhile slowly closing the orifice. When the size of jet proper to the reduced load has been established by the movement of the needle valve the necessity for spilling part of the water down the pipe Q is over, and the deflector P, through the agency of the rod T, the rod J, the lever G and the eccentric H, is once more brought tangential to the new size of the jet.

By this arrangement there was involved very little waste of water, the buckets

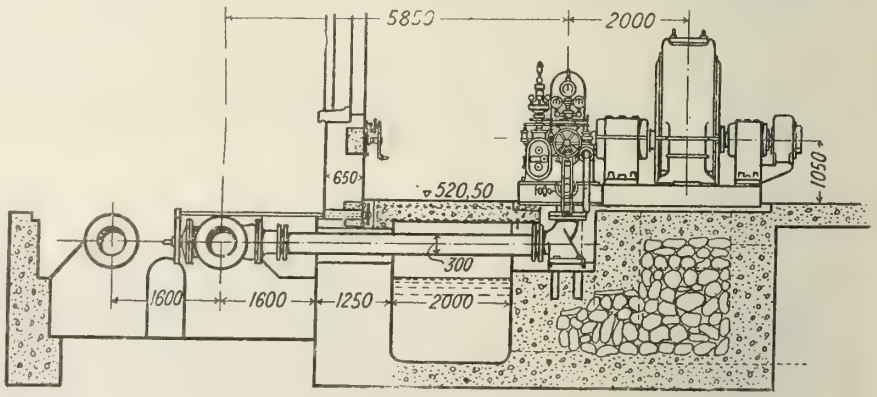


FIG. 8—ARMBERG HYDRO-ELECTRIC UNIT OF 13,000 H.P. CAPACITY

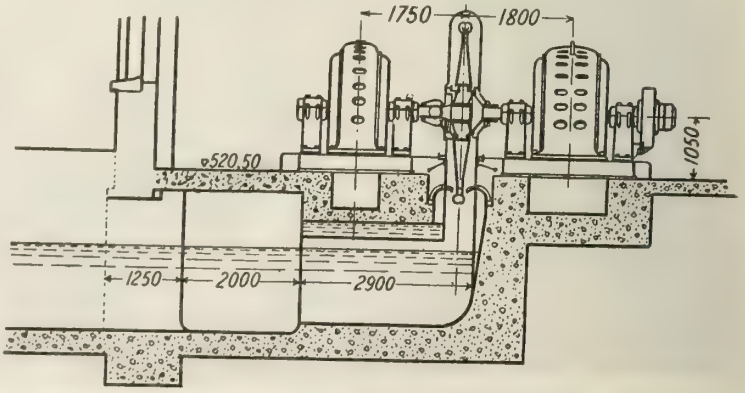


FIG. 9—3,000 H.P. UNIT OF ARMBERG HYDRO-ELECTRIC PLANT. DIMENSIONS ARE IN MILLIMETERS.

were not subjected to the action of a deflected jet, while the flow in the pipe line was reduced slowly by the action of the needle valve although the actual governing of the wheel is by the action of the deflector quite sharp. The pressure required for moving the pistons of the servomotors was obtained from a rotary oil pump driven off the same shaft as the governor.

The design of the 1,300 horsepower turbine was similar to that of the 3,000 horsepower unit. The boss of the Pelton wheel in this case was keyed [illegible] end of one generator shaft and on the other side carries a flange to which the shaft of the second generator was coupled. The turbines at Arniberg were designed at Kriens, Switzerland, where the 15,000 horse-power turbine was developed to work under a fall of 1,180 feet at the Lontsch Power Station. With the six 6,800 horsepower turbines installed at this station the capacity at Lontsch is now more than 55,000 horsepower.

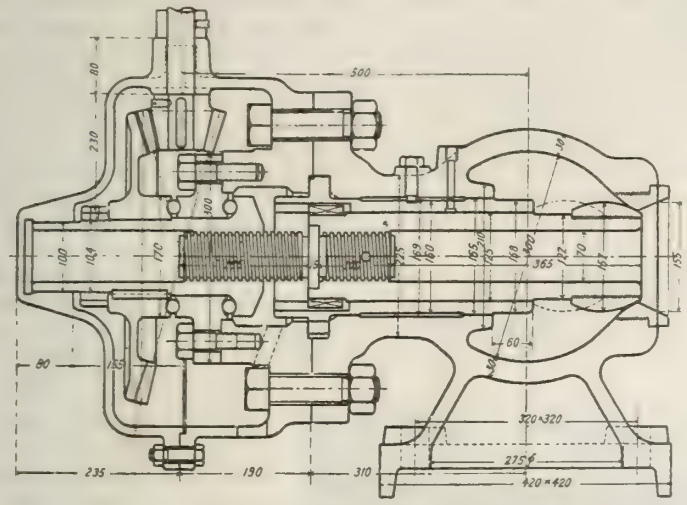


FIG. 10—REGULATING VALVE

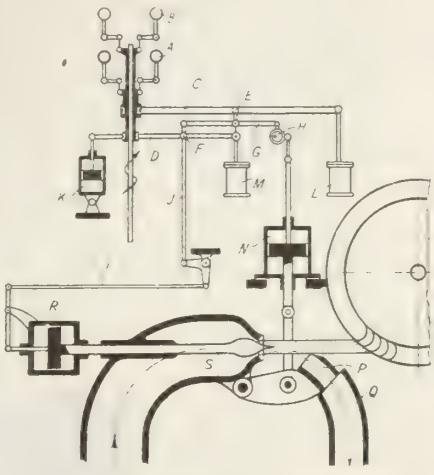


FIG. 11—DIAGRAM OF GOVERNING ENGINEER

SMOKE PREVENTION—COAL SAVING SUGGESTIONS

Just at this time when the conservation of coal is an absolute necessity and every practical suggestion for such conservation is a shot at our enemy, everyone realizes that smoke issuing from boiler stacks represents unused heat units, but everyone does not realize thot certain simple rules, if observed in the fire room, will materially decrease this loss. The suggestions herein are based on many years' experience of the Westinghouse Electric & Mfg. Company's combustion engineers and are briefly outlined below.

1. Give your fireman an opportunity to acquire the fundamental principles of fuel burning.

2. If you have a difficult fuel problem, consult a combustion engineer.

3. Prevent smoke by proper firing methods.

4. Use gauges to indicate exactly the condition of fire bed at all times. As a minimum these gauges shoulld consist of draft gauge indicating draft in furnace above fuel bed, draft gauge indicating draft at boiler side of flue damper and a steam flow meter for individual boilers.

5. CO_2 is the principle product of complete combustion of coal. Ten to twelve per cent CO_2 should be obtained in flue gases to insure minimum fuel loss.

6. Avoid loss due to unburned coal in the ash.

7. If you are wasting exhaust steam you are wasting coal.

8. Do not permit grates to clog. A systematic method of keeping the air spaces clean must be followed.

9. Inspect the baffles in boilers as broken or leaky baffles raise the flue gas temperature and waste coal.

10. Avoid leaking in of cold air around boiler setting.

11. Install stokers. Hand firing is rapidly being recognized as an absolute and wasteful method of firing.

12. Clean scale from tubes, as every particle of scale represents wasted coal

13. Avoid soot formation. All boiler tubes should be blown externally once every eight hours when in continuous service.

14. All smoke flues should be as short and straight as possible. Flues should also be made air tight and all joints and connections should be well fitted, caulked and riveted. Use asbestos gaskets on clean-out doors.

15. Locate flue dampers in front of boiler so that fireman will adjust them as required. Dampers located in rear of boilers are seldom disturbed regardless of conditions.

16. The size of coal has much to do with capacity and efficiency of boilers. In general, the air pressure penetrates the fuel bed formed by coarse coal easier than that formed by finer coal, resulting in disturbance of best furnace conditions.

In addition to the above suggestions the following "don't fail to do" list should be followed:

Don't fail to:—

Keep the heating surfaces of the boilers free from soot, scale or oil.

Keep the fires level and free from holes.

Do not carry the fires so thin as to draw a lot of excess air through.

Do not carry the fires so thick as to have incomplete combustion of the coal.

Do not soak the coal with water before firing.

Be sure the blow-off valves do not leak.

Do not have the safety valve popping off continually.

Cover steam pipes.

Do not waste steam through leaky valves or traps.

Never use live steam if exhaust steam is available and can be used as well.

An observance of the foregoing simple rules and suggestions should materially reduce the coal consumption of the average plant.

THE JITNEY CAR AND THE POWER PLANT

By N. G. Near.

Right now the jitney car is becoming very popular in the automobile field in spite of the fact that in some cities where used 50 per cent. of the owners fail to make them pay.

Why are 50 per cent. successful and 50 per cent. unsuccessful?

It is much like the power plant problems. Sink the question deep into your mind and think it out.

Does it not seem that the personal factor enters very largely in running a jitney car and a power plant? Business sense, judgment and mechanical ability are required to succeed where others fail. Hence the reports we read from time to time of isolated plant successes alongside of plants of the same size that prove to be uneconomical. The unbusinesslike engineer must give way to the central station or to the engineer who "understands" and who can "do things."

IN Japan, the government and the manufacturers are jointly spending $2,000,000 on an Institute for Physical and Chemical Research.

Why We Are Asked to Conserve Ammonia

Ammonia Being One of the Nitrogen Compounds, Plays a Very Essential Part in Modern Warfare, Even Though Its Connection is Not Apparent at First Sight

By W. F. SUTHERLAND, Associate Editor

THE engineer who has charge of a refrigerating plant knows all too well the trouble experienced in obtaining supplies of ammonia when required. This difficulty is explained when it is known that ammonia is obtained from many sources in direct competition with the production of nitric acid, so all important in the making of explosives, not only so but ammonia itself forms the basis of an extremely powerful explosive and also forms a starting point from which it is possible to form nitric acid.

The chemistry of the nitrogen compounds, to which the ammonia compounds belong, forms a very interesting chapter in the history of industrial chemistry.

A few years ago the only sources available for the production of nitric acid were the enormous deposits of nitrates in Chili and elsewhere and ammonia itself was obtained mainly from the destructive distillation of organic materials or as a by-product in the manufacture of illuminating gas and coke. Nitrogen as an element is more or less a chemically inert substance, but in the form of its many compounds is essential in the modern arts, of peace and war, and is of great importance to plant and animal life. The plant needs nitrogen compounds for its existence, the animal needs them also and obtains them through its plant food, either directly or through the other animals upon which it preys. A soil's fertility in large measure is directly proportional to the amount of fixed nitrogen present in it and when this is exhausted it is necessary to restore it by means of fertilizers either natural or artificial. Manure is valuable as a fertilizer, mainly through its large nitrogen content, mainly in the form of ammonia compounds. The Chili nitrate beds were formerly one of the largest sources of supply for Germany's artificial fertilizer requirements and since this source of supply has been cut off the results are seen in her greatly decreased food production.

THE UNITED STATES AS PART OF THEIR CAMPAIGN IN URGING THE CONSERVATION OF AMMONIA HAVE REPRODUCED THE POSTER SHOWN ABOVE. THE SIZE OF THE POSTER IS 22½ x 16½ INCHES., AND IT IS ATTRACTIVELY COLORED

Artificial Production of Nitrogen Compounds

The probable exhaustion of the world's supply of Chili saltpeter at no very distant date, estimated to be in 1940, brought attention to bear upon the possibility of the fixation of atmospheric nitrogen and several successful processes have been developed during the past few years for its accomplishment, all of them requiring much power for the carrying out of the particular process involved. The power necessary for this purpose is yet another reason for conservation of ammonia in every possible way.

The calcium cyanamide process is one of the most successful which has been developed commercially and the industry has reached an enormous size at Niagara Falls, where cheap power and other advantages are very favorable.

When a current of pure nitrogen is passed through calcium carbide at a proper temperature it is taken up and cyanamide results according to the formula,

$$Ca_2 + N_2 = CaCN_2 + C$$

or calcium carbide plus nitrogen gives calcium cyanamide and carbon.

This product was, before the war, used for fertilizing the soil, the nitrogen being given up as needed by the plants During the last few years, however, the farmer stands mighty little chance of obtaining plant food in this form, for by passing superheated steam through the cyanamide it has been found that ammonia is given off according to the formula,

$$CaCN_2 + 3H_2O = CaCO_3 + 2NH_3$$

or cyanamide plus steam gives calcium carbonate and ammonia. This ammonia in turn can be used if desired to make nitric acid and finally explosives.

Making Ammonia by the Haber Process

One of our ingenious enemies, a German, invented a process for the direct production of ammonia from nitrogen and hydrogen. It has long been known that these two gases when subject to the action of an electric spark produced ammonia, but Haber went one better and subjected them to intense heat and under high pressure in the presence of a catalyst. This resulted in the production of anhydrous ammonia.

Here one of the wily tricks of the devious Hun appeared, for fearing competition, or more likely realizing the value of many of his chemical processes to a country at war, the patent specifications covering them were made either vague or purposely misleading. This was discovered after the war started, and as expected, it cost the Allies large sums of money and considerable time to undo some of this trickery. All things have their compensations, and it's a poor rule that won't work both ways. Since the patents covering many important processes are incomplete and not being workable are invalid, anyone, therefore, is at liberty to go ahead and work many of them, and Germany is without patent protection after the war. This applies to many of the chemical processes in which Germany, before the war, had a monopoly.

Another method by which nitrogen is being won from the air is of considerable importance, but has to do with the making of nitric acid directly by means

of the intense heat of the electric arc. Several modifications of the process are in common use and it is probably by this means that Germany is obtaining most of the nitric acid needed for explosives.

Ammonia From Natural Sources

By far the largest quantity of ammonia obtained from natural sources is recovered from the waste liquors of gas works and by-product coke ovens. Coal always contains a small amount of hydrogen and nitrogen, and when distilled gives them off in combination as ammonia, which is caught in the wash water and afterwards recovered.

The distillation of animal products such as hair, hoofs, etc., is another source, while the destructive distillation of wood is a third.

Peat has received considerable attention of late owing to its possible fuel value, a consideration at present, needless to say, but it seems likely that better use may be made of some peat bogs by recovering the nitrogen which runs quite high. This is another source of ammonia and one which may prove to be quite valuable.

Modern Explosives

Nearly all the explosive compounds in actual use in the present war are nitrogen compounds and nearly all are obtained more or less directly from nitric acid. Nitroglycerine is a compound of nitric acid with glycerine; guncotton with cellulose or cotton; T.N.T., with toluol, a substance obtained from coal in the gas works or coke-oven plants. Picric acid or the English lydditte and the French melinite is formed of carbolic and nitric acids, and so it goes through the whole list of high explosives, each one of them consisting of some organic substance united with nitric acid in some particular way.

If it wasn't for the nitric acid and ammonia produced to-day the armies would have to fall back on gunpowder, almost a forgotten thing of the past. It is easily seen then that any careless waste of ammonia in the refrigerating plant means a direct loss of material, the replacement of which has a direct effect in the lengthening of the war.

The United States Fuel Administration as part of their duties have been emphasizing this fact and have brought the matter very forcibly to the attention of the plant engineers in the United States. In a message issued by them it is stated that:

During 1918, the Government should have for munitions alone 20,000,000 lb. of ammonia more than it is possible to make by working all the plants producing ammonia in the United States to their maximum capacity.

This shortage will be greatly increased by the ammonia that will be furnished ice-making and refrigerating plants, but it is hoped that by appealing to the patriotism and business sense of all ammonia users and urging them to stop all waste and leakage that the usual consumption may be curtailed to such an extent as will permit at least the most efficient plants to run; particularly where the natural ice is not available.

The returns lately received show that much ammonia loss is avoidable. Many plants use less than one-twentieth of a pound per ton of ice made; while others use from one-half to one pound per ton. The same inexcusable waste is found in many refrigerating plants. The only reason that can be given for permitting the enormous waste and expense to continue at some plants is that the management has not informed itself as to what is a reasonable consumption and the operating force is indifferent about leaks that might easily be stopped but are allowed to continue.

How to Save Ammonia

A saving of 25 per cent. in the ammonia consumption of ice and refrigerating plants would mean several million pounds annually for munitions. Each pound will make twenty hand grenades. Late returns show this saving can be accomplished if all will stop the leaks. To start an effective campaign to bring about this saving, the following urgent requests are being sent to all plants:

1. Before starting your plant (or if it is now operating) see to it that the ammonia system is tight. The slightest smell of ammonia indicates a leak which should be located and stopped at once.

2. Small leaks may be detected by burning sulphur in their presence.

3. Leaks in condensers or tanks may be traced by the use of phenolphthalein testing paper, which can be obtained from your ammonia dealer.

4. Test for leaks daily and be on the lookout for them constantly.

5. See that the pump or compressor rods are true and properly aligned, and that the stuffing-boxes are properly packed with good packing.

6. Stuffing-boxes are the source of heavy losses. When subjected to extreme changes in temperature they must be carefully adjusted and lubricated to prevent leakage or heating. Packings of proper design and material correct stuffing-box troubles.

7. Another source of leak is the pitting or roughening of infrequently used valve stems (particularly those that are exposed to moisture) tearing the packing when they are opened or closed. This can be prevented by smoothing up the valve stems and keeping the exposed part of the stem covered with a heavy grease.

8. Care should be taken in the manipulation of expansion valves so as not to force liquid ammonia to the compressor; it will start leaks and may cause accidents.

9. Do not pump a vacuum on ammonia system unless absolutely necessary, as a vacuum tends to draw air into the system. No vacuum is necessary when charging ammonia into the system. When it is found necessary to purge the system of air, or other noncondensible gases, shut off and cool down the condenser or absorber to be purged. Do not blow direct to the atmosphere when purging, but carry the purge line close to the bottom of a receptacle containing slowly running water. Purge slowly. Noncondensible gases are indicated by bubbles rising to the surface, while a crackling sound indicates the loss of ammonia.

10 Your own business interest demands that you get every employee interested in this campaign. There is no better way to get them interested than to offer them a share of what they save.

Give Employees a Bonus

The Food Administration urges you to give a bonus offer your favorable consideration and to put it promptly before your employees. The saving may be computed by finding the difference in fractions of a pound of ammonia used per ton of ice made in 1917 and 1918. This difference times the tons of ice made in 1918 gives the total saving of ammonia in pounds, and pounds saved multiplied by cost price of ammonia gives the saving in dollars and cents.

The employees' share should be agreed upon when the campaign starts. It may be any part of the entire saving, but for this campaign 50 per cent. is recommended.

Initial charges for plants started in 1917 or losses due to accident should not be considered as ammonia consumed.

All employees (engineers, oilers, and repairmen) who assist in keeping the system tight and saving the ammonia should share in the bonus.

11. Each plant shall report on the first of each month on forms to be later furnished by the United States Food Administration, as follows: (a) Amount of ammonia in the system when it is fully charged; (b) amount of ammonia put in during the past month; (c) amount that will probably be required for the present month; (d) ice made during the past month; (e) average daily refrigerating duty (in tons refrigeration) during past month (aside from ice making); (f) manufacturer furnishing ammonia; (g) if you have had excessive ammonia lost state cause; (h) state the amount of uncharged ammonia on hand. Have you adopted a bonus system?

What Are You Doing Towards It?

In view of what is being done in the United States is it too much to ask that those in authority here should take a more lively interest in the conservation of, well, everything from coal to ammonia? And in the meantime, Mr. Plant Owner and Operating Engineer, what are you doing towards the winning of the war in your own power plant?

Tight Boiler Settings An Aid to Economy

Author Cites Instances Coming Under His Own Observation and Discusses Practical Means For Securing Air-tightness

By J. E. McCORMACK

IN the immediate future when colder months are approaching, and the outside air which we use for draft absorbs more B. T. U. before reaching uptake temperature; the importance of having a minimum of air leakage through our boiler settings becomes of more moment. As it is only a few years since engineers began to properly appreciate the practical signficance of even small air leaks in boiler settings there may yet be some who do not fully realize their gravity.

I will cite two extreme instances which have come under my own observation. The first was that of a single boiler installed too late in the season and portions of the masonry became frozen before becoming properly dry. When the plant was put into operation, the masonry developed unseen air leaks owing to the action of its frozen portions and the outfit was extremely hard to fire during the winter months. Four fireman each in turn were put on the job and each in turn failed to hold steam satisfactory. As the weather became warmer during the spring months, the firing became more and more easy until in the following May when one of those same four fireman was back on the job he found it "dead easy" to hold steam then. There was apparently little reason for this change except that due to the difference in outdoor temperatures.

During the summer the masonry was torn down and rebuilt and later gave satisfactory results, both in summer and in winter.

In the other instance, I had, during October, been firing for a few days on a one boiler installation and everything went O.K. Later, I was away for some time, but during late November or early December returned to this same job. Being, as I thought, already familiar with the plant, I did not examine the upper part of the setting with any care. The work was light for the engine and so I carried a thin fuel bed and a light draft and got along fine, I thought, until one day some machinery requiring more power was thrown on and as I normally would have then required more draft, I increased it accordingly. Then my thin fuel bed failed me and I increased its thickness until it was as deep as I believed was practicable even with all the available draft on, yet it "kept me guessing" to hold steam and water where I wanted them.

I soon believed I had fire enough to "roast the bottom out of her" as popular expression has it, and after sizing up the load being carried by the engine I reasoned that a fuel bed such as I had then should carry the load even without heavy draft, so I unfastened the smoke box doors and let them hang loose. This reduceed the draft, but the steam did not drop. In fact I held the steam with no more exercise of judgment and with much less fuel than when full draft was on. This of course, indicated a bad aid leak somewhere. Had there been an CO_2 recorder attached I would probably have detected by it the presence of this leak perhaps sooner. When opportunity permitted I piled onfresh fuel purposely to make black smoke then stopped off the draft so as to let the said smoke pour out through the setting if it would. The sides of the setting emitted oo smoke, but on going on top I found lots of smoke.

At the back end of the boiler where the expansion and contraction tend to push the masonry away from the boiler, there had been an opening on which had been laid a piece of small steam pipe. This probably for a time had diminished the leakage at this point, but it had gradually worked down between the boiler and the setting and finally dropped through leaving behind it an opening as wide as the pipes external diameter. Conseqneutly when I had increased the draft I had increased the amount of cold air entering at this point and according as the fuel bed had become thicker the increased resistance to air passing through it greatly increased the proportion of cold air entering at the setting and resulting in the greater waste of fuel and difficulty in holding steam. Of course, I got the leak remedied before the next day's operation. These are extreme instances. The most extreme I have come across, but probably many have had experiences which to a certain extent paralleled the above.

In this connection, three points are worthy of note. (1) The temperature of the outside air has considerable influence on the amount of waste caused by a given size of air leak. (2) The thicker the fuel bed, the more resistance there is to air passing through it and since the resistance at the point of leakage is practically uniform the proportion of air passing through the setting becomes greater accordingly as the fuel bed becomes thicker, and (3) (What is more adoptable to practical use in everyday routine). The regulation of the draft by means of a damper in the stack or in the individual uptakes or—when it is a single boiler setting—by closing or slighly opening the smoke box doors, gives less leakage or air through the setting by reducing the pressure drop at the base of the uptake, whereas, regulating the draft by use of the ash pit doors does not reduce the said pressure drop there to the same extent, therefore, air still continues to filter through the setting at near the same old rate, while by this latter practice the grates are more exposed to overheating and consequent warping. For this reason I am pleased to say that to date my witnessing of stationary boiler furnace draft being regulated chiefly by use of ash pit doors has been confined almost entirely to firemen of limited boiler room experience. A boiler of the stationary type un-equipped with with any other possible method of draft regulation being a rarity and an exception.

In many small internally fired units, such as are used for portable or traction purposes, the ash pan damper is the most used and in some cases the only available means of draft control. In such outfits the air leak problem does not intrude itself, but I have been impressed by the conspicuous necessity for grate renewals in many of these outfits and am of the opinion that draft control by a damper in the stack and accompanied by avoidance of live coals in the ash pan would result in an appreciably prolonged life to the grates in these outfits. Where there was an exhaust nozzle in the stack I would like the damper placed below the nozzle, though I have seen one used above.

During past years the U. S. A. Government has carried out experiments and investigation regarding fuels, steam plant operation, producer gas plant operation, etc. Bulletins setting forth information thus gained have been published and made procurable from the Superintendent of Documents, Government Printing Office, Washington, D. C., and at a price so low as to surely cover little more than the cost of production together with postal rates for mailing them.

Bureau of Mines Bulletin 97, entitled "Sampling and Analyzing Flue Gasses," saye on page 40, "In the majority of instances leaky settings are the cause of a low percentage of CO_2 in the flue gases This cause is harder to remove than the holes in the fires. Even a well-cared-for boiler setting allows a considerable volume of air to leak in. In the average plant probably not less than thirty per cent. of the gases passing through the uptake leaks in through the setting.

Bureau of Mines Technical paper 80, entitled "Hand Firing Soft Coal Under Power-plant Boilers" says on page 63. "The amount of air that leaks into a boiler setting between the furnace and the uptake is seldom appreciated. Even in a well-cared-for setting the leakag amounts to 25 per cent. of the gases passing through the uptake. Therefore, to reduce the excess of air, the fires should be kept from holes and the seting free from cracks and other leaks."

On page 72 the same bulletin says: "The settings of all boilers should be kept air-tight. Too frequently no attention is given this feature. It is safe to say that on the overage fully one-third of the air found in the breeching entered the boiler setting through leaks, and in bad cases twice as much air may enter through leaks as through the regular openings.

Bulletin 97 describes experiments made with a furnace and long combustion chamber connected to the setting of a Heine boiler. The products of combustion passing from this chamber into the combustion chamber of the boiler, then up the stack serving the said boiler. The products of combustion were sampled just before they entered the boiler and again at its uptake. The bulletin describes in considerable detail the sampling devices used. All samples were collected simultaneously and the time of sampling was about twenty minutes. Eight sets of samples were taken. Two analysis tabulations are given, one is of the samples taken just before entering the boiler. The other is of the samples taken in the uptake. The bulletin on page 40 says: "The setting was seemingly in good condition; all the cracks as well as the joints between metal and brick wall were carefully packed with asbestos rope and the walls were painted with thick asphalt paint. In spite of all these precautionary measures considerable air entered the setting, as a comparison of the average values of the two tables shows. No serious objection can be made against the method of sampling the gases. Both sets of samples were collected simultaneously." With a view to ascertaining the percentage of air which really had leaked in through the setting I made calculations from the averages given in the respective tabulations, and, considering the condition of the setting as described, the result I obtained is agreeable with bulletin statements, that in general practice 25 per cent. to 33 per cent. of the air to be found in the uptake may have leaked in through the setting. Bureau of Mines Bulletin 23, entitled "Steaming Tests of Coals and Related Investigations," says on page 289: "The air entering the furnace through the small openings and cracks in the firing doors is useful, and is to a great exent necessary for the complete combustion of the gases and tar vapors leaving the fuel bed; in fact, air entering the furnace through any opening in the walls may be of some benefit for the combustion of the fuel, and therefore, need not be always regarded as harmful. But the air entering the boiler setting beyond the furnace where no combustion is taking place is always detrimental to good economy inasmuch as it lowers the temperature of the products of combustion, thus making less heat available for absorption by the boiler. All brick settings are more or less leaky, and, even if well cared for and the cracks constantly patched, there will be a considerable air leakage into the boiler setting.

At the fuel-testing plant at St. Louis, Mo., a man was constantly employed to patch up the leaks in the settings of the boilers, nevertheless, considerable leakage was shown by the analysis of the flue-gas samples collected at different places."

In one instance mentioned samples were collected—one set at the base of the stack, and another at the rear of the combustion chamber. The time of collection was thirty minutes and the samples were taken simultaneously. The object was to determine the leakage of air between the place where the gases leave the combustion chamber and the place where they leave the setting. The indications were that of the air supply shown by the gas composition at the base of the stack about 26 per cent. leaked in after the gases left the furnace. On page 290 the bulletin says: "This large air leakage makes it imperative that if the information obtained from the gas analyses is to be of any value in controlling the fire, the gas samples should be collected at some place before they are diluted by leakage. (Right here it might be well to note that as has been pointed out by Breckenridge, a high percentage of CO_2 is not necessarily an indication of high economy. When the air supply is reduced, the furnace temperature, CO_2, CO, and smoke are all increased after a certain capacity is reached. This may give a hint regarding difficulty of securing satisfying results when firing to secure a good CO_2 reading while the instrument is getting its samples from air diluted gases effected by leaks in the setting.) Referring again to the condition of the settings of the boilers in connection with which aforementioned experiments were conducted, I will quote from Bulletin 23, page 291, as follows: "All the walls were painted two or three times with thick barn paint and a man spent daily four or five hours in patching the cracks or otherwise reducing the infiltration of air, so that the leakage shown in the preceding discussion is perhaps smaller than that in the average steam plant."

I quote this by way of giving further emphasis to the advisability of giving frequent attention to the condition of the boiler settings, especially those portions to the rear of the bridge wall.

Concerning the method of draft control as effecting the air leak problem, I quote from technical paper 80, page 24, as follows: "Figure II. is intended to show air entering the furnace and setting in three streams, one through the ash pit door, another through the openings in the fire doors, and a third, which is found in most furnaces, through leaks in the furnace and setting. Only one way, the uptake, is provided for the gases leaving the setting. It is evident that when the damper in the uptake is partly closed the air entering in all three of the ways named is reduced in the same proportion and the total air supply per pound of coal consumed remains nearly constant. On the other hand, if the ash pit door is partly closed only the amount of air entering the furnace through the fuel bed is reduced, and the amount entering through the furnace door and the leaks is increased because of the higher draft in the furnace. For these reasons regulation of the draft with ash-pit doors is objectionable and should be avoided."

It is also obvious that where draft is secured by mechanically operated fans, a combustion of forced draft and of induced draft so proportioned as to give as nearly as possible a uniform air pressure on the two sides (inside and outside) of the setting walls at the rear of the bridge will greatly reduce the effect of air leaks here as compare with either induced or forced draft employed alone, though of course it is not every plant that could conveniently and profitably be so equipped.

DRY AND WET COAL

The effect upon the efficiency of a boiler when using wet and dry coal has not been definitely known, according to J. J. Light, instructor in mechanical engineering, in Bulletin No. 22 of the Engineering Experiment Station of the Pennsylvania State College. Among coal users, especially those operating house-heating boilers, there is a wide difference of opinion as to the relative merits of the practice of wetting the coal before firing. The object of a series of 10 tests tabulated was to show the efficiency of a house-heating plant when fired with coal that has been made wet, and with coal as usually found in cellars of residences, which can be considered as practically dry.

Since two series of tests were run under the same conditions except for moisture of the coal, it is possible to obtain information as to the benefits derived in house heating by firing either dry or wet coal. The conclusion is that the common inference that an addition of water to the coal as fired is beneficial to the operation of the furnace seems false.

The tests from which the results were obtained were in charge of an experienced fireman, who had very strong convictions, from his practical experience, that moistening the coal was a decided commercial advantage in the operation of boiler plants, which fact would in all probability produce an error in favor of wet coal provided any error was introduced.

The item, equivalent evaporation from and at 212 deg. Fahr. per pound of combustible, and the item, efficiency of the furnace, are two factors which would appear to decide the relative merits of the wet and dry coal. It developed throughout the tests that one pound of combustible evaporates more when the coal is fired dry or as is ordinarily found in cellars of residences than when it is purposely moistened. The efficiency of the furnace throughout the tests showed that wet coal tends to decrease rather than increase operating economy.

From a theoretical point of view the addition of water to the coal is a decided loss and would probably be equal to the heat required to evaporate the water added, from the room temperature into steam at a temperature corresponding to the flue gas under the pressure as maintained in the flue. It is the opinion of those who are believers in moistening the coal that the addition of water aids in the complete combustion of the volatile hydrocarbons. This fact probably cannot be disputed, but the tests showed that the gain due to complete combustion is less than the heat carried away by the water."

Interconnection Will Help Coal Situation

Shortage of Fuel—Necessity for Saving—Interconnection of Many Isolated Plants With Central Station Feasible and Would Result in Material Saving of Fuel

THIS is a subject which is foremost in the minds of most of the adult population of Canada, irrespective of sex, creed or profession, but to engineers especially it is one of vital (and I use the word advisedly) interest. During the past two winters Central Canada at least has suffered from a shortage of coal, and many and various have been the expedients adopted and suggested to relieve the inconvenience and in some cases actual suffering which the shortage has entailed. Now from all visible signs the coming winter will most likely see a further shortage of coal, and by this is meant that the coal will actually not be mined. Undoubtedly mine owners and operators and the railway companies will come in for their share in the wholesale condemnation, which is bound to come from an indignant public. But since the coal will not be forthcoming. Nothing remains to be done but to make the best of a bad job and get the most work (or heat) out of the amount that we do get. Hence the title of this article.

Now as the writer sees it conservation of coal does not just mean to be careful of the coal that is supplied to one's own plant, that is the individual view, but this question is one of national importance and should be viewed from a national viewpoint, so that the idea of conservation is not merely to conserve one's own coal, but also that of everyone else. Now this at first sight may seem ridiculous, but really it is not. If the engineer in one plant is careful of his own coal only, but allows oil or other supplies to be used, if not wastefully, in larger quantities than is absolutely necessary, he is causing the nation's coal to be used to make those supplies, which might have been saved by greater care.

So that conservation of coal means to an engineer using everything about the power plant to the utmost limit of efficiency.

Conservation of resources is at any time commendable, but under present industrial and national conditions it is a duty which devolves upon every one who claims to be at least patriotic.

Central Canada is entirely dependent upon the goodwill of the people of the United States for coal, and Eastern and Western Canada to a less extent. Now it cannot be expected that Canada will obtain more favored treatment than any one of the States of the Union, one does not feed strangers, or even friends, before one's family, so that if the U. S. is short of coal, Canada must of necessity be also.

Perhaps a word of explanation as to the wherefore of the coal shortage might not be out of place at this juncture.

The writer had the privilege of attending the N.A.S.E. national convention at Cincinnati last month, and at one of the meetings this question was very thoroughly ventilated and discussed. Every one present, including the writer, left the meeting impressed with a deeper sense of obligation to his employer, his country and the men who are fighting in his defence. One of the speakers, Mr. P. B. Noyes of the U. S. Fuel Administration said:—

"It is estimated that the needs of the war call for at least 100,000,000 tons more coal this year than in 1917 and 200,000,000 tons in excess of that provided in 1914, the year the war started. As figures, this does not sound difficult, but when considered that this must be produced with less man power and a railway system very little improved since the war started and taxed with inconceivably large demands from every war-making department, and when we picture this coal as being 4-5ths as much as was excavated during the sixteen years of the building of the Panama Canal, you will realize we have a problem out of range of any other.

"These war needs must be met with the most intensive work in three directions: First, the increase of production; second, through conservation; and third, by a distribution system which shall insure against "lost-motion" which shall fit our cloth exactly to our pattern.

"The Fuel Adminstration has been putting its most intensive work on increasing the production. This is evidenced by the fact that while every European country has decreased in production since the war began, the United States mined fifty million tons more coal during its first year of the war and will increase that by another fifty million tons this year.

"In almost every other line of activity the enterprise and energy of America is looked to make good, no matter what the figures. Coal alone is of too huge bulk to be increased to any extent quickly. You must remember that 52 per cent. of all railway cars loaded with coal, a tonnage equal to the great cotton crop of the United States, is moved every 1 1-3rd days; every eight days we are mining and transporting as great a weight of coal as the entire wheat crop of the United States. Our miners go deep into the earth and painfully bring up a tonnage of coal, and our railways transport it at an average of 300 miles every year, equivalent to 2¼ Panama Canals. We have fewer men in the coal mines than two years ago and will mine 100,000,000 more tons than then.

"The Conservation Bureau has organized, as you know, power, light and fuel conservation, going into every industry in the United States in addition to intensive work on domestic consumption. The figures coming in already are very encouraging. We have set a quota of 35 million tons to be saved in the boiler and power houses of industry and 15 million tons in the homes. If this can be accomplished the gap between our increased production and the much greater increase of demand will be filled.

Distribution is perhaps organized in the Fuel Adminstration more thoroughly than any other part of the work. Every week the distribution department lays on Mr. Garfield's desk a statement by districts, by states and as a nation, showing the amount of coal produced the week before in all of the 10,000 or more mines, also a statement of the amount consumed taken from the postal card reports with which you are familiar, and lastly, a statement of the amount of coal on hand, adding together the stock piles of every industry and every dealer in the country. With this information the streams of coal can be directed intelligently, can be shifted from time to time and made all the work permitted by the coal mined.

"But in the present crisis of the war with success depending upon steel, and steel depending upon coal, no ingenuity, rules or efficient adminstration will save us without practically 100 per cent. cooperation from the people of the country.

"We sometimes complain that the business men give us only a part of the cooperation we should have, that their attention is still divided by personal interests. I have found, however, in a year's association with the business interests that it is only necessary that men like yourselves should know what we know in Washington—should see the meaning of a shortage of coal as I see it every day in my connection with the War Industries Board—to get a cooperation which will ask only that it be told what sacrifice will really help.

"On March 21 Germany taught the world a new military science—that an overpowering weight of munitions and shells, guns, tanks, airplanes, etc., will bring success with a minimum of casualities. Germany got together a supply of all these munitions beyond anything the world had ever seen before. The Allies have profited by this experience. Guns, shells and everything else contributing to the saving of lives are being forwarded to France in unbeleivable quantities. The programme is founded on demonstrated fact that if you have shells to waste lives can be saved. From now on it is munitions against casualities.

"If you keep this in mind you will

have the background for the sternly drastic attitude of the Government during the next six months in clearing the way for filling Pershing's orders.

"Gentlemen, we are facing a catastrophe. It is not one of those catastrophes which makes such a noise that everyone knows when it happens. It is a silent tragedy. We cannot fill Pershing's orders in full because the United States cannot make sufficient steel this winter. Keep in mind and then look forward to the events of the coming spring. We shall have the drive. We shall succeed in it, but sometime in February or March, or whenever the time has come, Gen. Pershing will sit down with a pencil in hand, will figure up the exact deficit in the filling of his order for munitions. With military formulas now well recognized he will figure in place of those munitions how many extra men must be put into the battle to be killed. This is no fanciful statement. It is now possible to treat, in any aggressive movement, the question of munitions or of casualties as interchangeable quantities. So many thousand American youths must be thrown into the hopper for every thousand tons of munitions which are short.

With this background I know that discussion with any men present of wastage of coal or of coal to be used for any industrial or economic consideration would be very one-sided. You will go just as far as any of us in Washington in urging that no consideration be given to any economic compromise with the coal supply which balances civil prosperity against men's lives.

This statement of the case sounds tragic, but the worst of it is that it is terribly true, so true that I feel confident if every American business could see the actual facts as they come to us in Washington, there would be no need of regulations or rules, only directions. No man here would spare himself either labor to save the last pound of waste or the sacrifice involved in devoting the fuel and material he needs most in helping to complete the Pershing programme.

This will explain why a coal shortage is inevitable, and why coal conservation is a thing of national importance. What is true of the U. S. military program will fit Canada also.

The call for conservation may also be interpreted as a call for greater co-operation. This is no time for any class of people, be they representing capital or labor, to adopt any attitude or policy which will tend to reduce or slow up production in any shape or form. This country in common with all the Allied countries has one task ahead of it, "To win this war." To do this the men who have gone "over there" have done and are doing their share, so that it remains for those who are "over here" to see to it that they "carry on" and do their utmost to support those at the front. It must never be said that those who stayed behind failed in their duty to those who went overseas.

Those who are "over there" are in duty bound to co-operate, from general to buck private, and co-operation in conservation is the duty of every man and woman remaining here.

Conservation of fuel then is not a task for the engineer only but for everyone who has any interest whatever in this greatest of all world struggles. There is nothing that is required by the soldier but what is dependent upon fuel for its production and transportation. The Canadian and U. S. Governments have recently asked for gasless Sundays, and generally speaking their requests have been complied with. One reason, in the writer's opinion for this general compliance, is that the public has been told why. It is also the writer's opinion that if the public be told why all fuel should be conserved, irrespective of its kind, price or scarcity the public will heartily co-operate with the conservation boards.

Quoting from the general plans of the U. S. Fuel Administration, the writer notes the following ideas:

1. Elimination of uneconomical isolated plants.
2. The application of the skip-stop to railways and the regulation of car heating and lighting.
3. Economy in utilization of power and light in factories.
4. Utilization of excess water power and interconnection of power systems.
5. Limiting the production of power to the most efficient plants available.
6. Economy in the refrigerating and ice manufacturing industry.

Taking the first idea—to eliminate uneconomical isolated plants. This seems a drastic measure at first sight, but bearing in mind the great need for conservation, it will bear close examination. The Fuel Administration state that it is not their intention to impose any hardship upon the public, but that in many cases power can be supplied from the central station at a less expenditure of fuel than is the case with the isolated plant. This may or may not be so.

If there is a great demand for exhaust steam (or low pressure live steam) for either heating or process work, just the reverse to the above paragraph may be the case. If all the exhaust steam from the engines is utilized, central station power would not save the nation's coal, but to the contrary, more coal would be needed.

If the first and fourth ideas are combined coal might very readily be saved. There are many plants, electrically operated from an isolated power plant, which have use for all the exhaust steam (in Winter) for heating and in fact in many cases the exhaust steam is insufficient and large quantities of live steam are required to supply the heating demands. Many of these plants could be shut down to advantage in the summer and their machinery operated by central station current, with a material saving to the owner (by getting a low summer rate for power), to the power company (by having customers for power when the lighting load is light) and to the nation by saving coal, and the last is the most important at any rate, at present.

But in winter conditions are different. The central station has all the load that it desires, and very often more. The manufacturing plant is needing steam for heating, more than the engines are using. So that if the isolated plant could be connected to the central station lines, in many cases it could furnish power to the central station at a lower fuel cost (to the nation) than the central station itself can.

To take a definite example, the writer knows of four isolated plants within a quarter of a mile, which could amongst the four, in cold weather, supply 1,000 horsepower 24 hours per day and not notice the increased fuel consumption (if there were such). These four plants close down their generating plants for six months a year and run on central station current, to the satisfaction of both central station and plant owners.

One of the four has a live steam load of about 100 h.p., in cold weather a heating load of about 400 h.p. and an electric load of about 60 h.p. and has a generating plant of 250 h.p. It can readily be seen that this plant could furnish anything from 50 to 200 h.p. in cold weather without increasing its fuel bill, and this would save coal equivalent to that amount of power at the central station.

The question of profit or loss is only a secondary consideration to the fuel conservation board.

The Hydro-Electric System of Toronto is at present heavily overloaded, so much so that street lighting is reduced to a minimum and on dull days (and sometimes on other days) it has been found necessary to cut out some of the load in order that munition plants may have sufficient power. The Toronto Electric Light Co. is operating its steam plant up to 16,000 K.W. on the order of the Fuel Controller, and the writer was informed on good authority that this current is entirely for munition work. If all this power is necessary and we are compelled to believe that it is, surely a scheme that will release more power without increasing the fuel bill, is worthy of consideration, especially one which can be made to benefit all its participants.

There is another method by which coal can be saved and that is by paying more attention to electric lighting. Give ample light where it is needed, but turn out the lights where they are not needed.

There is another method of eliminating the uneconomical isolated plant, and that is to make it economical.

One of the slogans of the U. S. Fuel Administration is "Save the shovelful, the tons will look after themselves."

By close attention to details in the plant it may be changed from uneconomical to economical. But one thing which is fairly general should be changed before efficiency can be general, and that is the attitude of the average owner towards his power plant and its engineer. Many manufacturers look upon the power plant

and engineer as necessary evils, and treat them accordingly, instead of realizing that the power plant is one of the biggest factors towards successful business or otherwise according to the way it is operated. The man who buys the coal and the man who burns it need to get in closer touch, and both need to feel that they have an interest in the efficient operation of the power plant. In a good many cases if the wheels continue to turn when required to, it is considered quite sufficient; but the scarcity of coal with its accompanying increase of price will most likely cause some change in this attitude.

It is generally conceded that 90 per cent. of the savings to be effected in a power plant are to be made in the boiler room. That is most of the savings are to be made in the generation of steam even though there may be considerable saving effected in the use of steam.

One of the largest single causes of loss in boiler plants is in filtration of air through the brickwork of the boilers. This loss goes on hour after hour, unseen but nevertheless present. To prevent this the brickwork should be gone over with a lighted candle or other open flame and any cracks made up; this done the whole brickwork should be coated with some preparation to prevent air leaks. There are many preparations on the market.

Leaky blow-off valves, and other valves, all add the loss of efficiency. Poor grates —and this is one of the things that until recently the average owner seemed to think an extravagance—is another. So is bare pipe

The U. S. Fuel Administration has engaged a State Fuel Engineer in each State to travel from plant to plant, at the invitation of the owner, to help to increase the efficiency of the plants. I heard one of these engineers address the convention at Cincinnati, and he told us that in many cases the owner scarcely knew the way to the boiler room.. The engineer's criticisms are constructive; often he tells the engineer or firemen how to get better results, and often he tells the owner things that the plant engineer has been telling the owner, but could get no attention paid to. The idea works out well for all parties concerned. The plant owner or manager gets better acquainted with the man in overalls who keeps the wheels turning and quite often they find that they have interests in common which they did not know before. The writer remembers having occasion to use the boiler inspector in a similar manner, that is to recommend the purchase of different pieces of apparatus which the owner thought unnecessary but which afterwards proved to be good investments.

To help out during this present coal and industrial crisis the C. A. S. E. has offered the services of its members to the Canadian Manufacturers' Association to help solve any power plant problems they may have, provided that their own plants are not neglected. In this connection it is the writer's opinion that a travelling advisory engineer employed by the C.M.A. would be another method of helping to save the coal pile. The railway companies employ superintendents of power plants for the same reason, and presumably it is a paying venture or it would not be continued. It is human nature to do one's work a little better, if one knows that the work will come under inspection.

In the beginning of this article it was stated that fuel conservation was the duty of every patriotic man and woman.

The engineer may do all that science can teach, to utilize the fuel to best advantage, and with the highest efficiency but, if the products of the fuel are not used efficiently then the engineer's efforts go for naught. For example in heating, say public buildings, the usual temperature required has been 70° F, 68° F at the lowest. Quite often the writer has seen temperatures above this figure, and no attempt made by the occupants of the rooms to regulate the temperature, or if any attempt were made it would be by opening windows wide, and still leaving full steam on the radiators. Further, rooms unoccupied for hours daily, that is bedrooms, left with steam full on the radiators, window and transom wide open, and a strong wind blowing in winter, under the plea of ventilating the rooms. Leaving windows open is bad enough, but to have window and transom open and having a strong current of air blowing clear through the building is infinitely worse, and under present conditions nothing short of criminal.

So here is one way in which everyone can conserve coal; have the temperature of the rooms kept at 55° and get accustomed to it. Wear heavier clothing and get the air moister as it has been proved repeatedly that moist air gives a feeling of greater warmth, besides being healthier.

The Fuel Conservation Board recommends amongst other things having fewer stops in the street car service. Anyone who has investigated the subject, or made any tests on the starting and running currents of motors will readily see a method of saving considerable power by this method. For example, the writer in making tests on some motors found that one 10 h.p. elevator motor took nearly 30 h.p. to start, and only 3 h.p. when at full speed, and in street railway work the results are similar so that reducing the number of stops will result in saving fuel.

In public buildings and office buildings there is generally a waste of water both cold and hot, unless self-closing faucets are used and even these are not always satisfactory. Right here is another chance to economize, make sure the water is shut off properly. Water takes coal, both to pump and to heat it.

The U. S. Fuel Administration proposes to carry out its conservation plans, through the co-operation of the following:

1. A force of engineers organized and stationed with the Fuel Administration at Washington.

2. The Engineering Department of the U. S. Geological Survey.

3. The Power Division of the Council of National Defence.

4. A State Fuel Engineer attached to the office of the State Fuel Administration, to supervise the activities of his State.

5. The Public Service Commissioner and State Regulatory Bodies.

6. The Chambers of Commerce and similar representative business bodies.

7. Volunteer engineers located throughout the country.

The writer's opinion of the fuel question as formed by the lectures attended at the N. A. S. E. Convention were: That the question of fuel production and conservation is a vital one and one that every man and woman in the country is or should be interested in, and secondly that the leaders of the U. S. people realized its magnitude and seriousness and were bending every effort to cope with it, and also that the leaders realized that without the co-operation of all the engineers and firemen, the work of the Administration would go for naught. Also that the desired co-operation would not be wanting if the feeling of the above meeting were to be taken as a criterion.

If the U. S. can get co-operation between its Fuel Controller and fuel consumers, why cannot Canada? If Canada has a Fuel Administration it is nearly time that it got very busy.

BENDING CAST IRON PIPES

By M. E.

A successful bending of large straight cast iron pipes was recently effected in making the line of cast iron pipe which it had been decided to lay to convey water from the Guayabo River to the town of Present, Cuba. By mistake no sleeves or curves had been ordered. The canyon through which the pipe passes for a distance of about two miles from the dam is crooked, making impossible such easy curves as would be made in the pipe joints. As it might have taken several months to secure additional special pipes, the local engineer decided to bend some of the straight cast iron pipes. The Cuban workers had frequently bent steel or wrought iron pipes at their sugar mills, and they followed the same course of procedure with the cast pipes, with entire success, as they did not break or spoil a single pipe. The pipes were bent to various radii, the shortest being 50 feet. A cradle of old rails was first constructed with the desired amount of curvature, and a fire of hardwood was built under and around the pipes. Six or eight pipes were bent at a time. In one and a half or two hours after starting the fires, the pipes were hot enough to bend and settle under their own weight on to the cradle prepared for them. The pipes were 10 in. in diameter with 9-16 in. thickness of shell, their weight being about 760 lb per 12 feet length.

The United States Fuel Administration announces that manufacturers of incandescent electric light bulbs, by agreeing to limit the production of lights having carbon filaments and substituting them with the more efficient metallic filament types, have made possible a saving of one million tons of coal annually.

KEEPING BOILER TUBES FREE FROM SOOT

By W. Saller

SINCE the tubes of a boiler are the medium through which the heat units generated at the expense of burning fuel are delivered to the water, and converted into steam, it would seem logical and desirable to have these tubes and heating surfaces render as little opposition to the passage of the heat as possible, i.e., they should be kept clean and free of accumulation. The greater resistance offered to the heat transfer the greater the amount of fuel required to produce the desired results.

The ideal state of affairs is to have both sides of these tubes or heating surfaces perfectly clean. The uneconomical and expensive condition is to have these surfaces coated with unnecessary and undesirable barriers to the heat transfer—the collection of soot and fine ashes on one side, and mud and scale on the other side—the former deposited from the smoke and other products of combustion passing to the stack, the latter deposited from the feed water due to evaporation of the steam.

When it is considered that the dense accumulation of soot or scale constitutes one of the most effective insulating materials known, some idea can be had of the hinderance they present to the passage of heat. The mud and scale on the tubes comes from the feed water entirely, and therefore a remedy against this trouble must be secured by so treating the feed water that the scale forming substances are driven off before being fed to the boiler, as by chemical treatment, or by means of blowing down, skimming devices, etc.,

The loss of efficiency due to the collection of soot is just as important a feature of operation, to which special attention should also be given, and an outline of the causes and remedies will therefore be presented below.

Soot as generally spoken of includes not only the fine particles of unburned carbon, black in color, but also the fine ash, gray, white or black in color which is given off during the process of combustion of the fuel. These fine particles are gradually deposited on the surface of the boiler exposed to the combustion chamber of the boiler, where it lodges and hinders efficient transfer of heat.

Some idea of the non-conductivity of this soot can be had when it is remembered that one-fifth (1/5) of an inch of soot will stop as much heat as a layer of asbestos one inch thick—in other words soot is a more efficient insulating material than asbestos which is so widely used for this very purpose.

Not only does the soot act as a positive handicap to heat transmission, but it also serves to reduce capacity when present in aggravated form because of the effect it has in throttling or choking the draft passages, and cutting down the draft pressure.

The surface of the soot is also such that it absorbs to a greater degree than is ordinarily appreciated the hot gases of combustion, and as a result a layer of stagnant gas is formed about the section of the tube covered with the soot. This stagnant gas film offers a further impediment to efficient heat transmission.

The amount of soot deposit which can be expected will depend on a number of conditions, such as the load carried, whether the fires are greatly forced, whether complete combustion is being obtained, etc. The more complete and efficient the combustion the less will be the soot deposit. The grade of coal burned also has a considerable effect on the soot deposit.

Anthracite coal contains a very small amount of volatile carbon matter and therefore results in the production of but a very small amount of black carbon-like soot formation. The amount of fine ash contained in an anthracite coal, however, results in the presence of a large quantity of very fine flaky light colored ash which clings to the boiler surfaces. This ash-like soot while not offering in itself quite as positive a bar to the heat transmission, is nevertheless quite effective in reducing the heat transfer, especially when it is considered that the presence of the pure black soot will help to bind and hold the ash-like deposit in a semi-solid mass. The ash-like soot also has a tendency to cling to the surface in layers which after alternate baking and re-baking causes a hard accumulation necessitating scraping or hammering in order to loosen and remove it.

Soft, or bituminous coal, is very high in volatile matter, which is given off in great volume during combustion, and hence the soot accumulataion where this kind of coal is used is of a black dense carbon-like form, though with it will be mixed the fine ash and residue which is particularly noticeable with anthracite coal.

Because of its deleterious effect on boiler efficiency, soot formation should in the first place be maintained at the minimum point by careful attention to the methods of firing, draft, air supply, etc., to see that complete combustion is obtained. Then the next step is to see that the soot is removed as promptly as it forms.

Soot can be removed very readily by means of blowing with air or steam, if this is done frequently and before the accumulation becomes too great. If the collection of soot is allowed to become thick, the intense heat present in the furnace will tend to bake and solidify it and in this condition it is difficult to remove, it being necessary to use a scraper of some kind, and in some cases even a hammer and chisel would be necessary to dislodge it.

Obviously the most desirable way is to provide some arrangement for blowing off the soot at regular and frequent intervals before the deposit becomes too thick and heavy to interfere seriously with heat transmission and before it bakes hard. This is advantageous because it will not only eliminate the unnecessary expense of hand cleaning and scraping, with consequent shutting down of the unit, but it also means that the heating surfaces will be kept clean or comparatively clean at all times, and thus a better efficiency obtained.

The soot can be blown off the tubes either by hand or mechanical means, the latter being preferable in every way since it is more reliable, thorough and efficient.

Hand-blowing of the tubes is accomplished by means of a hollow tube or lance through which the steam is directed against the various parts of the heating surface, the lance usually being inserted through the hand-hole or man-hole openings. While hand-blowing, of course, removes the soot at those parts which it reaches, there is always the possibility of overlooking or missing certain parts of the tubes. Hand-blowing at best is a dirty, hot and disagreeable job, and it is therefore to be expected that the operators will endeavor to dodge it as often as possible, and when it is done the chances are that it will be rushed through as quickly as possible to the detriment of the best of results.

The logical thing to do is to install a system of fixed or mechanical blowers so arranged that the steam can be turned on and the tubes blown whenever it is desired with no inconvenience or loss of time. These soot blowing systems convey the steam by means of fixed pipes to various parts of the tubes, where it is distributed by means of movable nozzles, jets, etc. Hence with the mechanical system a better distribution, a more certain distribution, of the steam can be obtained in even the most remote and inaccessible sections, and as a result the cleaning is more thorough. When the mechanical cleaners are installed the hand-hole and manhole openings can also be tightly and permanently sealed so that the possibility of air leaks from that source is also eliminated. The mere fact that the mechanical system can be used without undue annoyance and inconvenience will result in the operators using the cleaner at frequent intervals and hence the maximum efficiency will be maintained. The danger to the men from burns and dust attendant on hand blowing is also eliminated. The cost for steam is also reduced because the mechanical blower can clean thoroughly and in less time a boiler with the expenditure of considerably less steam than the wasteful and more inefficient hand type.

Causes of Failure in Boiler Plates

Effect of Grain Growth—Alteration of Crystalline Structure by Mechanical Deformation—Some Remedies

By WALTER ROSENHAIN and D. HANSEN.

THE occasional cases of failures in boiler plates met with in practice have formed the subject of several papers and discussions before the Iron and Steel Institute in recent years. A number of such cases have been investigated by the authors, and an account of one which offers features of particular importance which do not appear to have been previously noticed was read before the Iron and Steel Institutes in May. These are of special importance because it may be found that they afford a clue to the cause of failure in other cases, particularly in boiler plates of the largest dimensions.

The failure occurred in the last stage of the manufacture of the plate. The size and dimensions of the plate are illustrated in Fig. 1. The plate has a thickness of 1¾ in. and measures 4 ft. 4 in. in width by 11 ft. in length. It was manufactured under a stringent specification, but cracked during the straightening of the edges after the bending operations had been completed. Inquiry showed that the bending operations had been carried out in stages in the cold, the plate being subjected to intermediate annealings between the various stages. The position of the crack which formed in the plate is indicated in the diagram.

The material of the plate was first submitted to chemical analysis, mechanical tests, and general microscopic examination. The results obtained were as follows:

CHEMICAL ANALYSIS

	Per Cent.		Per Cent.
Carbon	0.16	Manganese	0.623
Silicon	0.079	Nickel	0.10
Sulphur	0.030	Chromium	nil
Phosphorous	0.048		

There is nothing abnormal in this composition, which represents a mild steel of high quality.

Tensile tests were taken from the outside and inside of the plate as received, with the results in Table 1, columns 1 and 2:

Here again there is nothing abnormal, except perhaps a slight indication of an unusual condition of the steel in the comparatively large difference between elastic limit and yield stress. It was thought that possibly this peculiarity might arise from the existence of internal stresses in the material, and in order to remove these as far as possible without changing the structural condition of the steel, a portion of the plate was annealed at 550° C. for 30 minutes. The results of tensile tests of a plate in this condition are given in the third column of Table 1. It will be seen that the difference between elastic limit and yield stress is still comparatively large.

In order, further, to test this point, and also to ascertain how far the tensile tests obtained on the material, as received and after annealing at 550° C., correspond to the best properties which the material is capable of attaining, a sample of the plate was normalized by

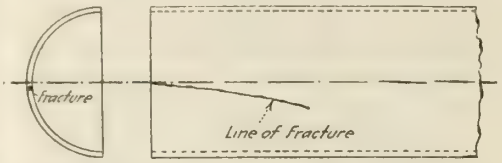


FIG. 1—WHERE THE FRACTURE OCCURRED.

heating to 900° C. followed by cooling in air. The results of tensile tests made on the sample thus treated are given in column 4 of Table 1. Here it will be seen that the elastic limit has come very much closer to the yield stress, while the yield stress itself has been raised. The ultimate stress has only been slightly affected, but, on the other hand the elongation has been markedly improved.

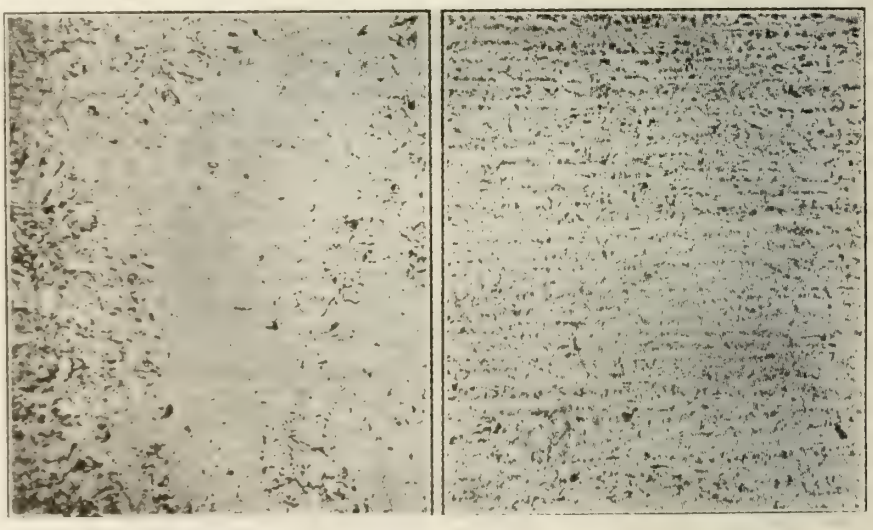
Since the tensile tests showed little or no departure from the normal in the material of this plate it became desirable to apply other tests in order to ascertain whether the properties of the steel were really as satisfactory as the tensile tests would indicate. For this purpose an impact test has been used, for although it is recogized that the conditions under which failure occurs in boiler plate possess no apparent resemblance to those of an impact test, yet experience has repeatedly shown that materials which give a low figure under an impact test are liable to fail under apparently static conditions.

The form of impact test employed is that known as the international notched bar impact test, made with a modification of the Charpy impact testing machine, and on specimens measuring 10 mm. by 10 mm. in section by 53.3 mm. in length, having in the middle a rounded notch with a radius of two-thirds of a millimeter. On the material as received this test gave a mean figure of 0.75 kgm. per sq. cm., the actual values obtained being: 0.84, 0.88, 0.66, 1.08, 0.86, 1.20. These figures are of course very abnormally low, a reasonable value for a boiler plate of this kind being from 8 to 11 kgm. per sq. cm. It was thought that possibly this low value might be

TABLE 1—PHYSICAL TESTS OF THE FAILED PLATE

Particulars.	Plate as Received		Plate Annealed 550° C.	Plate Normalized 900° C.
	Outside	Inside	Outside	Outside
	1	2	3	4
Diameter, in.	0.375	0.375	0.375	0.375
Cross sectional area, sq. in.	0.1105	0.1105	0.1105	0.1105
Elastic limit, tons per sq. in.	14.2	11.3	15.4	18.3
Yield stress, tons per sq. in.	18.3	16.1	18.7	19.15
Ultimate stress, tons per sq. in.	26.88	27.24	27.61	27.94
Modules, lb. per sq. in.	29.8×10^6	29.8×10^6	30.4×10^6	30.2×10^6
Extension per cent. on 1.3 in.*	31.6	33.1	34.5	42.2
Reduction of area per cent.	59.6	60.7	59.1	62.5

*A gage length of 1.3 in. is chosen to give a ratio of gage length to diameter equal to 3.5.



FIGS 2 AND 3—STRUCTURE IN TRANSVERSE AND LONGITUDINAL SECTION OF THE ORIGINAL METAL, 50 DIAMETERS. A CONSIDERABLE AMOUNT OF BANDING IS PRESENT.

veur, who made the well-known experiment of straining by compression a conical piece of nearly pure iron, and subsequently annealing the piece thus treated at a temperature below the lowest critical point. On cutting a section and etching it, a band of very large ferrite crystals was found at one point, and this

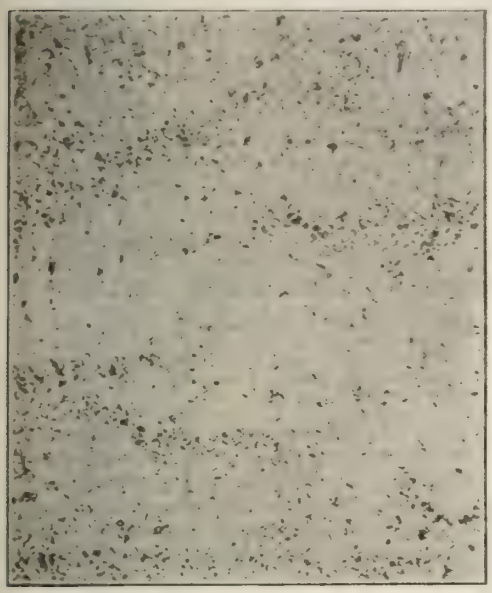


FIG. 10—MICROSTRUCTURE OF PLATE NO. 2 USED EXPERIMENTALLY. VERY LITTLE BANDING PRESENT, THE PLATE BEING ONLY ½-INCH THICK

led to the view that there is a critical amount of plastic deformation which, for a given annealing temperature, below the critical range produces very rapid grain growth.

The subject has been more fully investigated by Chappell,[4] and has also been dealt with in America by Sherry.[5] The latter author has shown that grain growth occurs, not only in comparatively pure iron, but in any region existing in a mass of mild steel from which pearlite is absent or nearly absent—in the carbonless bands such as those met with in boiler plates, provided, of course, that the necessary treatment, consisting of plastic deformation of the right intensity followed by annealing at a correspondingly low temperature, has been applied.

In view of the results obtained by the authors just referred to, the observations made on the boiler plate which forms the subject of this paper at once suggested that the development of coarse ferrite crystals in the carbonless bands of the plate was the result of grain growth following upon deformation in the cold and subsequent low temperature annealing. When it is borne in mind that this plate was bent cold and then annealed several times in succession, it will be seen that the conditions likely to produce grain growth in carbon-free areas had been present.

The authors, however, were not satisfied with a general inference of this kind, but endeavored experimentally to reproduce the conditions under which the steel had developed the coarse and relatively brittle structure which it possessed when received. For this purpose two series of experiments were undertaken. In both series the material was first normalized in order to destroy the previously existing coarse crystals and to bring the material into the condition in which it gives a satisfactorily high impact figure. Deformation was then applied to the material in two ways; in one case, in the cold (by hammering), and in the second case at a temperature between 600° and 700° C., or below the critical range. Specimens treated in both ways were then annealed at 650° C. for 30 min. The microstructure was examined both before and after this last annealing, and impact tests were taken on the material at each stage.

The resulting structure in one of the carbonless areas of the specimen which has been hammered in the cold and subsequently annealed at 650° C. is shown in Fig. 6 under a magnification of 150 diameters. Comparison with Fig. 5 shows at once that considerable grain growth has taken place, although the resulting grains are not quite so large or well developed as those in Fig. 4. The sample which has been hammered between 600° and 700° C. gives a very similar structure, and the impact figure in this case is brought down to 1.56 kgm. per sq. cm.

In order to test the matter further another series of experiments was undertaken in which varying amounts of mechanical deformation were applied in the cold followed by annealing at 650° C. In order, however, to prove that it was not the annealing process alone which resulted in the reduction of the impact figure, the normalized sample was also annealed at 650° C. without previous mechanical deformation. The results obtained by impact tests on specimens thus treated are given in Table 2:

TABLE 2—TESTS ON BOILER PLATE NO. 1

Treatment	Resistance to Impact. Kilogrammeter per Square Centimeter
Normalized at 900 deg. C.	10.46
Normalized at 900 deg. C.	8.92
Normalized; annealed at 650 deg. C.	9.04
Normalized; severely deformed; annealed, 650 deg. C.	11.7
Normalized; reduced 12.4 per cent.; annealed, 650 deg. C.	10.66
Normalized; reduced 7.1 per cent.; annealed, 650 deg. C.	8.44
Normalized; reduced 6.9 per cent.; annealed, 650 deg. C.	10.04
Normalized; reduced 4.9 per cent.; annealed, 650 deg. C.	8.14
Normalized; reduced 3 per cent.; annealed, 650 deg. C.	6.34

In this table the amount of mechanical deformation is measured by percentage reduction of thickness produced by pressing in the cold in a powerful press.

The results given in Table 2 are instructive. It will be seen that large amounts of reduction actually improve the impact strength slightly, but with decreasing amounts of mechanical deformation followed by low temperature annealing the impact strength is very much reduced, although the lowest value obtained in this way, 6.34 kgm. per sq. cm., is still very much better than that

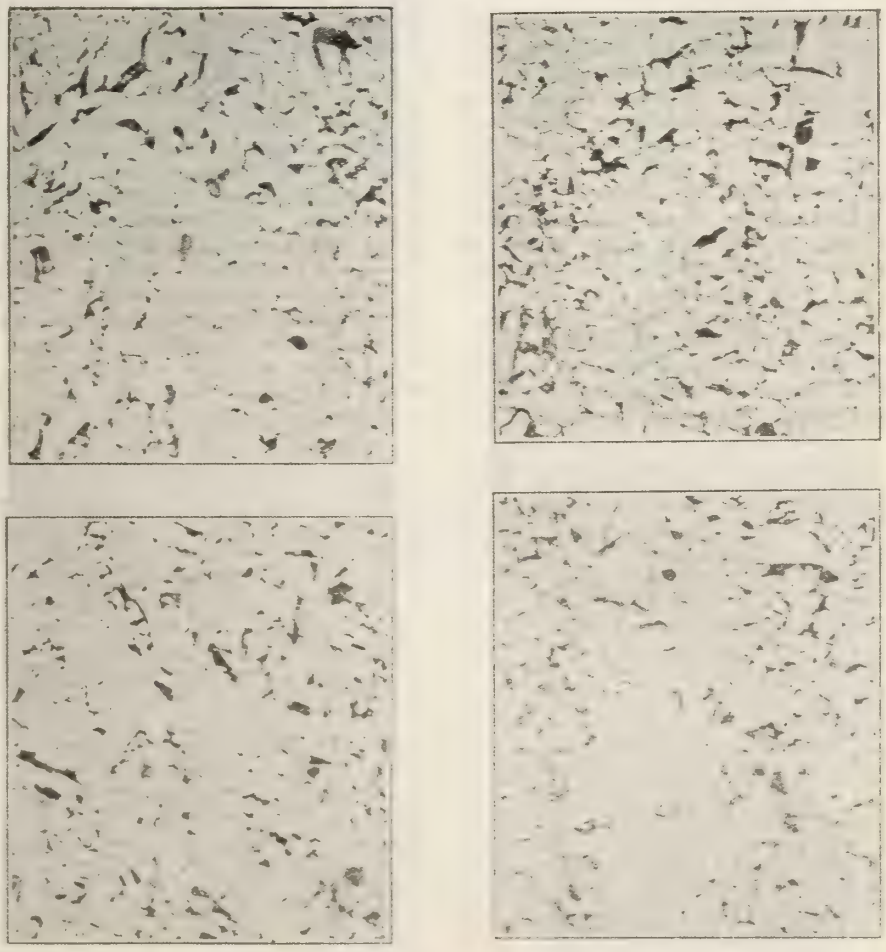


FIG. 11, 12 (UPPER), 13 AND 14 (LOWER), MICROSTRUCTURE OF PLATE NO. 2 AFTER TREATMENT REFERRED TO IN TABLE 2.

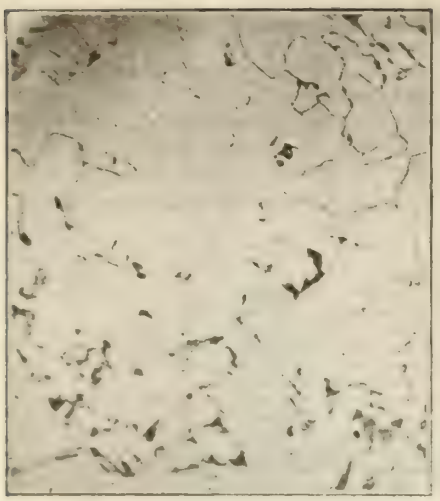


FIG. 4 (LEFT) LARGE FERRITE CRYSTALS IN THE CARBONLESS BENDS OF THE STRUCTURE AFTER FURTHER ETCHING: MAGNIFICATION IS 150 DIAM.

FIG. 5 (CENTRE)—SAME MATERIAL AFTER NORMALIZING; MAG. 150 DIAM.

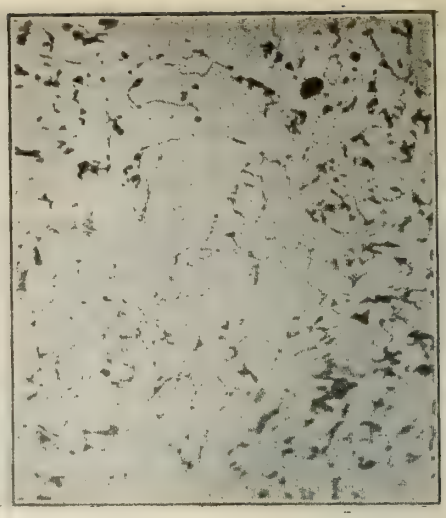


FIG. 6 (RIGHT)—STRUCTURE OF ONE OF CARBONLESS AREAS OF THE SPECIMEN WHICH HAS BEEN HAMMERED IN THE COLD AND THEN ANNEALED AT 650° C. MAG. 150.

due to cold work which the plate had received, leaving it in a work-hardened and, possibly, internally strained condition. The impact tests were therefore repeated on specimens of the plate which had been annealed for thirty minutes at 550° C., in the same way as had been done with the tensile test pieces. The mean result of six impact tests made on the steel in this condition gives a value of 2.90 kgm. per sq. cm., the actual figures obtained being as follows: 2.10, 3.86, 2.64, 3.36, 3.52, 1.92.

It will be seen that this very low temperature annealing, by removing cold work and internal stress has improved the impact behaviour of the material quite appreciably, but that, even when thus treated, it is still very far below the normal value for steel of this grade. This is indicated by the impact figures given on samples of the plate after normalizing at 900° C., when values of 10.78 and 11.72—mean, 11.25 kgm. per sq. cm. were obtained.

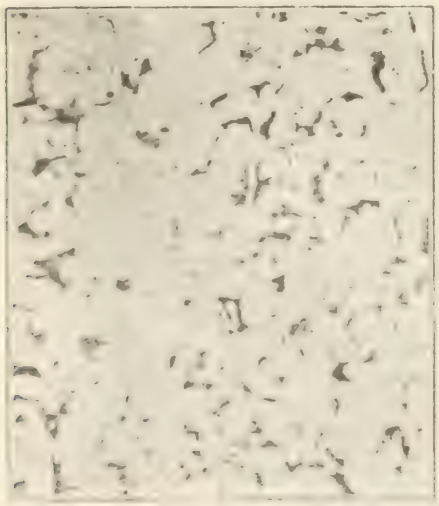
It is evident from these figures that the steel of the fractured plate is in an abnormally bad condition, presumably as the result of some treatment—thermal or mechanical, or both—which it has received during manufacture, and it became necessary to discover, if possible, the cause of this abnormality.

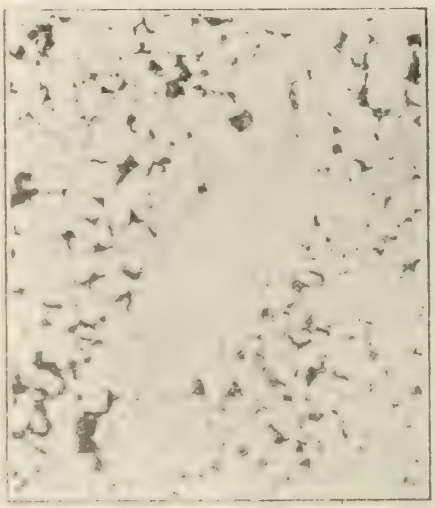
The general microscopic examination of the steel showed at first sight nothing abnormal. The structure in general transverse and longitudinal section is shown under a magnification of 50 diameters in photomicrographs Figs. 2 and 3. It will be seen that the scale of the structure, so far as ferrite-pearlite distribution is concerned, appears to be satisfactory, but there is a considerable amount of banding present, although this amount is not in itself abnormal for a plate of such large size.

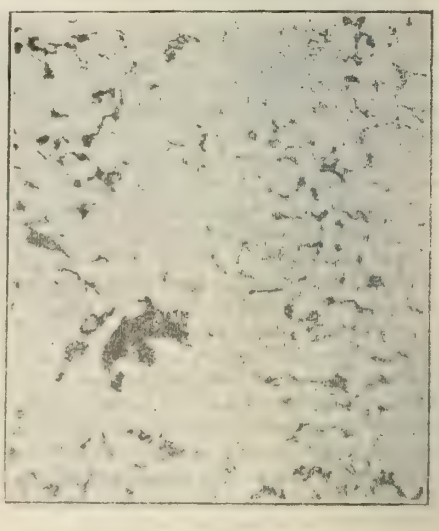
More careful examination of the structure, however, particularly after it had been etched in such a way as to develop the ferrite boundaries, revealed a striking pecularity. This takes the form of relatively very large ferrite crystals in the carbonless bands of the structure. These are illustrated, under a magnification of 150 diameters, in Fig. 4. The corresponding grain size of the same material, after normalizing, is shown in Fig. 5 under the same magnification. It should be noted, however, that the normalized structure shown in Fig. 5 has been obtained not by treating a small laboratory sample but from a comparatively large piece of the plate about a foot square which had been subjected to the heat treatment described. The most careful study of the steel in both conditions revealed no other difference between the "as received" and normalized conditions. The inference is thus indicated that the abnormal impact behaviour of the steel as received may be due to the development of coarse crystals in the carbonless bands which occur in this material, and the possibility is suggested that the failure of this plate may be connected with the phenomenon of grain growth which has in recent years been discovered in the case of iron and very low carbon steel.

The subject of grain growth is of fundamental importance in connection with the further investigation of this plate, and it is referred to it in greater detail at this point.

Phenomena which are now recognized as coming under the general title of grain growth were discovered and described by Stead[1] and Charpy[2]. A considerable advance in our knowledge of the subject was, however, made by Sau-







FIGS. 2, 3 & 5. MICROSTRUCTURES AT 150 DIAMETERS OF THE STEEL, CORRESPONDING TO THE VARIOUS FORMS OF HEAT TREATMENT OUTLINED IN TABLE 3.

found in the plate in its condition as received, or that described in the hammered sample given above. There is nothing to suggest, however, that hammering, as distinct from such deformation as occurs in cold bending, has any specific effect. It should further be borne in mind that when a thick plate is bent in the cold, a considerable range of plastic deformation is produced, ranging from a maximum at the surface of the plate to zero at the neutral axis. Somewhere within this range the critical deformation, corresponding to the annealing temperature employed, is likely to occur.

The microstructure corresponding to the various forms of treatment referred to in Table 2 are illustrated in Figs. 7, 8 and 9, at a magnification of 150 diameters. Fig. 7 refers to the last specimen mentioned in the table having the lowest impact figure and correspondingly showing the largest development of grain growth in the carbonless bands. Fig. 8 refers to the material as normalized and annealed at 650° C. without intermediate deformation. It will be seen that here there is no appreciable difference in grain size between the carbonless band and the adjacent steel. Finally, Fig. 9 refers to the material which has been severely deformed and subsequently annealed at 650° C., giving a high impact figure. Here it will be seen that the grain has been very much refined even in the carbonless areas, and this corresponds in a striking manner with the very high impact figure, 11.7.

When the evidence above described is carefully considered it will be seen to afford a considerable degree of proof of the view that the brittleness, as evidenced by the very low impact figures and actual failure in manufacture which has been found in the plate under discussion, arises from the existence of coarse ferrite crystals due to grain growth in the carbonless bands of the steel, and that this grain-growth is the result of a moderate amount of deformation in the cold, followed by low temperature annealing. It is further evident that normalizing the material, or indeed merely heating it to a temperature above the critical range, is sufficient entirely to obliterate this grain growth and all its evil effects.

It will be seen that this conclusion indicates that the presence of carbonless bands, which is regarded as a normal feature and has not hitherto been considered a serious source of danger or weakness in a boiler plate, may become the cause of failure if associated with a suitable combination of mechanical deformation and low temperature annealing. If carbonless bands are to be regarded as a normal feature in boiler plates—and in existing practice this is probably inevitable—and if deformation in the cold, such as bending, etc., is otherwise a desirable practice, it seems that subsequent normalizing is necessary, or certainly desirable, as a safeguard against dangers of the kind described here.

In order further to test the view which has been advanced above, the authors have endeavored to carry out similar experiments and tests on other samples of boiler plate, but the other samples at their disposal came in every case from plates of much smaller size and thickness, with the result that the banding, where it existed to a marked extent, was on a much smaller scale. Experiments on these plates were, however, made in order that the results might be regarded as a check on the observations already described. In the case of a plate half an inch thick, which may be referred to as No. 2, the chemical analysis was as follows:

	Per Cent.		Per Cent.
Carbon	0.123	Phosphorous	0.057
Silicon	0.014	Manganese	0.49
Sulphur	0.03		

which again indicates a steel of satisfactory composition. The general microstructure of this plate in the condition as received is shown in Fig. 10. A certain amount of banding is present, but not on the scale found in the first plate described. A piece of this plate was

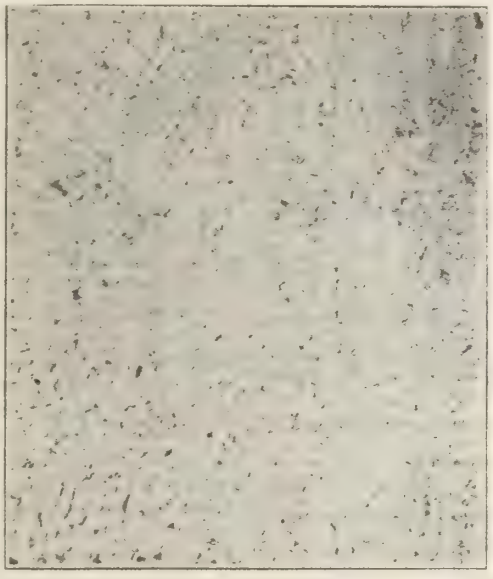


FIG. 15—MICROSTRUCTURE OF ANOTHER ½-INCH PLATE. THERE IS AN ABSENCE OF MARKED BANDING.

normalized at 950° C., and portions were subsequently treated as follows:

Hammered cold and annealed at 650 deg. C.
Hammered between 600 and 700 deg. C., and annealed at 650 deg. C.
Annealed at 650 deg. C. without previous mechanical treatment.

Impact tests have subsequently been carried out on the samples thus treated, with the results given in Table 3:

TABLE 3—TESTS OF BOILER PLATE NO. 2

Treatment	Energy to Fracture. Kilogrammeters
As normalized at 950 deg. C.	11.06
Normalized at 950 deg. C.; hammered cold and annealed at 650 deg. C.	5.52
Normalized, 950 deg. C.; hammered between 600 deg. C. and 700 deg. C., and annealed at 650 deg. C.	7.18
Normalized at 950 deg. C., annealed at 650 deg. C., without mechanical treatment	10.44

It will be seen that the normalized material again gives a high value, and that this value is not appreciably diminished by a further anealing at 650° C. On the other hand, cold hammering followed by annealing at 650° C. lowers the impact figure to one half of the normal value, while hammering between 600 and 700° C. reduces it considerably but to a lesser extent. The corresponding microstructures are illustrated in Figs. 11, 12, 13 and 14. Fig. 11 shows the material as normalized, Fig. 12 shows it after normalizing and reannealed at 650° C. without mechanical treatment, Fig. 13 shows the effects of cold hammering followed by annealing at 650° C., and Fig. 14 shows the effect of hammering between 600° and 700° C., followed by annealing at 650° C.

It will be seen that, in general terms, the results obtained with this material are of the same kind as those found in the first plate but, probably owing to the smaller scale of the banding originally existing in this steel the results are not quite so intense in character. It may be mentioned that this plate also had failed in practice, but not during manufacture, and in a manner which is not necessarily related to the phenomenon of grain growth. The experiments on this plate serve to confirm the observations made with the first example, but they indicate that in plates of a smaller thickness the effects are not likely to be so serious as in the larger plates.

The results obtained with plates Nos. 2 and 3 thus confirm the view that the low impact figures found in the first plate, and to a lesser extent in plate No. 2, are associated with the coarse crystal structure in the carbonless bands, and that these are the result of grain growth produced by slight deformation and subsequent low temperature annealing; also that normalizing in every case completely removes this source of weakness.

[1]Stead, *Journal of the Iron and Steel Institute*, 1898. No. I, p. 145; *ibid.*, No. II, p. 137.

[2]Charpy, *Comptes Rendus*, vol. cli.

[3]Sauveur, *Proceedings of the International Congress for Testing Materials, Sixth Congress*, 1912, vol. xi.

[4]Chappell, *Journal of the Iron and Steel Institute*, 1914, No. I, p. 460.

[5]Sherry, *Faraday Society*, December, 1916.

New Patents Out.—The following is a list of Canadian patents recently issued through the agency of Messrs. Ridout & Maybee, 59 Yonge street, Toronto, from whom further particulars may be obtained: Samuel R. Kitchen, spring mattresses and the like; Harvey M. Russ, dump wagons; Albert E. Salway, multicylinder internal combustion engine; Joseph H. Price, sights for rifles, pistols and the like; William Wilkie, machines for opening and pressing the seams of wearing apparel in the process of manufacture; John G. Robinson, steam superheater; Robert Blakoe, tires of motor cars and other vehicles; Carl F. Doerschuk, self-locking device; Thomas Mitchell, shim boring and cutting machine; Frank D. Parmenter, attaching means for electric fixtures.

Copper ranks next to steel as the most important war metal. Of a world's production of approximately 3,100,000,000 pounds in 1917, the refineries of the United States produced 2,362,000,000 pounds, or a trifle less than 80 per cent.

The MacLean Publishing Company
LIMITED

(ESTABLISHED 1888)

JOHN BAYNE MACLEAN - - - - - - President
H. T. HUNTER - - - - - - Vice-President
H. V. TYRRELL - - - - - - General Manager

PUBLISHERS OF

POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power, and to the design and operation of Refrigerating Machinery.

B. G. NEWTON, Manager. A. R. KENNEDY, Editor.

Associate Editors:

W. F. SUTHERLAND J. H. RODGERS (Montreal) T. H. FENNER

OFFICES

CANADA—

Montreal—Southam Building, 128 Bleury St., Telephone Main 1004.
Toronto—143-153 University Ave., Telephone Main 7324.
Winnipeg—1207 Union Trust Building, Telephone Main 3449.
Eastern Representative—E. M. Pattison.
Ontario Representative—S. S. Moore.
Toronto and Hamilton Representative—J. N. Robinson.

UNITED STATES—

New York—R. B. Huestis, 111 Broadway, New York, Telephone 8971 Rector
Chicago—A. H. Byrne, 900 Lytton Bldg., 14 E. Jackson Street, 'Phone Harrison 1147
Boston— C. L. Morton, Room 733, Old South Bldg., Telephone Main 1024

GREAT BRITAIN—

London—The MacLean Company of Great Britain, Limited, 88 Fleet Street, E.C., E. J. Dodd, Director, Telephone Central 11960. Address: Atabek, London, England.

SUBSCRIPTION RATE

Canada, $1.00; United States, $1.50; Great Britain, Australia and other colonies, 4s. 2d. per year; other countries, $1.50. Advertising rates on request.

Subscribers who are not receiving their paper regularly will confer a favor by telling us. We should be notified at once of any change in address, giving both old and new.

Office of Publication, 143-153 University Avenue, Toronto, Ontario.

Vol. XI. OCTOBER, 1918 No. 10

PRINCIPAL CONTENTS

Conservation and Its Relation to the Power Plant.....277-281
Power Plant Management: The Use of Instruments.....281-283
Electricity and Hydraulics.....284-285
Principles and Operation of Modern Electrical Equipment.
A Description of Some of Europe's Water Powers.....286-289
Why We Are Asked to Save Ammonia.....290-291
Tight Boiler Settings an Aid to Economy.....292-293
Conservation of Coal and the Interconnection of the Isolated Plant and Central Station.....294-296
Keeping Boiler Tubes Free From Soot.....297
Causes of Failures in Boiler Plates.....298-301
Editorial.....302
Association and Personal.....303
Operators' Point of View.....304-307
Saving Coal by the Elimination of Air Leakage....Greater Coal Profits....A Day of Rest?....In the Power Plant.
Safety Code for the Operation of Electric Cranes.....309
Selected Market Quotations.....310
Industrial News.....52-54

TIME FOR REAL ACTION IS HERE

THE time has gone past when it is much use to discuss the saving of fuel in an academic way. The matter has been talked of until it is threadbare, and yet there are plants all over the country which waste fuel every day they operate. The more power they make the more fuel they waste.

The element of compulsion will have to enter into the whole plan before there is going to be much action taken that will be worthy of the name.

It's mighty little use for the government to send out lists of do and don't ideas for the power plants of this country unless they are prepared to go out and follow up these suggestions and see that they are put into operation.

The non-efficiency of the power plants of the Dominion is the cause of the coal waste, and just as long as many of these plants are allowed to run they will run and waste fuel.

There is not enough of the iron fist in the methods adopted by the fuel controller and his assistants. The owners of power plants follow the directions of the fuel controller if they feel so disposed and they refuse to follow these directions or suggestions if such a course meets their fancy. And generally it is the latter case that comes to the top.

If the production of power by a central system is the cheapest and most efficient, then the individual plant should be closed down. If the individual plant is the better way, then the central station should be restricted and disciplined accordingly. There are engineers in Toronto, and reputable ones, too, who are willing to state positively that they can put, by co-operation, anything from 250 to 1,000 h.p. on the power lines during the months when they need a large amount of exhaust steam for heating purposes. The power companies need this power at the same time that the plants need the steam for heating purposes. If this situation is as presented to us, then there should be no option in the matter. It should be made compulsory for that power to be turned into the power line of the large operating companies of this city.

The officials should not be concerned over the fuel that the power plants of the country actually burn, though the tonnage be large. Their chief concern should be over the fuel that passes up the chimney in the shape of gases that have been allowed to escape with only part of their power-producing value taken out, owing to improper combustion.

There is all sorts of advice and assistance to be had for the asking in this matter. In fact the Toronto branch of the C. A. S. E. has expressed its willingness to solve any power house problem that a manufacturer has before him, and these services are offered especially in reference to shortage of fuel at the present moment.

In short, there is one solution that should be aimed at. It might cause some ruffled feelings for a time, but such things are not to be considered seriously now. Insist on a power plant coming up to a reasonable standard of efficiency, or else cut off the supply of fuel until such a standard is arrived at. When the power plant owners find that they are standing up alongside a yard stick instead of measuring themselves with a foot rule, the chances are that there will be some improvement. Until such time we do not look for much progress.

Coal Situation East and West

THE miners in Pictou county, N.S., are out on strike, and have been since early in September. In district 18 of the U.M.W. of A., which takes in Alberta and British Columbia, a strike is likely in a large section of that country, as there is a dispute which has not been settled between the miners and operators.

This, with winter only a few weeks away, and with tremendous demands being made for coal for war industries and other purposes, presents a mighty poor lookout.

The mining of coal in Canada is a poor index of the coal that could be mined in Canada.

Western Canada has a coal wealth that should make her prosperous the year around. The southern part of British Columbia should be busy and developing all the time. It is not. About half the time it is tied up with strikes. On operation and tie-up it looks like a fifty-fifty proposition.

There is a foreign element in Western Canada that is making trouble. That element is feeling its power to-day as it has never had a chance to do before. It is bluffing the whole Dominion, and especially the West. It is playing fast and loose with the big question of supplying Western Canada with coal this year.

Association and Personal

Arthur Crumpton, formerly assistant valuation engineer for the Grand Trunk, has been promoted to the head of this department.

Word was received of the death in Ottawa of Lieut.-Col. W. Mahlon Davis. Lieut.-Col. Davis was for several years the efficient City Engineer of Woodstock, Ont. He was born at Aylmer, and was a graduate of the Royal Military College, Kingston. From there he went to Kitchener, then to Prince Rupert, and later settled in Vancouver. While in Woodstock he was a prominent member of the 22nd Regiment of which he was Adjutant. After going to Kitchener he was appointed Lieut.-Colonel and raised the "Grey Horse" Cavalry, of the Oxford company of which the present Brig.-Gen. John Ross was Major.

When war broke out he recruited a battalion in British Columbia. Later Sir Sam Hughes asked him to raise a pioneer battalion in the east, and in less than six weeks he raised what was known as the 2nd Pioneer Regiment, and went overseas with it some two years ago.

The Hydro Situation.—Speaking at Hamilton recently, Mr. Sifton, engineer to the Hydro Electric department, impressed on his hearers the necessity of conserving the available power. Although by November 1st the Hydro should be receiving 20 per cent. more power than at present, all this extra power will be needed, as the Dominion Foundries and Steel Co. would shortly be putting their electric furnaces into operation, and these alone would consume 2,000 H.P.

Power Is Needed.—At a meeting of the Hamilton Board of Control a letter from the Dominion Forgings and Steel company was read, in which it asked that the Beach road, near its premises, be repaired to facilitate its war business, and that a sewer contractor, at present doing city work under a time penalty, be released for a short time to do important work for it. The company stated that its pay-roll amounts to $250,000 a month, and its work is largely in munitions, and for this reason should be given consideration. The board referred that part of the letter to the works department. The letter also contained this statement: "A few days ago we were refused consideration on a very large contract because power was not available in Hamilton; in other words, Hamilton's industrial growth its stunted because we are at the limit of power." Controller Wright asked about the investigation ordered by the board in regard to Industrial Commissioner Kirkpatrick's charges that the Ontario power committee is discriminating against Hamilton in the matter of allotting power, and the mayor stated that the local Hydro commission was still seeking information to bring before the board.

Epidemic Stops Meetings.—Owing to the growing seriousness of the Spanish influenza in the city of Montreal and the surrounding district, the Board of Health has issued orders for the closing of all schools, theatres and other places of amusements where large numbers of people are accustomed to congregate. These regulations have been extended to include all meetings of societies, clubs and such places where periodical meetings may be held. These conditions will likely continue until the epidemic has been got under control. The current meetings of the Canadian Railway Club and the meeting of the Engineering Institute have been posponed until further notice.

Will Scrap the Road.—The London & Lake Erie Railway & Transportation Company will cease to operate at a very early date and the work of scrapping the road will commence immediately, it was announced by general manager Warburton. There is no likelihood of the city purchasing the whole road and the chance of purchasing even part of it is very small. The idea suggested by Sir Adam Beck some time ago of the municipalities along the line purchasing the part of the road that runs through their district and operating it in connection with the London & Port Stanley Railway was not carried out through lack of co-operation on the part of St. Thomas and other municipalities. A suggestion is now before the city to purchase eight miles of the road that runs between Lambeth and London and connect it with the London Street Railway.

Using Straw for Gas.—Progress has been made in the research conducted by Dr. R. D. MacLaurin, Professor of Chemistry in the University of Saskatchewan, which has as its object the utilization of the waste straw in Western Canada by converting it into gas by the process of carbonization. Dr. MacLaurin has been investigating this project with a view to making the process practicable so that the individual farmer could use his own straw fuel in the form of gas for heating, lighting and power. An experiment was conducted recently by Prof. MacLaurin which proved that it was possible to use the straw gas as motor fuel. A bag containing 300 cubic feet of gas produced from straw was fastened to the top of the car, and this was produced from 50 pounds of straw. This fuel was equivalent to one gallon of gasoline. A ton of straw is capable of producing about 11,000 feet of gas, and is equivalent in power to 35 or 40 gallons of gasoline.

Markham.—The Markham Township Council, at its session in Unionville, gave the Hydro-electric by-law adopted by the Village of Unionville a month ago, its third and final reading, and application will at once be made to the Ontario Hydro Power Commission for the construction of a light and power line from Agincourt. Markham will at once take steps to have the system extended to that point two and a half miles further on.

Chatham.—The city council contemplates drastic action as a result of the alleged failure of the American Well Works Co. to live up to the agreement with the city, when the company purchased the Defiance plant. As an instance, they charge only three men are employed. The city solicitor will be consulted with a view of cancelling all concessions, and instructing assessors to value the property and machinery with a view of compelling the company to pay taxes on the true value.

The Buffalo Forge Co., Buffalo, have issued an attractive catalogue of some 112 pages, pocket size. The pages are made in such a way that they can be replaced—loose leaf style—by others. In its introduction the company says: "In order to simplify the catalogue and also to keep up with improvements which are made from time to time it has been decided to replace the bulky catalogue with sections which are easily and quickly replaced without affecting the rest of the catalogue. Another innovation and one which will be found very convenient, is the renumbering of forges. This numbering is based on the well known Dewey Decimal System of numbering. All forges are numbered according to their blower number. The first figure, therefore, classifies the various forges according to blower, the second figure according to hearth and the third figure according to side of hearth. The letters indicate the style of hood.

The Operators' Point of View

SAVING COAL BY THE ELIMINATION OF AIR LEAKAGE

By W. F. SCHAPHORST.

ON account of the temperature variations in boiler settings it is not always easy to keep it in a leakless condition. Brick settings are perhaps the worst offenders of all in permitting leaks, because they usually crack in time and an enormous volume of air finds its way through to dilute the gases. Some makes of boilers require settings that are prone to cause more serious troubles along this line than others. The greater the surface surrounding the furnace, generally, the greater the danger of loss through air leaks. A low horizontal boiler, therefore, has its own particular advantages, but it must not be forgotten, at the same time, that a large combustion chamber is a prerequisite to thorough and complete combustion.

If there is a leak into the burned gases after they have left the heating surfaces of the boiler no particular harm can result aside from the fact that such leaks will reduce the intensity of draft. It is, therefore, useless to take samples of gases from the chimney itself, especially if there are leaks through the base of the chimney or through the breeching. The proper place from which to draw samples is from the point of departure of the heating surface; in other words, from the place where the heating surface and gases "part company." The samples referred to are those taken for purpose of analysis. For example, if the leaks are of the nature described above the gases would have a smaller CO_2 content in the chimney than at the "leaving point."

Even where boilers are cased in steel or cast iron, air leakage is not uncommon. It is possible for the steel to warp, as every engineer knows. The warp causes a crack or space to form, and "there you are again." A good way in which to detect air leakage is to build a smoky fire and start it a-going nicely. Then, suddenly and completely, close the damper in the breeching and find the fissures through which the puffs of smoke are emitted. Close as many of the fissures or cracks as possible with plastic fire brick or other good material, and then try it again. In a short time a smokeless setting will be the reward. Some engineers have found it profitable to cover the entire setting with a special paint, sheeting, or tarry preparation, for it is claimed, evidently with some truth, that air "seeps" through ordinary brick and its mortar joints.

It is possible to repair the inside as well as the outside of brick settings while in operation if it is found desirable to do so, as it often is. The fallen brick or crack openings may be filled with plastic fire brick applied from the end of the poker or slice bar. The patched job may not look very neat, but it will do temporarily. There are sound arguments in favor of using monolithic structure or lining from this plastic material, thus reducing the leak factor to the minimum. Durability and strength are other advantages of this kind of lining.

One of the prime essentials of efficient firing is the keeping of the furnace doors shut. The fireman should be taught to become skilled in the quick opening of the door, quick though careful discharging of the scoopful of coal, and the quick closing of the door. During every second that the furnace door is open a copious and costly quantity of air is admitted.

GREATER COAL PROFITS

By N. G. NEAR.

Retail coal dealers can do much toward lessening the price of coal if they will just get together and purchase from the mines at a uniform rate and not wait until a certain season of the year as is now so commonly done. They could then make a greater all-the-year-round profit and sell coal at a lower price at the same time. There is no good reasons why mines should not be operated to the same extent during the summer months as during winter months.

The way things are now running mine operators are at a disadvantage. They are not backed by the dealers.

It is therefore evident that if retail dealers will either increase their own storage capacity and buy during summer months as well as during winter months, and advise the consumers to also buy during summer months, the lowest possible average cost per ton will soon be attained.

As for the profits of the retail dealer he must not forget that by building a good up-to-date plant, when increasing size, in order to facilitate handling, he will easily do better than the one who sticks to the old fashioned coal yard.

Power, now-a-days, is cheap. Harness the coal which you are handling to do your mechanical work—all handling. The man with the shovel is decidedly expensive in places where he is not absolutely needed. This has been proved over and over again in hundreds of various fields. There is hardly a detail in the retail business that should be looked after more cautiously than the method of handling.

I would therefore advise retail dealers to investigate the power methods of handling with diligence, if you have not already done so. You will discover many surprises. You will find that hand labor is indeed a luxury.

Thus, by pulling together in two ways —with the mine operator and with power operation—the ultimate consumer will get better service, better coal, and a truly reasonable price. And incidentally you will make more money.

HOW MUCH HEAT IS LOST?

By W. F. SCHAPHORST.

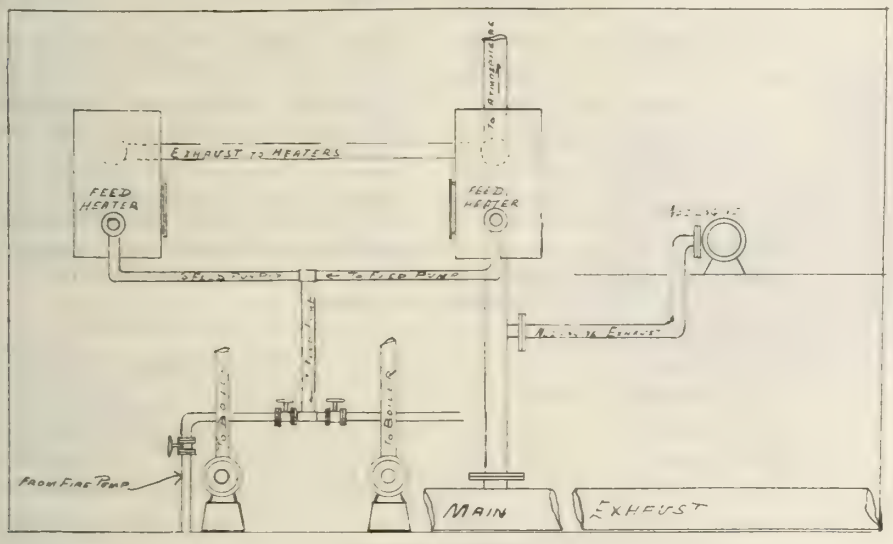
How much heat is lost in allowing a boiler to cool off for cleaning and in starting it up again? There is a question that will cause many an engineer to stumble. It is much like the time-worn conundrum, "Which came first, the egg or the hen?" When a boiler cools off the heat is being dissipated into the air, true enough. And when the boiler and setting are being reheated, the heat out of the coal is all being apparently wasted. None of it is converted into work. The amount of heat lost on cooling is equal to the amount required to heat it all equally again, but the actual loss is "only one of them." Don't add them together. Or, add them and divide by two.

Winnipeg, Man.—The final barrier in the tunnel connecting the east and west sides of the Red River has been broken. The tunnel is to bring the Shoal Lake water to Winnipeg, and all that now remains to be done is to place the cast iron lining and fill the space between pipe and rock with concrete.

A DAY OF REST? IN THE POWER PLANT

By T. H. FENNER

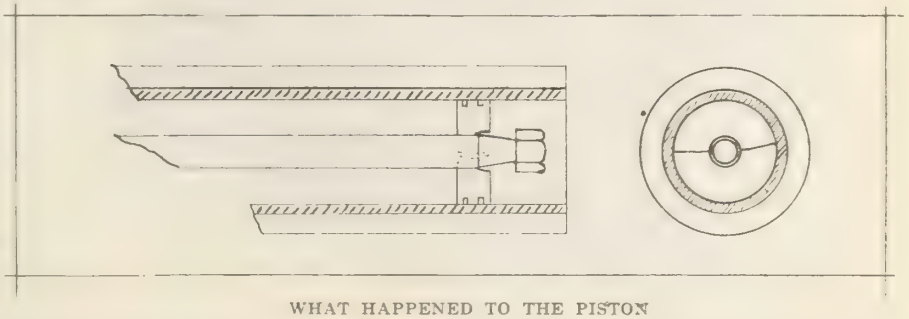
A SERIOUS and expensive breakdown occured to an 11"×9"×14" high speed tandem compound engine under my charge in a peculiar manner. The accident occurred on a Sunday, when the regular engine room attendant was not on duty. As a matter of fact, no one was in the engine room at the time, the fireman on duty in the boiler room being under orders to come up and look at the oiling arrangements from time to time. To understand what happened we must have a glance at the boiler room, where the cause of the accident originated.



PIPING LAYOUT

The feed pumps took their water from overhead open heaters, of the Webster type, discharging through economiser to boilers. There was also a direct discharge to main feed leader direct, by passing the economiser, and also a direct discharge to an auxiliary header, as shown. The suction pipe from heaters to pump came down to a T between the two pumps, and branched off to each pump. There were also two independent suctions on each pump connected to hot and cold wells. On one of these suctions a connection had been made from the discharge of the fire pump for washing out boilers, and an emergency boiler feed. A branch was tapped off the auxiliary header at each boiler to connect the valve of the turbine hose for washing out. When washing out the fire pump was used, discharging through the feed pump suction, through the pump, and auxiliary header. The boiler room staff had stringent orders never to touch this fire pump valve, the engineer on duty in the power house being the only one authorised to make the connection. The reason for this care was apparent, as if the valve from the fire pump was opened and the suction from the open heater left open at the same time, the discharge from the fire pump would have clear access to the heater and from this to the whole exhaust system.

The day that the accident happened being a Sunday, in the ordinary course of events nothing would have been running. However a 50 h.p. armature had burned out on the Saturday morning, and the millwrights and electricians had been working Saturday afternoon and Sunday morning and were ready to try the motor after dinner Sunday. This would mean, if the repairs were O.K., about ten minutes running. Being anxious to know if everything would be alright for Monday morning, I decided to go down to the factory myself. The regular day engineer had been instructed to come in after dinner to run the engine as required, but as he had not shown up I started up myself, made the switchboard connections, and saw that the forced lubrication was alright. I told the fireman where I was going, and warned him to come up at intervals of not more than ten minutes, and look at the engine. I expected to be all through before he came up twice. However, some minor troubles developed in connection with the motor and shafting. A man was sent over to the engine room to see how things were and he reported everything alright. We got ready to start the motor again, and it started up this time perfectly, but after running about five minutes the motor started to slow down and the lights to dim. I started for the engine room on the run, but about half way there was met by the fireman, who informed me in quite a disinterested way that No. 1 engine had "gone to h—." He also volunteered the information that there was a lot of water in the basement. Arriving in the engine room, I saw a tangle of oil pipes, and the broken crank case lying on the floor, and at the same moment an ominous cracking broke on my ears. Coupling this with the fireman's statement of the leak in the basement, I made a rush for the feed pump, finding what I expected, the valve from the fire pump open, and the heaters and exhaust system flooded. The leak in the basement was the excessive overflow from the heaters backing up the water seal from the sewer. The next thing was to look at the water gauge to find the water just bibbing in the bottom nuts of the glasses on the two boilers that were working. I began to reconstruct things a bit in my mind, and then proceeded to catechise that picture of injured innocence, the fireman. The evidence being so complete, he could not deny opening the valves, but hedged a bit about the reason. However, I had a good idea of that, too, and on putting it up to him, he admitted the soft impeachment. He began the course of events by neglecting to watch his gauge glass, and when he did look, found the glass full, but how much more he knew not. However, he promptly stopped the feed pump, neglecting to shut the checks on the boilers. He then resumed his paper, being anxious to see how Foch was making out. Presumably he found the news to his liking, for when he next looked the water was about half glass. He congratulated himself on his excellent judgment in stopping the pump, and thought it would be all right now to start it up again. Here he struck a snag. The boiler checks not being dead tight, when the pump stopped some leakage occurred from boiler to pumps, resulting after a while in the pumps and heaters getting good and hot, too hot to handle water. Deciding that here again was a case for a good man to use his own judgment, he decided to pump some water through from the fire pumps, achieving the double purpose of feeding the boilers and cooling off the lines and pumps. He started up the fire pump, opened the discharge through the feed pumps, and left the main suction open. The water in the boilers did not rise, but it did somewhere



WHAT HAPPENED TO THE PISTON

else, and his ears were soon assailed by numerous strange noises. At the same time his gauge glass lamps started to lose their brilliancy, and it crept into his mind that something was wrong. He went up to the engine room just in time to hear a crash, and had then decided to go and get advice. His view of the matter was that it was decidedly unjust to spoil any poor man's Sunday by involving him in a series of untoward happenings that kept him in a state of nervous tension. Not having time to discuss the matter fully I went to ascertain the damage. I found both the crank pin and crosshead gib straps sheared off, the brasses themselves broken in several pieces, and all the oil piping twisted and broken. The cast iron crank case was also broken, though this was a detail. This was the outer damage. Next thing was to look for the internal troubles. The H. P. cover was removed and an attempt was made to move the piston ahead.. It was apparent at once that something was jammed, and jammed hard, as the hammer rebounded as though from an anvil. It was decided to take the nut off the end of the rod, and a spanner was brought for the purpose, but at the first application the end of the rod and the nut came away together, and it was evident that the rod had been ready to break. We then found that the piston came off the taper surprisingly easy, and after removing the piston from the rod a tentative tap with a hammer was tried on the end of the rod with the same result as before. The next step was to open up the L. P., and this achieved, the trouble was at once evident. The L. P. piston was cracked across, the crack being open from ⅛ in. to 3-16 in., and the piston had been forced over the taper into the parallel part of the rod, jamming on the walls of the cylinder. The only way it could be removed was to drill holes all round the boss and break a piece out, letting the piston come down on the rod, and relieving the pressure. The piston was then taken out in halves. The repairs necessary were new piston rod, new low pressure piston, new connecting rod end brasses, gibs, straps, cotters, and bolts complete, and oil piping, guards, etc., all of which was done at the factory.

Cause of the Trouble

What had happened was as follows: The water from feed pump had backed up through open heaters till they filled up to overflow level. The overflow took care of some of the water, but the level still rose till it came to the exhaust steam opening. Entering this it dropped down to the main heating exhaust and travelled along to the building. Presumably about this time the engineering genius in the boiler room, finding he was getting no water in the boilers, speeded the pump up a bit. There was some back pressure on the engine by now but the water had not yet reached the level of the cylinder. However, shortly after it did, with the results as named. When the final smash occurred the engine was just coming to the back centre. She must have been considerably slowed down from her normal 260 P. P. M., and was probably running about half that. The L. P. piston met a solid wall of water, and the energy of the fly wheel was enough to force the rod through the piston, splitting the piston and jamming everything hard and fast. The fly wheel still possessed considerable energy, the whole of which was applied to move the crank ahead, against the resistance of the immovable L. P. piston. The weakest parts were evidently the straps in crankpin and crosshead, and these parted. The fly wheel evidently made a few revolutions after this, as the connecting rod was thrown back near the front cover, and pieces of the bearing boxes were in the crankpit and on the floor, while the oil piping gave mute testimony of what it had gone through. The shock of the sudden stop on the H. P. end of the rod had to be absorbed by the piston nut, and this had evidently been too much for it. The metal had given, and the piston had loosened in the taper and was ready to let go at the first movement. This shows what can happen through one man's carelessness, and the guilty one should be susceptible to a more drastic punishment than being discharged as in these days being discharged holds no terror for the average fireman.

BURNING LIGNITE WITH THE MECHANICAL STOKER

Considerable difficulty has been experienced at various times in the burning of lignite slack. It is well known that lignite is very friable and although it contains 17 per cent. moisture, burns very quickly and is very difficult to fire by hand if results are to be satisfactory.

Competent engineers in Western Canada have long held the opinion that the most satisfactory way of burning lignite is to feed the lignite slack in a continuous slight stream. For this reason the est recently made at the Government of Alberta power station on the Galt Sprinkler Stoker is of particular interest and shows the excellent results obtained with these stokers in connection with the 200 h.p. B. and W. boiler there installed.

EVAPORATION TEST MADE AT THE GOVERNMENT OF ALBERTA POWER STATION, EDMONTON, WITH LIGNITE SLACK COAL.

Summary of Test.

1.	Date of test	Sept. 19, 1918
2.	Duration of test	7 hours
3.	Type of boiler	Babcock & Wilcox
4.	Heating surface of boiler	2,000 sq. feet
5.	Builder's rating	200 horse power
6.	Method of firing	Galt Sprinkler Stoker
7.	Grate surface	38 sq. feet
8.	Ratio of heating to grate surface	43 to 1

Fuel.

9.	Kind of fuel used on test	Pembina Lignite Slack
10.	Cost of coal per ton at bunker	$2.50
11.	Calorific value of fuel as fired	8,500 B.T.U.
12.	Percentage of moisture	17%
13.	Average thickness of fire	3 inches
14.	Total coal fired (wet)	7350 lbs.
15.	Total coal fired (dry)	6100 "
16.	Coal consumed per hour	1050 "
17.	Coal consumed per sq. ft. of Grate per hour	27.6 "
18.	Ash clinker and refuse	1199 "
19.	Total combustible	5106 "

Average Pressures and Temperatures.

20.	Steam pressure by guage	150 lbs.
21.	Temperature of water fed to boiler	180°
22.	Draft over the fire in inches of water	0.2
23.	Temperature of flue gases	420°
24.	CO^2	9%

Water

25.	Total water evaporated at 180° coal as fired	43,000 lbs.
26.	Water evaporated per hour at 180° coal as fired	6,143 "
27.	Total equivalent evaporation from and at 212°	46,526 "
28.	Hourly equivalent evaporation from and at 212°	6,646 "

Economic Results

29.	Water evaporated per lb. of coal, acutla conditions	5.85 lbs.
30.	Equivalent evaporation per lb. of coal from and at 212°	6.33 "
31.	Water evaporated per lb. of dry coal. Feed water at 180°	7.05 "
32.	Equivalent evaporation per lb. of dry coal and at 212°	7.62 "
33.	Evaporation per lb. of combustible feed water at 180°	8.42 "
34.	Equivalent evaporation per lb. of combustible from and at 212°	9.1 "
35.	Cost to evaporate 1000 lbs. of water into steam from and at 212°	19.8c
36.	Factor of evaporation	1.082¾

Efficiency.

37.	Efficiency of boiler, furnace and grate	72%

100 x item 30 x 970.4
item 11.

Boiler Rating.

38.	Horse power developed per hour	192 h.p.
39.	Percentage of builders rating developed	96%

TEST CONDUCTED BY:
MR. CHARLES A. DEFIEUX,
CHIEF ENGINEER OF GOVERNMENT POWER STATION.

FUNDAMENTALS OF INDUSTRIAL PROGRESS

I have just read Mr. S. R. Parsons' address (under the above heading), at the annual general meeting of the Canadian Manufacturers' Association at Montreal in June last. I beg to be permitted, through the medium of the POWER HOUSE, to express my views on this subject as a timely warning to my brother workmen, especially engineers.

I am certainly in sympathy with all the points in Mr. Parsons' address, especially with reference to the tariff. Personally, I have some experience of free trade and, plainly speaking, I have found it to be the enemy of the working class. Previous to the introduction of free trade in the British Isles there were numerous small concerns, such as grist mills, blacksmith shops, sugar beet factories, and shoemakers, etc., wherein a person could start for himself on very small capital and make a comfortable living.

Those concerns remained in existence for some time after the introduction of free trade, but gradually got swallowed up by the large monopolies.

Free trade created those monopolies which starved out the honest, industrious small manufacturer, because nothing but monopoly could stand against the inrush of imported finished articles. We ought to fight against monopoly and give everybody a chance.

It is also a fact that there were few industries harder hit by free trade than the farmer. He had to stop growing wheat altogether, and there were thousands of bushels of oats imported annually; also hay and cattle, which cut down his profits to a minimum. I am of opinion that if the Western grain growers had five years of reciprocity they would be clamoring for tariff reform.

We are a young country and we have a vast Dominion with abundance of mineral wealth of all kinds. Under the national policy we can develop that wealth and gradually become more and more independent. While under reciprocity our mineral wealth will be allowed to lie dormant and we will gradually become more and more dependent on others. Under reciprocity our hopes of one day becoming a great manufacturing centre are shattered.

Some people are inclined to look at this question only from a selfish point of view, viz., a cheaper cost of living; but they fail to realize that a cheaper cost of living means cheaper labor, or less wages; and if the cost of living was reduced 50 per cent. the farmers' product would also be reduced by that amount. I say, what is the use of a loaf of bread to me if it only costs 5c if I have not the money to buy it?

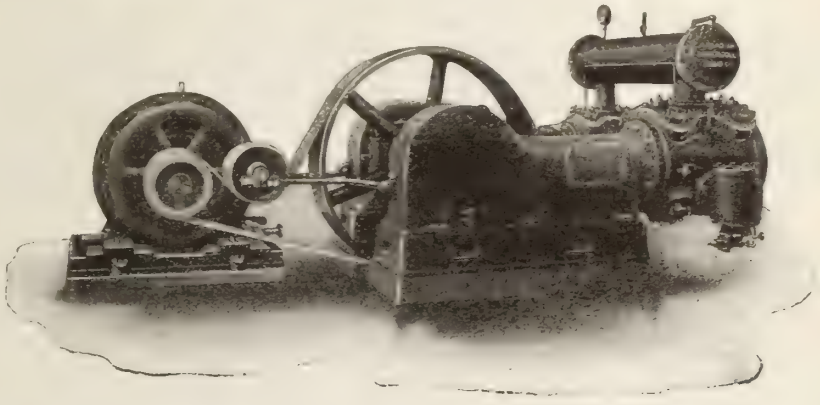
Trusting that my brother engineers will stand shoulder to shoulder with the manufacturers in support of the national policy. Thanking you in anticipation,

R. S. WRIGHT.

THE SHORT BELT DRIVE FOR AIR COMPRESSORS

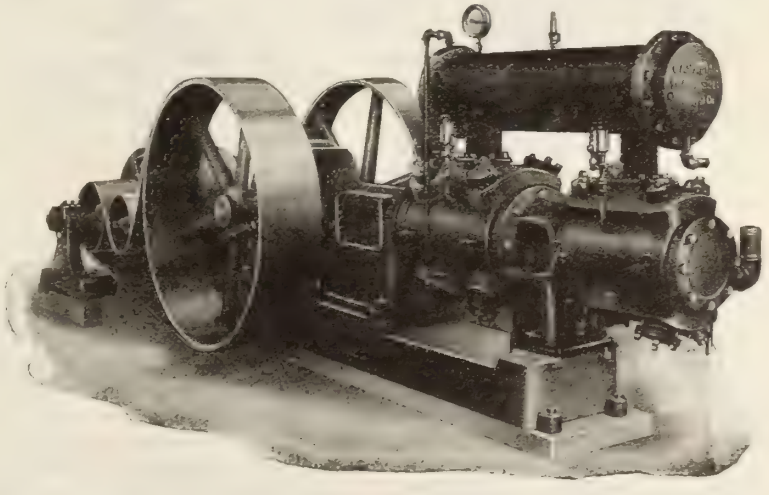
COMPRESSED air is a necessity in most plants. In the machine shop the air chuck is becoming more and more common, air hoists are used for heavy work in the machine shop and the foundry, and in the yard. In the majority of plants that use compressed air the installation of the compressor is usually a problem. In many plants the air compressor has to be squeezed somehow into an existing power-house where space is at a premium, and the question of the compact air compressor becomes very acute.

The steam-driven compressor by the very nature of its construction takes up very little room, but the steam driven type is not so common nowadays, and is usually found where steam is already generated for some other purpose. Now the ordinary belt drive for any type of machine takes up quite a floor space, and the compressor 8 feet long needs almost three times its own length for the ordinary belt drive. For the larger sizes the drive by direct-connected motor solves the space problem, but this form of drive is best suited to compressors large enough to require a motor of 100 H. P. or more, so that the direct driven compressor is not much help to the man who wants to get a small compressor into a corner "two by twice."



The short-belt drive solves the problem for him. The principle of the short-belt drive is best explained by a reference to the illustration; it consists simply of a light idler pulley riding on the belt between the compressor and the motor. But there is an important difference between the idler pulley of the short-belt drive and the ordinary idler; in the short-belt drive the idler is carried on arms mounted on the compressor frame, these arms are free to move up and down to a limited extent. Now the objection which at once leaps to the mind is that this idler pulley will increase friction to such an extent that other benefits will be of little use. However this objection is not so formidable as it looks. If the idler were rigidly fixed the friction would be objectionable, but it is not fixed, and the very slight added friction does not weigh against the advantages of the drive. So much is this the case that at least one large American company makes a specialty of short-belt drive for large mill power transmission of all descriptions.

As to the advantages:—in the first place the short-belt drive saves space; a 10 x 8 inch Canadian Ingersoll-Rand EL-1 air compressor with short-belt drive takes up only 11 ft., 0 in x 3 ft., 0 in.—belt, motor, and all. The outlay on belting is reduced, and the increased contact angle on belt wheel and pulley



adds a good deal more to the efficiency of the drive than is lost in idler friction. Lastly the belt needs no extra initial tension—many a good belt has been stretched too much for its first run;—and the idler automatically looks after tension.

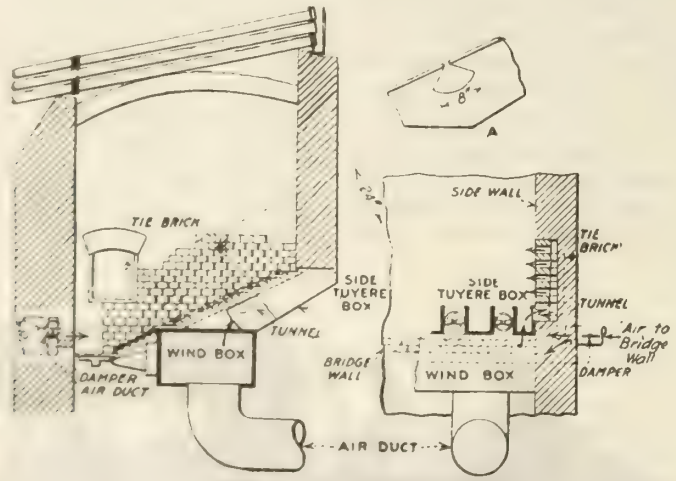
Where compressors are concerned both chain and gear drive are not only very expensive, but they are too rigid, and consequently wear quickly, so that they are not very serious competitors of the short-belt drive—and the short-belt drive is noiseless.

In the installation care should be taken to follow carefully the maker's instructions regarding alignment. The correct location for the idler is just where it would be in the sag of the belt if there were no arm to restrain it. The belt should be slack enough so that it will wrap around the small pulley at least 180 degrees and preferably more usually made up endless by the manufacturer and given a special treatment to make it pliable for this service. With this type of drive it is considered advisable to use belt dressing very sparingly.

THE BERNITZ METHOD OF FURNACE INSTALLATION

Efficiency in power plants at the present time is of the utmost importance and anything making for efficiency in furnace construction, fuel consumption and conservation, constant and uniform service, lessening of labor, and increased economy is specially commendable.

The source of all power derived from coal is the furnace, and a pound of coal saved or more effectively transferred into heat units, results in an increase along the entire line of the power installation Therefore, any improvement in the initial steps in the generation of power is of the greatest value, and it is to this beginning in power plant engineering that Mr. Ernest Bernitz devoted his efforts, resulting in his present invention.



DETAIL OF CONSTRUCTION

The invention has passed through all experimental stages, and exhaustive tests under the most varied and exacting conditions have now fully demonstrated it to be fundamentally sound, mechanically excellent, and commercially successful

Furnaces are constructed largely of firebrick, and whether ordinary grates or automatic stoker grates are used, it is a constant problem to keep the fire burning clear and to secure a maximum of combustion.

The proper combustion of coal is not an altogether simple matter. Coal naturally slags down into clinkers, especially where an intense fire is maintained. Clinkers readily adhere to the sides of the furnace walls, and fuse with the brick and build into masses, preventing a clear combustion of the coal adjacent to such clinkers. The clinker mass extends into and against the grates, obstructing and preventing their being shaken or oscillated, and diminishing the capacity of the fuel bed. The removal of such clinkers presents a task requiring exhausting labor with sledges, hammers, slice bars and the like and is frequently of daily occurrence and one most objectionable to the operators in charge. In order to operate the slice bars and to clear the sides of clinkers it is often necessary to partially or completely dump the fire and subsequent rebuilding in order to work the slice bars and keep the sides clear. The loss of efficiency while fires are down or drawn to remove said wall clinkers, and the even greater loss resulting from the dumping of the fires and rebuilding, cannot be readily determined but is recognized to be large.

The manual labor of running a furnace is another serious phase in the matter of securing boiler room efficiency, the men employed often shirking and half do the job, and frequently leave because of the hard, exhausting tasks. The common and natural result of working the slice bars and hammers is to break off the fire brick so that the entire walls have to be torn down and rebuilt every four or five weeks of use.

Numerous attempts have been made to keep the furnace wall free of clinkers by the use of iron furnace sides and pipes and other devices all of which have proven to be impractical and unsuccessful. This difficulty with clinkers on the furnace walls has been even greater at times in automatic stokers of the under feed type preventing the working and operation of the stokers by choking, etc., and consequently causing uneven and inefficient operation of the entire plant.

The Bernitz method consists in an arrangement of the fire brick in a furnace wall whereby air is admitted into the fuel bed through or between the bricks at the side or at the bridge walls. By supplying forced draft through these air passages, the face brick in the furnace wall is kept sufficiently cooled and consequently free from surface adhesion of clinkers. The consumption of fuel at these points is stimulated and increased.

The formation of clinkers is almost eliminated, the fires are kept uniformly going, and the intense labor, delays and losses incident thereto is reduced to a negligible quantity.

Where forced draft is applied to the furnace fires, a branch conduit to the air passage back of the spaced setting of brick is made, and the same forced draft applied through these narrow brick spaces in the side walls, thus requiring no undue expense. It has been demonstrated that the setting, while largely preventing the formation of clinkers, maintains the fire brick surface in a better resistance condition, so that even when clinkers are formed thereon, they are readily removed by the slice bars without tearing away part of the brick itself, and the furnace wall of fire brick will last indefinitely, from six months to a year, without rebuilding, in comparison with the former conditions at the same plant where entire rebuilding of the furnace wall was required every four or six weeks.

The circulation of air passing directly into the fire from the furnace wall, supplies a mass of fresh oxygen carrying air directly into the furnace fires at a point where it seems to be most needed, where it keeps the fire brick cool and prevents the same from becoming soft or "clinker-adhering." A damper or valve operated from outside instantly controls the amount of air thus supplied. No more forced draft is used than that supplied to the fires under the grates. In installations employing forced draft the desired amount is obtained by simply deflecting a part into the furnace walls provided.

The Bernitz setting as installed by the Bernitz Method Company, Boston, Mass., is usually applied to the side walls and may be applied to the bridge walls with excellent result. A few days watching will quickly determine the proper amount of opening of the damper for the supply of air therethrough.

Safety Code for the Operation of Electric Cranes

Association of Iron and Steel Electrical Engineers Formulates Complete Set of Rules For Operators—Adoption of Rules Will Lead to Fewer Accidents and Less Loss

A COMPLETE set of rules for the safe operation of electric cranes which may be the means of avoiding heavy losses through damage claims and which were prepared after an exhaustive study of the situation with respect to the rights of employers and employees and the law was presented to the Association of Iron and Steel Electrical Engineers by its safety committee at the association's twelfth annual convention in Baltimore, Sept. 11-14.

The committee in its report emphasized the necessity of the employer placing in the hands of his employees printed rules that should be complied with for prevention of accidents, stating that only by so doing may the employer remove the possibility of an injured workman obtaining excessive damages on the grounds that he had not been properly warned. Verbal instruction may be denied and a doubt created which would be favorable to the contestant. The law implies and in some cases demands that hazards of every situation employees are brought in contact with shall be made known to them before they begin work; also that they be instructed how to do their work so that no injury befall themselves or fellow workmen.

The committee declares that the rules should be understood by employers as well as employees and that they should be carried out even at the cost of delays. The rules provide for their own enforcement, each rule being followed by explanatory paragraphs stating the authority and duty of the employee. The rules follow:

1. While the operators of cranes usually are subject to orders of operating foremen, in the departments where they are employed, they should not start a motor even when ordered to do so, if so doing is likely to cause an accident.

(a) A signal to stop the travel of a crane or the movement of any of its parts, by whoever given, should be obeyed.

(b) A motor should not be started, to make a lift, if the operator knows that an improper hitch has been made with chains or slings, or if hooks permanently attached to the crane fixtures are not properly adjusted.

(c) In any case of doubt as to making a lift with safety the crane operator should call the attention of the foreman in charge to the condition that created the doubt.

2. The crane operator should be held responsible for the safe condition of his crane insomuch as he should know by observation from his cab and from inspections of the entire crane.

(a) He should see that all bearings are properly oiled; that all cables are traveling properly on their drums; that brakes, limited devices, controllers, switches, hooks, yokes, blocks and other attachments are in good and proper condition.

3. Operation of cranes while doing construction or repair work should be governed by a code of signals prescribed by the management. They should be given by some one person known by the operator to have authority. On occasions when it obviously is necessary to deviate from this rule the operator should act with exceeding caution.

(a) Cranes engaged in their regular routine work should follow such practices as is the custom in the mills they are operated in and as has been agreed on by the operating management.

(b) Changing rolls, removing and replacing parts of machinery, working two cranes to lift one load, and all unusual operations are classified with repair work and operators should be governed by signals when cranes are so employed.

4. When more than one crane is operating on a runway, an audible signal should be sounded, to avoid collisions when moving. Signals should be sounded when cranes are moving while carrying suspended loads in the vicinity of where men are working.

5. Cranes carrying material should be so manipulated as to avoid carrying suspended loads, or magnets with or without loads, over men working below. In cases where men working below cannot or do not from any cause whatever move away the crane should stop if the line of travel of the load or magnet is over the workmen.

6. Operators on leaving their crane cabs to inspect, oil or repair parts, or to get off the crane, should open the main switch and lock it open with a safety seal lock.

(a) Switches controlling the current to magnets should be kept constantly open and locked open while the magnets are detached, or while they are not in use.

(b) On notification from workmen that they want to disconnect the magnet, the operator should open the main switch and lock it open, before the wires are disconnected.

7. When handling ladles filled with molten metal, the brakes for controlling ladle hoists should be tried to see if they are in good working order before the ladle is moved from over its support. To make this trial the ladle should be lifted a slight distance, then apply the brake to see if it will hold the load.

(a) Ladle cranes with but single motors and outfits for the ladle hoists should not be used to handle a ladle containing metal when the brakes will not hold.

8. Operators should not leave the crane cab for any purpose whatever while a heat of metal is suspended from the crane. In case any adjustment of parts of the crane is required help should be called on to make it.

9. Operators should be responsible for preventing men from riding on their cranes who are not required to do so for some purpose. They also should be responsible for preventing men from riding on any attachment to the cranes as hooks, magnets, etc.

(a) At all times, whether carrying loads or not, hooks and chains should be kept high enough to clear men or apparatus below the crane.

(b) Blocks should not be lowered below a point where less than one and one-half turns of cable will remain on the drum.

10. It is not good practice to make side pulls. If they are permitted they never should be made by use of ladle hoist.

11. Prompt action is required to stop the descent of a load when the brake will not hold. If it should be necessary to apply power to a motor in order to stop the travel of a crane or the descent of a load the contact point of the controller lever should be moved for lifting or reversing as the case may require, one point only beyond the off position. If this does not give enough power then try the second point, continuing the movement one point at a time as necessity requires, but no more power should be applied than is actually required to bring the crane or load to a stop.

12. Two or more safety seal locks for locking switches open should be carried in crane cabs along with the tool equipment. These locks should not be used for any other purpose than to keep a circuit open when the closing of it might cause an accident.

(a) The crane operator should use a safety lock for locking the main switch open every time he leaves the cab to go on the crane runway, or out on the crane for inspection or to make adjustment of parts.

(b) The inspector should, in addition to notifying the crane operator of his intentions, use a safety lock for locking the main switch open, every time he goes out on the crane.

(c) Repairmen should in addition to notifying the crane operator of their intentions, use a safety lock for locking the main switch open every time they go on the crane. The foreman in charge of repairs should be responsible for locking open the main switch and all individual switches, while repairs are going on and for removing the locks when the repairs are finished and the men are off the crane.

SELECTED MARKET QUOTATIONS

A Record of Prices Current on Raw, Semi-finished, and Finished Materials Entering Into the Manufacture and Operation of Power Plant Equipment

BOILER TUBES

Size	Seamless	Lap-welded
1 in.	$36 00	$.....
1¼ in.	40 00	.....
1½ in.	43 00	36 00
1¾ in.	43 00	36 00
2 in.	50 00	36 00
2¼ in.	53 00	38 00
2½ in.	55 00	42 00
3 in.	64 00	50 00
3¼ in.	.....	58 00
3½ in.	77 00	60 00
4 in.	90 00	75 00

Prices per 100 feet, Montreal and Toronto.

PLATES

	Montreal	Toronto
Plates, ¼ to ½	$10 00	$10 00
Heads	10 30	10 25
Tank plates, 3-16 in.	10 50	10 10

WROUGHT PIPE

Effective Jan. 7, 1918.
Standard Buttweld.

Size	Black Per 100 feet	Galvanized Per 100 feet
⅛ in.	$ 6 00	$ 8 00
¼ in.	5 16	7 29
⅜ in.	5 16	7 29
½ in.	6 55	8 12
¾ in.	8 28	10 41
1 in.	12 24	15 39
1¼ in.	16 56	20 82
1½ in.	19 80	24 89
2 in.	26 64	33 49
2½ in.	42 72	53 53
3 in.	55 85	70 00
3½ in.	70 84	87 56
4 in.	83 93	104 10
Standard Lapweld		
2 in.	29 60	36 08
2½ in.	44 46	54 70
3 in.	58 14	71 53
3½ in.	72 68	90 62
4 in.	86 11	107 37
4½ in.	97 79	122 56
5 in.	114 00	142 82
6 in.	147 80	185 28
7 in.	192 80	241 57
8L in.	202 50	253 75
8 in.	233 30	292 32
9 in.	279 50	350 18
10L in.	259 20	324 80
10 in.	333 70	418 18

Prices—Ontario, Quebec and Maritime Provinces

WROUGHT NIPPLES

4" and under, 45%.
4½" and larger, 40%.
4" and under, running thread, 25%.
Standard couplings, 4" and under, 35%.
4½" and larger, 15%.

IRON PIPE FITTINGS

Malleable fittings, class A, 20% on list; class B and C, net list. Cast iron fittings, 25% off list. Malleable bushings, 25 and 7½%; cast bushings, 25%; unions, 45%; plugs, 20% off list. Net prices malleable fittings; Class B black, 24½c lb.; Class C black, 15¾c lb.; galvanized, Class B, 34c lb.; Class C, 24½c lb. F.O.B. Toronto.

COLD ROLLED SHAFTING.

At mill ..... list plus 40%
At warehouse ..... list plus 50%
Discounts off new list. Warehouse price at Montreal and Toronto.

FINISHED IRON AND STEEL

Per lb. to Large Buyers	Cents
Iron bars, base, Toronto	$5 25
Steel bars, base, Toronto	5 50
Steel bars, 2" to 4" base	5 00
Iron bars, base, Montreal	5 25
Steel bars, base, Montreal	5 50
Reinforcing bars, base	5 25
Small shapes	5 75

SHEETS

	Montreal	Toronto
Sheets, Black, No. 28.	$ 8 00	$ 8 25
Sheets, Black, No. 10.	10 00	10 00
Canada plates, dull, 52 sheets	9 00	8 65
Canada plates, all bright	9 50	9 50
Apollo brand, 10¾ oz. galvanized	....	....
Queen's Head, 28 B.W.G.	....	....
Fleur-de-Lis, 28 B.W.G.		
Gorbal"s Best, No. 28.		
Colborne Crown, No. 28	....	....
Premier, No. 28 U.S.	....	9 20
Premier, 10¾ oz.	....	9 50

PROOF COIL CHAIN B

¼ in.	$14 35
5-16 in.	13 85
⅜ in.	13 50
7-16 in.	12 90
½ in.	13 20
9-16 in.	12 70
⅝ in.	12 50
¾ in.	12 40
⅞ in.	12 90
1 in.	12 65
Extra for B.B. Chain	1 20
Extra for B.B.B. Chain	1 80

ELECTRIC WELD COIL CHAIN B.B.

⅛ in.	$13 00
3-16 in.	12 50
¼ in.	11 75
5-16 in.	11 40
⅜ in.	11 00
7-16 in.	10 60
½ in.	10 40
⅝ in.	10 00
¾ in.	9 90

Prices per 100 lbs.

FILES AND RASPS

	Per Cent.
Great Western, American	50
Kearney & Foot, Arcade	50
J. Barton Smith, Eagle	50
McClelland, Globe	50
Whitman & Barnes	50
Black Diamond	37½
Delta Files	37½
Nicholson	37½
Globe	50
Vulcan	50
Disston	50
P.H. and Imperial	50

OILS AND COMPOUNDS

Castor oil, per lb.	....
Royalite, per gal., bulk	18
Palacine	21
Machine oil, per gal.	26½
Black oil, per gal.	15
Cylinder oil, Capital	49½
Cylinder oil, Acme	39½
Standard cutting compound, per lb.	06
Lard oil, per gal.	2 60
Union thread cutting oil antiseptic	88
Acme cutting oil, antiseptic	37½
Imperial quenching oil	39½
Petroleum fuel oil	13½

BELTING—No. 1 OAK TANNED.

Extra heavy, single and double	30-5%
Standard	40%
Cut leather lacing, No. 1	$1 95
Leather in sides	1 75

COAL AND COKE.

Solvay Foundry Coke	.....
Connelsville Foundry Coke	.....
Steam Lump Coal	.....
Best Slack	.....

Net ton f.o.b. Toronto.

BOLTS, NUTS AND SCREWS

	Per Cent.
Coach and lag screws	25
Stove bolts	55
Plate washers.....list plus	20
Machine bolts, 7-16 and over	net
Machine bolts, ⅜ and less	10
Blank bolts	net
Bolt ends	net
Machine screws, fl. and rd. hd., steel	27½
Machine screws, o. and fil. hd., steel	10
Machine screws, fl. and rd. hd., brass .....add	20
Machine screws, o. and fil. hd., brass .....add	25
Nuts, square blank .....add	$1 50
Nuts, square, tapped.....add	1 75
Nuts, hex. blank .....add	1 75
Nuts, hex. tapped .....add	2 00
Copper rivets and burrs, list plus	30
Burrs only list plus	50
Iron rivets and burrs	15
Boiler rivets, base ¾" and larger $8	50
Structural rivets, as above	8 40
Wood screws, flat, bright	72½
Wood screws, O. & R., bright	67½
Wood screws, flat, brass	37½
Wood screws, O. & R., brass	32½
Wood screws, flat, bronze	27½
Wood screws, O. & R., bronze	25

MISCELLANEOUS.

Solder, strictly	0 60
Solder, guaranteed	0 70
Babbitt metals .....18 to	1 00
Soldering coppers, 3 to 6 lbs.	0 64
Putty, 100-lb. drums	5 20
White lead, pure, cwt.	16 20
Red dry lead, 100-lb kegs, per cwt.	15 50
Glue, English	0 35
Gasoline, per gal., bulk	0 33
Benzine, per gal., bulk	0 30½
Pure turpentine, single bbls., gal.	1 03
Linseed oil, raw, single bbls.	1 95
Linseed oil, boiled, single bbls.	1 98
Lead wool, per lb.	0 15
Plumbers' oakum, per cwt.	9 00
Sandpaper, B. & A.....list plus	20
Emery Cloth.....list plus	20
Sal Soda	0 03½
Sulphur, rolls	0 05
Sulphur, commercial	0 04½
Rosin "D." per lb.	0 03
Rosin "G." per lb.	0 03½
Borax crystal and granula	0 14
Wood alcohol, per gallon	1 80
Whiting, plain, per 100 lbs.	2 20

COPPER PRODUCTS

	Montreal	Toronto
Bars, ½ to 2 in.	$42 50	$43 00
Plain sheets, base 16 oz. and heavier	46 00	44 00
Copper sheet, tinned, 14x60 in., 14 oz.	48 00	48 00
Copper sheet, planished, base 16 oz. and heavier	57 00	45 00
Braziers' in. sheets, 6x4 base	45 00	44 00
Tubing T.P.S., base ¾ in. up to 3 in.	60 00	60 00

Above prices are full sheets and bars. Cut sheets and bars are 5c per lb. higher.

BRASS PRODUCTS.

Brass rods, base ½" to 1" rd.	$0 43
Sheets 24 oz. and heavier base	0 48
Brass tubing, seamless	0 55
Tubin, I.P.S., 1" base	0 55

POLISHED DRILL ROD.

Discount off list, Montreal and Toronto ..... Net

RUBBER BELTING

Standard	10%
Best grades	15%

WASTE

White.	Cents per lb.
XXX Extra	21
Peerless	21
Grand	19¾
Superior	19¾
X L C R	18½
Atlas	18½
X Empire	17¼
Ideal	17¼
X press	16
Colored.	
Lion	15
Standard	13½
No. 1	13½
Popular	12
Keen	10½
Wool Packing	
Arrow	25
Axle	20
Anvil	15
Anchor	11
Washed Wipers	
Select White	11
Mixed colored	10
Dark colored	09

This list subject to trade discount for quantity

MILLED PRODUCTS

	Per Cent.
Set screws	25
Sq. & Hex., Head Cap Screws	20
Rd. & Fil Head Cap Screws	Net
Flat & But. Hd. Cap Screws plus	Net
Fin. & Semi-fin. nuts up to 1 in.	25
Fin. and semi-fin. nuts, over 1 in., up to 1½ in.	20
Fin. and semi-fin. nuts, over 1½ in., up to 2 in., list plus	10
Studs	20
Taper pins	40
Coupling bolts, pins	10
Planer head bolts, without fillets .....list plus	10
Planer head bolts, with fillet list plus 10 and	10
Planer head bolt nuts, same as finished nuts.	
Planer bolt washers	net
Hollow set screws..list plus	20
Collar screws...list plus	30, 10
Thumb screws	20
Thumb nuts	65
Patch bolts .....add	40, 10
Cold pressed nuts to 1½ in. add	$4 50
Cold pressed nuts over 1½ in. .....add	$7 00

METALS

	Montreal	Toronto
Lake copper	$31 00	$29 50
Electro copper	31 00	29 50
Castings, copper	30 00	28 50
Tin	125 00	125 00
Spelter	11 50	11 00
Lead	10 00	10 00
Antimony	17 50	18 00
Aluminum	55 00	58 00

Prices per 100 lbs...

ROPES AND PACKING

Packing, square braided	0 34
Packing, No. 1 Italian	0 40
Packing, No. 2 Italian	0 32
Pure Manila rope	0 39
Transmission rope, Manila	0 45
Drilling cables, Manila	0 41

LEAD SHEETS

	Montreal	Toronto
Sheets, 3 lbs. sq. ft. lb.	$12 00	$13 25
Sheets, 3½ lbs.	12 00	13 25
Sheets, 4 to 6 lbs.	13 00	12 50

Cut sheets, ¾c per lb. extra.
Cuts sheets to size, 1c per lb. extra.

How they Cheer for Alexander!

Again he wins in under 40 minutes—

UP stepped Alexander to the start! A rival cleaner was rounding the track at four to six hours to the lap.

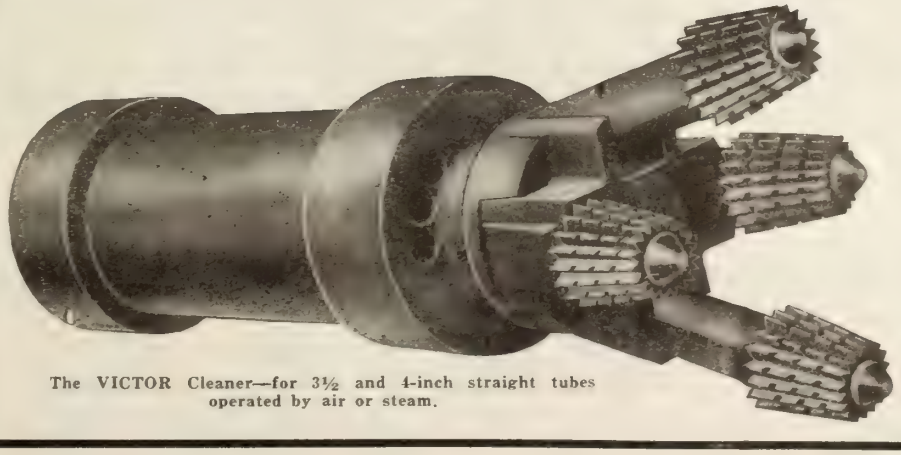
Bang! went the gun. Off shot Alexander, his spurs flashing behind him. Forty minutes was his time on the first tube. Then thirty-four—then a tube in thirty minutes!

Thirty minutes against four to six hours!

Count on Alexander, the Victor Tube Cleaner, for speed and good performance. Ask more about him. Write for Catalog H.

Liberty Manufacturing Company

443 Diamond Street, Pittsburgh, Pennsylvania



The VICTOR Cleaner—for 3½ and 4-inch straight tubes operated by air or steam.

TRADE GOSSIP

London, Ont.—A new heating plant is to be installed in the County Court building, for which tenders will shortly be called.

Summerland, B.C.—The Town Council of Summerland are considering the laying of a pipe line, according to Councillor Johnson.

Rosthern, Sask.—The Town Council of Rosthern have in mind the construction of a plant for sewage disposal, the estimated cost being $15,000. Mr. R. S. Fleury is the mayor.

Preston, Ont.—Tenders for the construction of an 8-inch sewer will be shortly called for by the Board of Works. Mr. Wismer is the deputy reeve.

Toronto.—The Hydro Electric Commission has granted an extension of time on the tenders for the four 52,500 h.p. turbines for the Chippawa-Queenston development. The new date is November 1st.

Change of Name.—The Lauzon Engineering Co., Ltd., of Levis, P.Q., has changed its name to Lauzon Engineering, Ltd. There is no change of directors or staff. Mr. Henry Paquette is the managing director.

London, Ont.—City Engineer Bazur of London is considering alternative schemes for raising the sewage from the low level districts to the level of the city sewers. There are two plans, one being to raise the sewage by direct pumping into the King street sewer, and the other to pipe the sewage over to West London and have it pumped from there when the proposed pumping plant is installed. The objection to the latter plan is the delay that might ensue in handling the sewage from Penman's, Ltd., while waiting to make the connection.

McAvity Plant Growing.—The McAvity machine plant, Marsh road, St. John, N.B., is rapidly developing into one of the largest enterprises of the kind in eastern Canada. The 400-foot unit, which was completed in such record time in 1916, has recently had a unit of similar dimensions added to it and this is being quickly filled up with machinery. But even with this enlargement the firm are not satisfied, for within a few weeks the erection of another large foundry building has been begun on the southern end of the company's lot near Westmorland road. Grant & Horne, who constructed the original unit have the contract for the later additions.

To Save Metal.—Discussing the matter of pig and scrap supplies, a representative of the White Mfg. Co., Guelph, makers of the White Sewing Machine Co., stated that their stock was not being replenished at a very rapid rate. As a matter of fact not more than 25 per cent. of the usual pig iron supply was coming in. The fact that a fairly large stock was kept on hand was helping the plant out now. A change is being introduced by which wooden legs or frames will be used in place of iron, and in this way a considerable quantity of metal will be saved, and the machine frames will lose neither strength nor rigidity.

New Boiler Plant.—The Tidewater Shipbuilders, Ltd., of Three Rivers, Que., are going in for the building of marine engines and boilers at their shipyards. They are installing buildings and plant for this purpose at an estimated cost of half a million dollars.

C.G.E. in Enlarged Quarters.—The sales and supplies departments of the Canadian General Electric Company, Toronto, are moving into their new quarters in the new building which has been erected on the property adjoining the company's head office building at the corner of Simcoe and King streets. The executive, engineering and foundry purchasing department's offices will remain in the main building on the corner.

Start Night School.—The Montreal Technical School is starting a night class for instruction in oxy-acetylene and electric welding, this course will constitute a series of 20 lessons and will be in session every Friday evening during the winter months, commencing on the 4th of October. Mr. C. Royer, manager of the Welding and Supplies, Limited, will be the instructor of the class.

New Boiler Shop.—The Waterous Engine Works are making a $16,000 addition to their boiler house.

Contract Awarded.—The Nova Scotia Construction Company has been awarded the general contract for the Sacred Heart Convent power house and coal cellar to cost $13,000.

The H. W. Johns-Manville Co. have issued a booklet dealing with the waste of fuel in power plants. The pamphlet lists certain common but preventable fuel losses which can be corrected by using proper remedies. Air leakage is dealt with and a method is given of finding leakages. Leaking baffle walls, heat radiation, and heat losses from pipes are dealt with, as well as preventable losses in the engine room.

New Motor Plant.—At a special meeting of the Chatham City Council an agreement was signed between the city and the Denby Motor Trucks Company calling for the erection of a $20,000 plant here, to be ready for occupancy by March 1, next. The plant is to employ at least thirty hands and to pay at least $20,000 a year in wages. The company is newly incorporated in Canada, with a capital stock of $200,000. The city will vote on giving the company three acres of land now, and an additional acreage will be made available if the company needs it within four years.

SOME LARGE TURBINES

The largest turbine in the world is owned by the J. P. Norris Company at Shawinigan, on the St. Maurice River, eighty-four miles from Montreal. The wheel is 30 ft. in diameter, with a horizontal shaft, and is designed to give 10,500 h.p. The runner weighs five tons, and is made of bronze. The shaft weighs ten tons, being 52 ft. 3½ in. long, 22 in. in diameter at the centre, and tapering to 16 in. on the end which is coupled to the generator, and to 10 in. on the other end. The water at the rate of 400,000 gallons per minute flows under 140 ft. head into the casing, which is of the well-known spiral volute form which is seen on centrifugal pumps. The inlet pipe is 10¼ ft. in diameter, and the water enters the wheel all round its circumference, being guided to the wheel vanes in the casing. These guide vanes are pivoted on pins, so that they can be given a small angular movement for regulating the speed. The water, after flowing radially inwards through the wheel, is discharged to right and left through two draft tubes. The direct coupled generator gives alternating current at 2,200 volts 3 phase for transmission to Montreal.

Though the turbines already described are for very high falls of water, it must not be assumed that more modest and less spectacular natural supplies of water power cannot be used. Messrs. Moorhead have a very satisfactory installation for electric lighting and power on the Newry River, the fall being only 5 ft. 6 in. on an old weir formerly used to divert the Newry River to a mill a quarter of a mile away. The turbine was supplied by Escher Weiss, and Co., of Zurich, and is of the radial inward flow type. The wheel consumes 6,200 cubic feet of water per minute, and gives 40 h.p. at 76 per cent. efficiency.

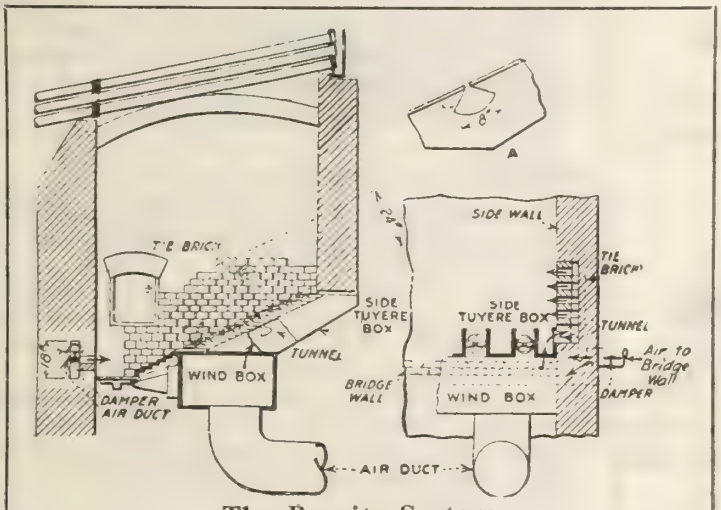
It is suspended from a collar bearing placed above the level to which the water may rise when in flood. The turbine spindle drives a horizontal shaft through level gearing in the ratio of 3 to 1. An overhead shaft is driven at 300 revolutions per minute by belting from the first shaft, and itself drives through belting a compound-wound four-pole direct current generator at 650 revolutions per minute. The dynamo gives 130 amperes at 230 volts. The loss in the transmission is only 7.2 per cent. over all, and the installation proves that in this country, where low heads only are available, the natural reserve of energy available in our rivers may be usefully and efficiently tapped.

At the present time the most remarkable development of water power is taking place in Sweden, where it is estimated that 4,000,000 to 6,000,000 h.p. is available, the power is for tramways and lighting for a hydro-electric railway, and for carbide, steel, zinc, and nitrate factories. Of 100 towns in Sweden, sixty-nine have hydraulically generated electric power stations finished or in course of construction. Three hydro-electric installations have been built for the State of Trollhatten, Elfkarleby and the Porjus of 60,000 h.p., 45,000 h.p., and 50,000 h.p respectively.

Add Power to Your Furnace

by eliminating the fuel-waste resulting from the "freezing" of clinkers to the side walls. The Bernitz Method of constructing side walls with interior air passages through which cooling air currents are passed to keep the bricks below the fusing point will

Positively Prevent the Accumulation of Clinker Mass



The Bernitz System
as applied to a Taylor Stoker Installation

The Bernitz Method

1. Saves coal by insuring more perfect combustion of the fuel used.
2. Increases boiler efficiency by shortening time spent in cleaning walls.
3. Increases efficiency by burning coal which formerly clinkered.
4. By shortening time spent in cleaning walls reduces influx of air through doors.
5. Saves B.t.u.'s usually lost by radiation through side walls.
6. Permits increased forcing of fires by eliminating danger of clinker "freezing."
7. Makes it possible to remove such clinkers as are formed without dumping fire.
8. By reducing manual labor in boiler room keeps laborers more contented.
9. By keeping fires clean insures greater uniformity in heat applied.
10. Is equally applicable to old or new constructions.

The Bernitz Method is licensed, not sold. It has received full patent protection in Canada and the United States and in foreign countries, and licenses under these patents are being granted on the basis of the H.P. rating of the boilers under which the Method is to be installed.

Several Installations in Canada

Write for full particulars to

BERNITZ METHOD COMPANY

506-507 Tremont Building
Boston, Mass.

The **LONG Patent Steam Trap**

Automatically drains jacket kettles, separators and steam mains. Nine hundred to 1,500 feet of one-inch pipe isn't beyond its ability. Also used with splendid success in drying room systems.

Only One Movable Part

Works against 1 and 200 pounds of pressure—no possibility of freezing. Has **two outlets** so it can be installed in any position.

Circular gives full particulars.

Write to-day.

J. T. LONG
84 Adam Street
MONTREAL, CANADA
If your dealer does not sell it, write direct

R.D. Wood & Co.
Philadelphia, Pa., U.S.A.

Water and Gas Work Supplies,
Cast Iron Pipe and Castings,
Mathews Hydrants and Valves,
Hydraulic Presses and
Accumulators,
Operating Valves,
Mechanically Operated Gas
Producers.

CONDENSED ADVERTISEMENTS

FOR SALE

FOR SALE CHEAP—ONE 30 K.W. GENERATOR Set 220 Volt D.C. Ideal Engine—Westinghouse Generator on sub-base—Switchboard; one 20 K.W. Generator Set on sub-base, same as above. These two sets are in perfect condition and we offer decided bargain for quick sale. Winnipeg Machinery Exchange, Sutherland and Gladstone Sts., Winnipeg.

FOR SALE—ONE 42-INCH, DOUBLE PLY, Viking brand, waterproof, leather belt, seventy-five feet long, in perfect condition, being operated only four thousand hours under normal load. Apply Public Utilities Commission, London, Ont. p10h

POSITION WANTED

STATIONARY ENGINEER WANTS A POSITION. Can handle all makes of engines or boilers. First-class man. Holder of certificate. Apply to Chas. Mismer, 920 Concession Street, Mt. Hamilton. (p11h)

WANTED.

REFRIGERATING ENGINEER REQUIRED TO take charge of plant in Montreal. Apply stating experience. Box 621, Power House. (p10h)

WANTED—STEAM OPERATING ENGINEER, to act as erector for steam specialty. Should be good steamfitter. Excellent opportunity. Write, stating age, experience, salary expected to start and give references. Address Box 619, Power House. p10h

BOOK REVIEWS

The Austin Book of Buildings (No. 5), just off the press, is a 64-page volume completely covering the length and breadth of the service as performed today by the Austin Company, Cleveland.

A perusal of the index shows the following well defined departments of this new catalogue. Starting with a definition of "The Austin Methods," its chapters cover the ten Austin Standards Building Units, Railway Standard Units, ters cover the ten Austin Standards, Specifications, the Austin Industrial Building Service, its equipment service, and export service. It also includes a long list of owners of Austin-built buildings, and a full explanation of the way to use Austin service to save time.

More than a half a hundred illustrations of interiors and exteriors, made from photographs are to be found on its 64 pages. Some are illustrations of the Austin Standards without special architectural features, others show how it is possible to adapt a standard proposition like the Austin Company's to special requirements. Different architectural details are shown to be easily met, whether for one building as in the case of the Dayton (Ohio) Metal Product Company or a large group of buildings as in the case of beautiful Nela Park (The National Mazda Lamp Works at Cleveland) where the architect's specifications were fully and satisfactorily met.

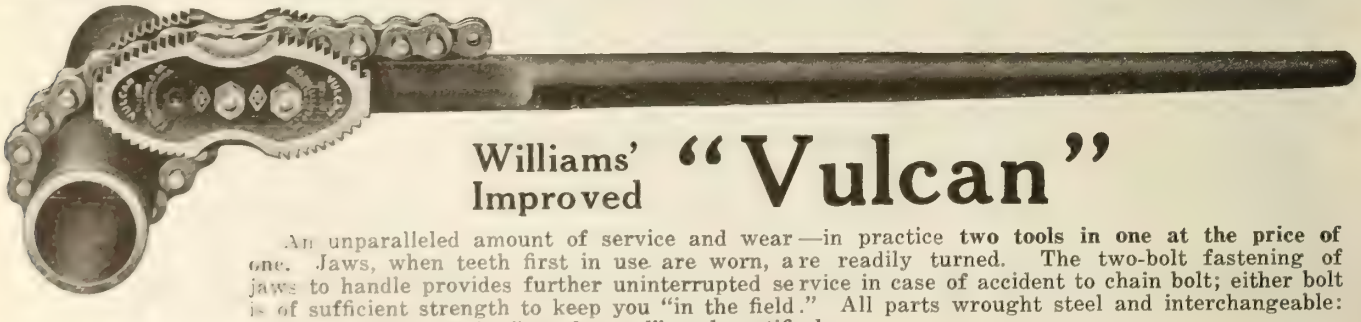
The Nela Park group is worthy of particular mention, for it includes an engineering building, sales building, administration building, research laboratory, working building, power house, garage, purchasing and service buildings.

Detailed drawings of all cross-sections, floor plans, side elevations, front elevations, etc., are given. Also full specifications for each standard, the exact uses for each type of building, as well as their adaptability to crane service of attractive Austin interiors and exteriors.

"Condensers, Pumps, Cooling Towers, Etc.," is the name of Bulletin 112-A just published by the Wheeler Condenser & Engineering Co., Carteret, New Jersey.

Readers contemplating the installation of a condenser will be interested in a discussion in this bulletin entitled "Choice of Kind of Condenser" and in the remainder of the bulletin which illustrates and describes other Wheeler condensing machinery in detail. The bulletin embraces large and small surface condensers showing typical complete installations, rectangular and cylindrical types, jet condensers, barometric condensers, Wheeler Edwards air pumps, Wheeler rotative dry vacuum pumps, the Wheeler turbo air pump; centrifugal pumps for circulating water, neutral and forced draft cooling towers. In addition a page is devoted to the Wheeler feed water heater and two pages to Wheeler multiple effect evaporators and dryers.

Peterborough.—The Town Council of Lakefield are looking for quotations on 6, 8 and 12-inch water mains. They are also considering the purchase of a double cylinder chemical fire engine.



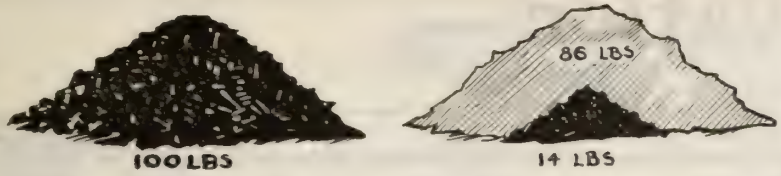
Williams' Improved **"Vulcan"**

An unparalleled amount of service and wear—in practice **two tools in one at the price of one.** Jaws, when teeth first in use are worn, are readily turned. The two-bolt fastening of jaws to handle provides further uninterrupted service in case of accident to chain bolt; either bolt is of sufficient strength to keep you "in the field." All parts wrought steel and interchangeable: **each and every chain "proof-tested" and certified.**

J. H. WILLIAMS & CO., "The Wrench People"
78 Richards Street,
Brooklyn, N.Y.

The A. G. Low Co., Ltd., 78 Pacific Ave., Saskatoon, Sask.
Agents for Manitoba, Saskatchewan, Alberta and British Columbia.

Study The Piles



Seven Times the Power for the Same Coal

The first pile represents coal used making steam to feed boiler using direct steam pump.

The black part of the second pile shows the relative amount of coal necessary to do the work with a Cole Return Trap.

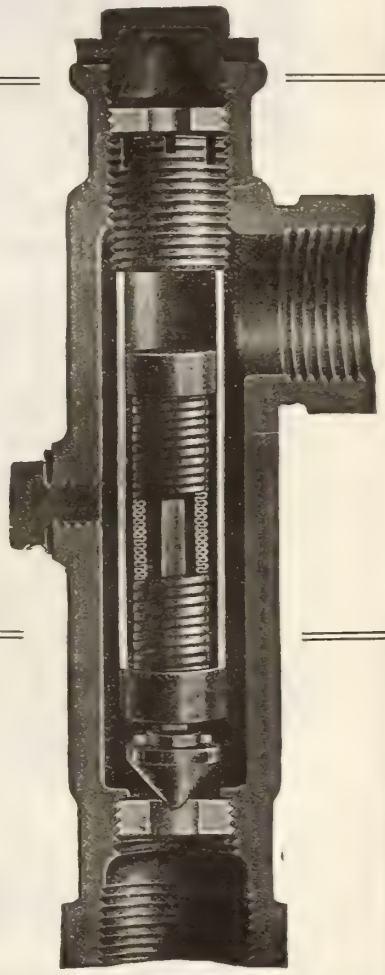
In other words, you get seven times the power for the same coal—or 86% of the fuel saved.

If you want further proof get our latest folder on boiler feeding—No. 9.

GEO. W. COLE, Ltd. 2002 Dundas St. W. TORONTO

STEAM TRAP SARCO

Is Hydraulically Operated
Automatic—Positive—Sure



The employment of the hydraulic principle as used in the Steam Trap Sarco gives this trap unique advantages and insures absolutely positive action.

Saving of fuel is an "essential industry" and the saving of steam means a saving of fuel.

The Sarco is small, compact, 100 per cent. automatic and small in cost. It can be used as an elbow or bend in any steam line. Its small cost makes it practical and profitable to trap steam lines at many advantageous locations (instead of one point).

When you plan to use a big, heavy, expensive trap, you cannot trap where you ought to, but where the trap fits. The Sarco fits everywhere and you can buy six for the price of a bucket or float trap. It is supplied for any pressure from 0 to 200 lbs.

Free 30-day trial will conclusively prove the value and need of the Sarco. Write for Circular No. J-6.

SARCO COMPANY, Inc.
Woolworth Bldg., New York City
Elliott Square, Buffalo
Drexel Bldg., Philadelphia
New Telegraph Bldg., Detroit
Monadnock Block, Chicago
Williamson Bldg., Cleveland
Healey Bldg., Atlanta.
and representatives in all principal cities.
Canada—Peacock Brothers, Montreal.

MacKinnon Steel Co. Ltd.
Formerly
MacKinnon, Holmes & Co., Ltd.
SHERBROOKE QUEBEC

Engineers, Manufacturers and Erectors of Steel Structures

We Specialize in

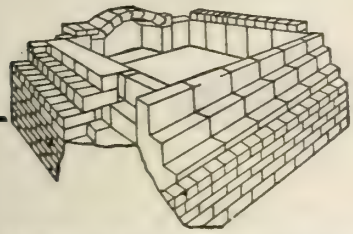
Bridges, Buildings, Towers, Tanks, Penstocks, Roof Trusses, Columns, Smoke Flues and Stacks, Coal Bins, Ore Bins, Buckets, Refuse Burners, Stills, Air Receivers, etc.

WRITE FOR PRICES.

NON-CORROSIVE
CYLINDER OIL
MANUFACTURED ONLY BY
E. H. KELLOGG & CO.
NOS. 242 & 244 SOUTH ST. NEW YORK, U.S.A.
FRICTION LOSS

An overload is often a necessity. But it is hard on an engine. To successfully carry an overload so that there will be no after effects on the engine a very careful selection of your oil should be made. An oil that is not free from impurities will cause a greater wearing on the bearings, a great friction loss will occur. You will need to fire the boiler more often because the engine will be harder to run. In this manner you lose out. You work harder, have larger operating costs, and less power all because of your oil. Do as a great many Canadian engineers have done—give Kellogg's "Non-Corrosive Cylinder Oil" a trial. Absolutely pure. Write us regarding it.

E. H. KELLOGG & CO.,
New York, U.S.A.



Gates Boiler Furnace
Patented 1916

Will last three times as long as ordinary good grade Fire Brick. These blocks are inter-locking, and made so that any handy man or fireman can renew them without disturbing any of the other brick work.

WRITE FOR PARTICULARS.

John W. Gates 2 St. James St., MONTREAL, QUE.

WALTER J. FRANCIS, C.E. M. Can. Soc. C.E. M. Am. Soc. C.E. M. Inst. C.E.
FREDERICK B. BROWN, M.Sc M. Can. Soc. C.E. Mem. Am. Soc. M.E. Mem. A.I.E.E.

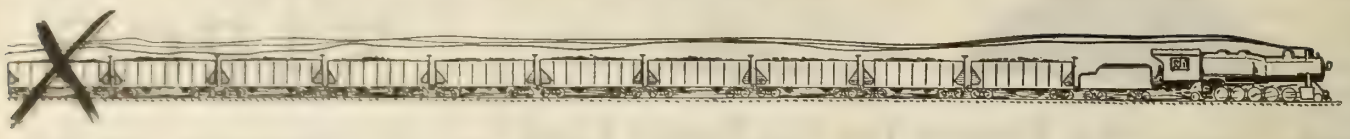
WALTER J. FRANCIS & COMPANY
CONSULTING ENGINEERS
Head Office, 232 St. James St., Montreal
Cable Address, "Walfran, Montreal"—W.U. Code.
Long Distance Telephone, Main 5643.

MONCRIEFF'S "UNIFIC" WATER GAUGE GLASSES

Stand in a Class by Themselves for Quality, Efficiency and Economy
A trial will convince you. Write for Catalog

W. J. WALL, 134-136 BLEURY ST., MONTREAL
(Canadian Representative)

Real Conservation—



GREEN'S ECONOMISERS

save one or more cars out of ten.

THE use of Economisers is more important now than ever before and all new plants should be equipped with them, also all old plants that are engaged in essential work.

The others will have to wait until after the war.

Some of the reasons for the importance of Economisers now are:

FIRST—They save 10 to 15 per cent. of the coal that would be needed if the boilers were operated without them.

SECOND—They can be used to increase the present boiler capacity or to get greater capacity out of new boiler equipment.

THIRD—The coal saving releases cars and railroad facilities which are very important under present conditions.

FOURTH—This saving also helps in overcoming the shortage of miners caused by enlistment or drafting.

FIFTH—If used to increase the boiler capacity this releases boilermakers and steel that can be used to make boilers for marine service and other important uses.

The complete list of reasons is too long to be given in detail. Our Engineers will be glad to give you others and also explain the application of Economisers to your plant.

A new Economiser Catalog will be ready soon. May we put your name on our mailing list now? Just fill in and send the coupon.

GREEN'S ECONOMISER, LTD.
TORONTO

Tear off here.

Green's Economiser, Ltd.,
605 Kent Building, Toronto.

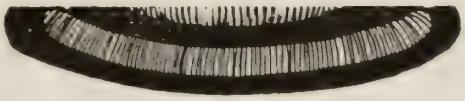
Please send a copy of your new Economiser Catalog to

Name .....

Position .....

Company .....

Address .....



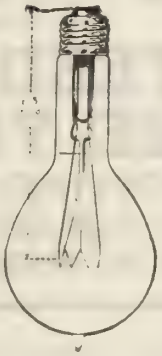
Reduction In Prices

on all large style

Sunbeam and Edison MAZDA LAMPS

NOW EFFECTIVE

MAZDA—the most efficient Tungsten Lamp made.



They retain their initial Candle Power during their whole life.

All Mazda Tungsten Lamps of our manufacture are guaranteed to give an average life of not less than 1,000 hours, in acordance with Standard Specifications issued by U.S. Government (Bureau of Standards.)

LONGER LIFE means POOR EFFICIENCY.

Why not write us to-day for our proposition covering your year's requirements?

Our prices will interest you.

CANADIAN GENERAL ELECTRIC CO.

LIMITED

Head Office : Toronto. Sales Offices : Montreal, Quebec, Halifax, Sydney, Ottawa, Cobalt, South Porcupine, London, Winnipeg, Calgary, Edmonton, Nelson and Vancouver.

This book should be in the hands of every pump user. A postal will bring your copy promptly

MARSH and AMERICAN

Steam and Power Driven Pumps and Air Compressors

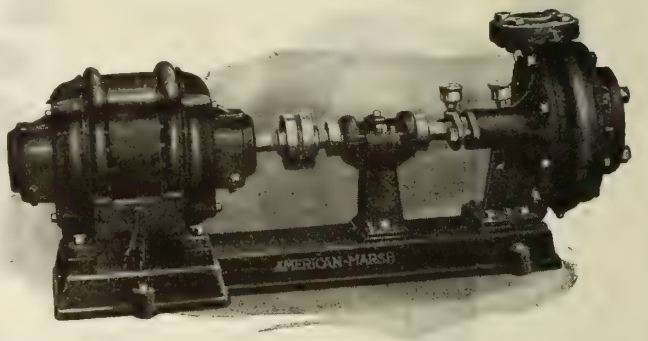
Marsh and American Pumps are especially adapted for long, hard service because they are *extra heavy* in design and of *extremely rigid construction*. Every unit is built amply strong to withstand 24-hour-a-day service and to stand up under any unforeseen strain which may be placed upon it. Piston rods on the steam pumps are extra large and made of solid bronze. The water ends are equipped with heavy cast bronze removable bushings.

This superior construction not only insures continuous and satisfactory operation, but practically *eliminates expensive shut-downs*. Marsh and American Pumps are the product of over 25 years' experience in the design and construction of high grade pumping machinery. Over 135,000 in actual service throughout the world.

The AMERICAN-MARSH LINE OF CENTRIFUGAL PUMPS is composed of both single and double suction types which are designed for heads up to 125 feet. They are equipped with wide ring oiled bearings and the single suction type has overhanging casing enabling the discharge to be taken at any angle desired.

CANADIAN AGENTS

A. R. Williams Machinery Co., Toronto.
Williams & Wilson, Montreal.
London Engine Supplies Co., London, Ont.
Stuart Machinery Co., Winnipeg.
Mechanics' Supply Co., Quebec, Que.
Gorman, Clancy & Grindley, Limited, Edmonton and Calgary.
Taylor Engineering Co., Ltd., Vancouver, B.C.



American-Marsh Centrifugal Pump.

American Steam Pump Company

Battle Creek, Mich.

Self-Lubricating

SAFETY PLASTic

METALLIC PACKING

FOR STEAM, WATER, AIR, GAS, ETC.

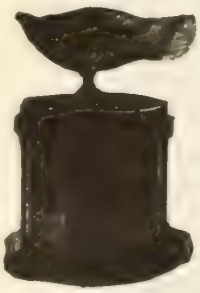
Pat. Dec. 22, 1903 Highest Award World's Fair, St. Louis, 1904

GUARANTEED TO LAST THREE YEARS

WITHOUT RENEWAL

Drop us a line and let us tell you all about this Remarkable Packing.

STEEL MILL PACKING CO., WINDSOR, ONT. Established 1899



In Bulk

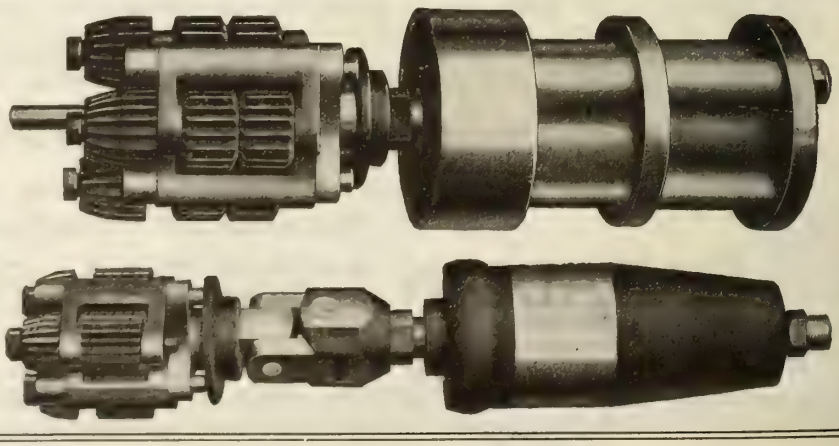
Practically Frictionless

In Cotton Tubes

ROTO TUBE CLEANERS

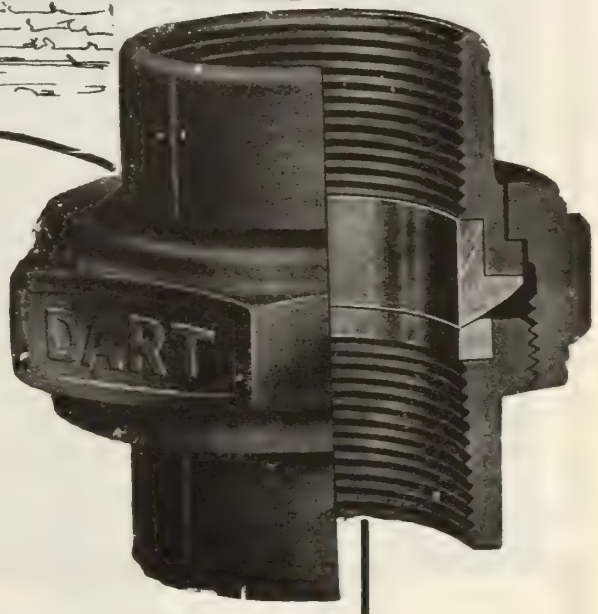
Type A.D.—Driven by Air or Steam
Type W.D.—Driven by Water Pressure

The use of Roto Cleaners is essential to the most efficient operation of Boilers, Condensers, Economizers, Evaporators, etc.
Roto succeeds where all others fail. It is faster, safer, more thorough and the standard of the largest steam power plants.



THE ROTO COMPANY
HARTFORD, CONN.
WRITE FOR CATALOG

Permanence



Dart Unions

are as the Pyramids in the Pipe Coupling World

Bronze to Bronze at the joint

They stay perfectly tight for years and years.

Require no attention when in service—never have to be replaced—and they can be disconnected and connected as often as desired without affecting their efficiency.

THE SECRET OF THE DART'S PERMANENCE lies in the facts (1st) that both faces of the joint are BRONZE (a non-deteriorating metal); (2nd) that the HEAVY IRON PARTS will not stretch or pull apart; and (3rd) that they are made in a factory whose only product is Dart Unions.

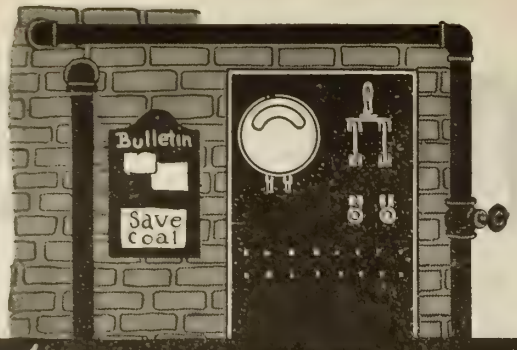
Pipe coupling trouble and their upkeep expense do not exist where Dart Unions are used.

DART Unions Never Leak

SOLD BY ALL DEALERS

Manufactured by
DART UNION CO., Limited
Toronto, Canada

If any advertisement interests you, tear it out now and place with letters to be answered.



Tycos Temperature Instruments

Industrial Thermometers (angle and straight stem)
Capillary Recording Thermometers
Self-Contained Recording Thermometers
Capillary Index (or Dial) Thermometers
Thermoelectric Pyrometers
Recording Thermoelectric Pyrometers
Fery Radiation Pyrometers
Temperature Controlling Devices—Time Controls
Coal Oil Testing Instruments
Capillary Electric Contact Temperature Controls
Laboratory Engraved Stem Thermometers
Hygrometers (wet and dry bulb) Indicating and Recording
Outdoor and Household Thermometers
Thermographs
Medical and General Use Thermometers
Hydrometers, M. C. Vacuum Gauges, Aneroid Barometers
Aviation Altimeters, Barographs, etc., etc.

That manufacturer expecting much through the installation of indicating, recording and controlling Temperature Instruments will realize in full such expectations and derive profit—if he specifies *Tycos* products.

We shall be glad to give detailed description of any of our temperature instruments

Taylor Instrument Companies

ROCHESTER, N.Y.

There's a *Tycos* and *Taylor* Thermometer for Every Purpose

201 Royal Bank Building, Toronto, Ont.

SAVE COAL!!

USE

ECONOMIC BOILER COMPOUND

The cry for economy has gone through the land as a war necessity, so why not cut down your COAL CONSUMPTION? If you will send us a piece of scale from your boilers we will analyze same and send you our ECONOMIC BOILER COMPOUND, which we will guarantee to remove the scale from your boilers, or no pay for same.

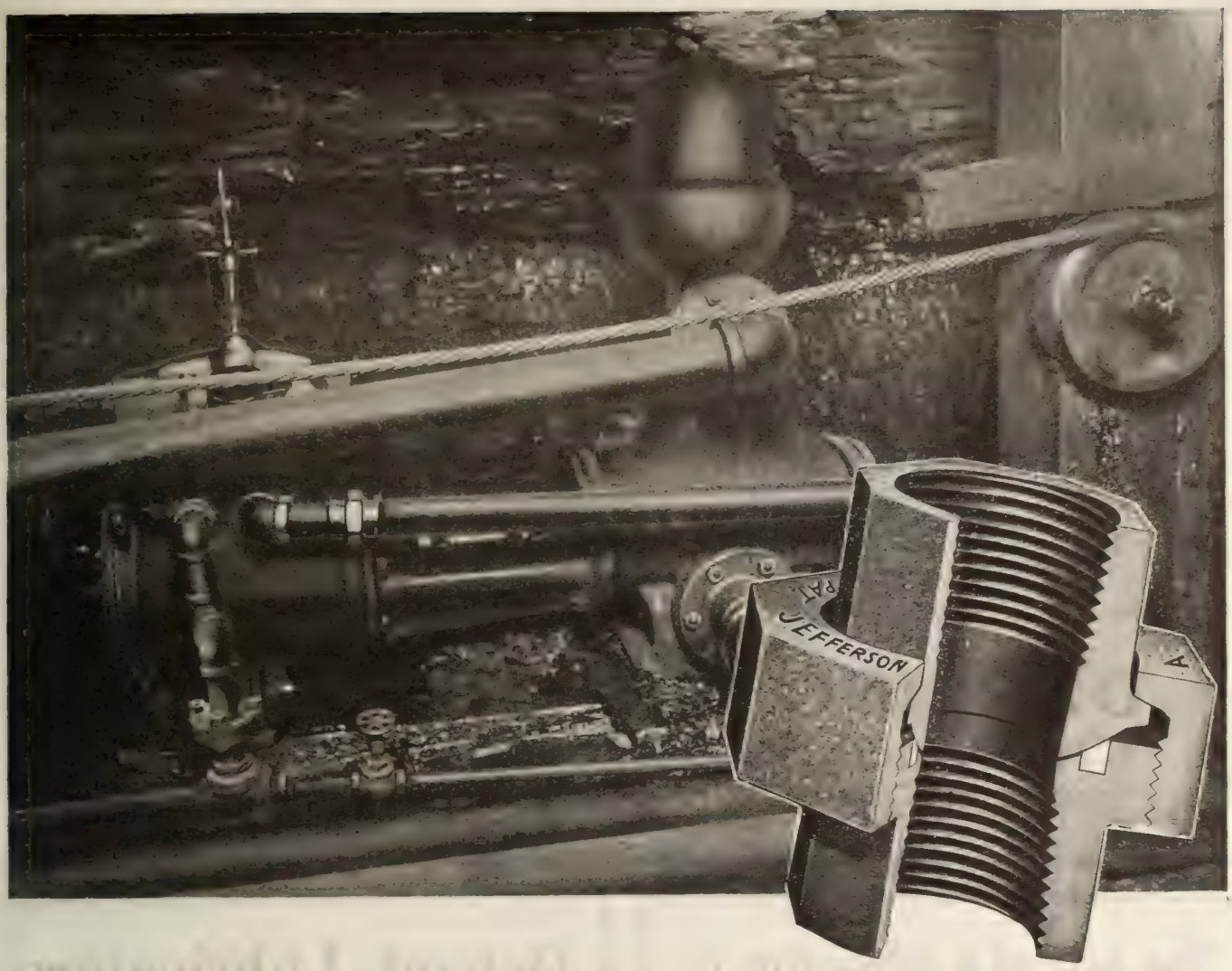
ECONOMIC BOILER COMPOUND

Manufactured by

Canadian Economic Lubricant Company, Limited

MONTREAL

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.



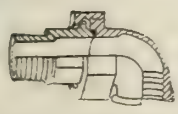
The Union for Power Plant Service—JEFFERSON

Whether hidden in a dark corner, hundreds of feet below the surface, or located within easy reach, you can depend upon JEFFERSON UNIONS to give perfect service wherever they are put to work. Rid yourself of power losses, leaks and pipe line troubles of all kinds by using JEFFERSONS.

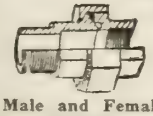
Why take chances with "Just-as-good" unions? The efficiency of the entire pipe line depends upon the quality of the unions installed. By selecting JEFFERSON UNIONS you are assured of perfect service under the severest test that can arise.

The Patented Brass Seat Ring, the Ground Ball Joint, the extra weight and high grade, air-refined malleable iron, etc., are all features to the success of JEFFERSON UNIONS.

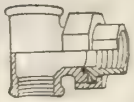
Your jobber has JEFFERSONS in stock. Get his opinion of them and you'll have no doubts as to the right union for your job. Write for our catalog, "UNIONS," which shows all types and sizes.



Union Elbow, an economizer of the most pronounced type. Also made all female.



Male and Female Union. Takes the place of an all-female union and a nipple. Makes a short connection.



Union Tee, with union on the outlet. Made also with male end on outlet.

JEFFERSON UNION COMPANY

LEXINGTON, MASSACHUSETTS

MAIL THIS HANDY COUPON FOR THE JEFFERSON BOOK "UNIONS."

Jefferson Union Co.,
Lexington, Mass.

Please send me without obligation on my part a copy of your new catalog.

Name .....

Firm Name .....

Address .....

10-18

THERE is one reliable and unfailing method of saving fuel in any and every known building in Canada.

The method is simple and economical.
It simply means the installation of the

Webster Vacuum System of Heating

If you are really desirous of economizing, besides getting greater and more uniform heating, why—**tell us.**

DARLING BROTHERS, LTD.
120 Prince St. MONTREAL, P.Q.
Vancouver, Calgary, Winnipeg, Toronto, Ottawa, Halifax

The test of a lubricator is what it can do

Rhinestones sparkle, but they can't cut glass.

Any lubricator may look good, and cost a lot of money to install, but it doesn't follow that it's going to perform its functions properly.

The Rochester Lubricator

can be likened unto the diamond—it looks good and is good, because it does the work it's supposed to do.

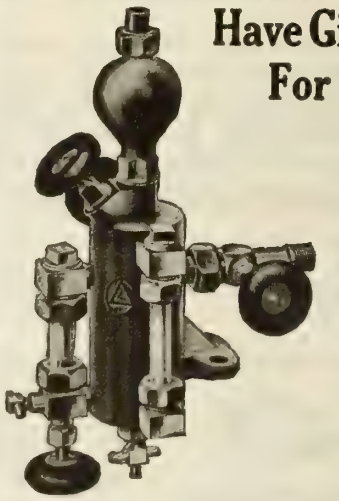
Manufactured by Greene, Tweed & Co.
New York

Sole Agents for Canada

Darling Brothers, Limited
120 PRINCE STREET MONTREAL

Detroit Lubricators

Have Given Satisfaction For Forty Years.



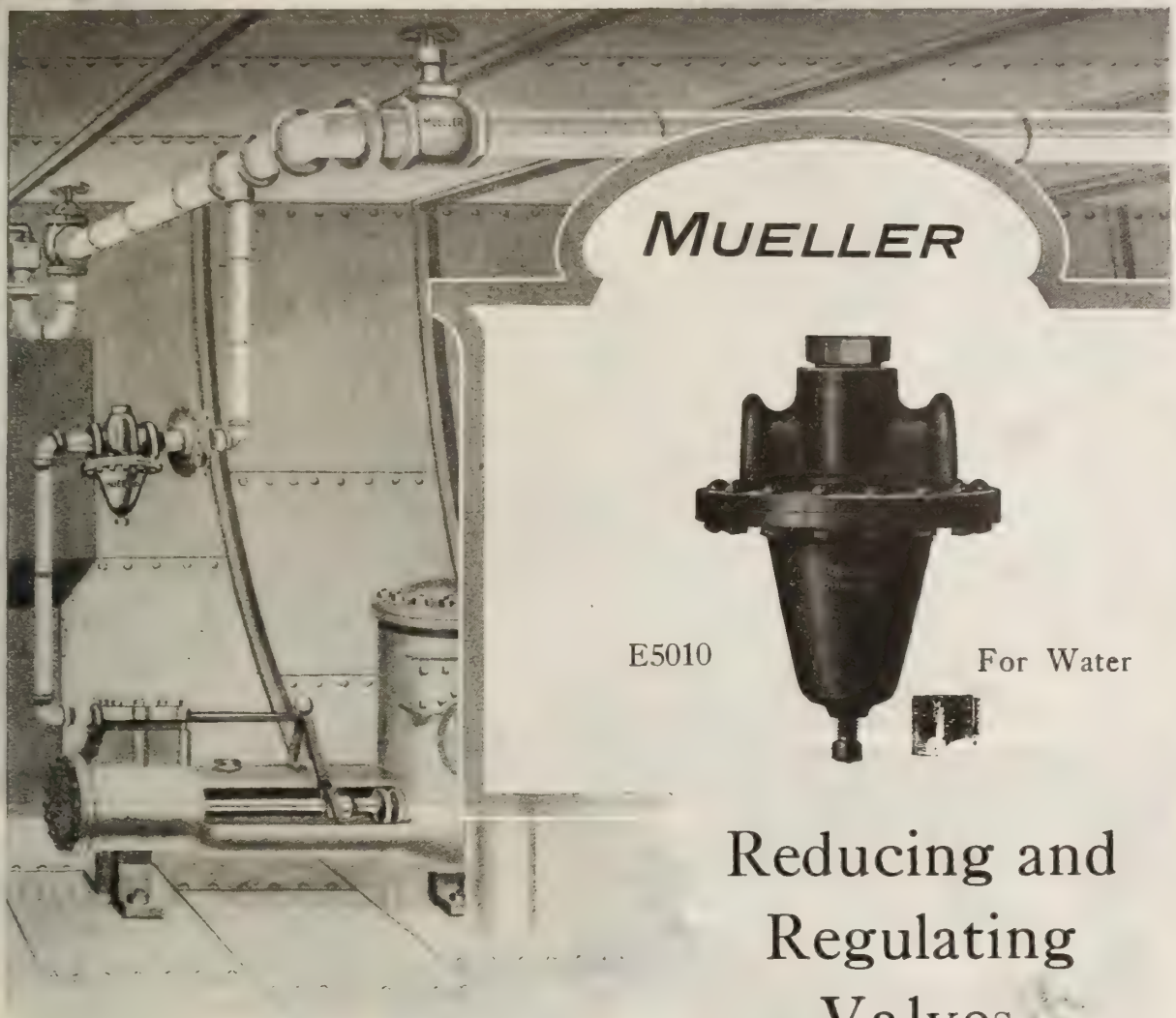
Built in a sufficient variety of styles to lubricate properly every type of steam engine, pump, gas engine, air compressor, etc.

Send to-day for catalog L 1. The information on lubricating devices contained in it will be valuable to you.

THEIR efficiency holds over half the world's trade.

Makers of Stewart Carburetors.

CANADIAN DETROIT LUBRICATOR COMPANY, LTD.
WALKERVILLE, ONT.



MUELLER

E5010 For Water

Reducing and Regulating Valves

Before you install your valve, be absolutely sure on these three points.

1. **The right kind** of valve is the one that is adapted to your particular service. No one type will answer all purposes. Different service and at times different conditions in the same kind of service necessitates different types of valves.

2. **The right size** of valve is the size that will make the proper reduction and regulation and has a wide enough seat opening to prevent obstruction and cutting out of the seat. *A general fault is using a valve that is too large.* Ordinarily they should be smaller than the pipe to which they are attached.

3. **Proper assembling** means that valves should have working parts suitable to service, and diaphragms and springs suitable to pressure range.

Don't guess. Consult us. When valves are installed under MUELLER supervision, we fully warrant them to perform the service for which we recommend them.

We make valves for water, steam, gas, air, oil and ammonia. There is a stock valve in our catalog that will meet your needs. If you have a specially intricate problem to solve, our experts are at your command.

H. MUELLER MFG. CO., LIMITED

SARNIA, CANADA

MUELLER

Canadian Turbines

Highest perfection in Normal Speed Turbines.

Step and Stepless Type Vertical Shaft Turbines.

Horizontal shaft equipment for every service.

The guaranteed working efficiency of these turbines is 85%. Their operating and governing qualities are unequaled.

Designed and manufactured by

THE CANADIAN TURBINE WATER WHEEL — CONSERVE THE WATER POWERS — TRADE MARK

Chas. Barber & Sons

Meaford, Ontario, Canada

Established 1867

THE CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED.

Fairbanks Scales

For more than 90 Years

The World's Standard for Accurate Weighing

The Canadian Fairbanks-Morse Co., Ltd.

Halifax, St. John, Quebec, Montreal, Ottawa,
Toronto, Hamilton, Windsor, Winnipeg,
Saskatoon, Calgary, Vancouver, Victoria.

THE CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

METLSKIN does prevent scale

Send for this illustrated booklet. It explains the dose, the method of action, and other important details

Some of Canada's and the United States' biggest and most representative plants have learned the truth of the above statement from first-hand experience.

So many "compounds" and "cure-alls" have been foisted upon unwary power-plant owners that the feeling, common to many of them, is one of doubt, of skepticism. And small wonder!

METLSKIN is not a "compound," nor does it work on the same principle. It is a boiler metal treatment, a boiler preservative that gradually removes scale by a safe process.

When the scale has been entirely removed METLSKIN forms a minute, grayish-white skin or covering over the bare metal.

So long as the daily dose is continued the scale-forming particles in the feed-water cannot adhere to the metal. Nor will METLSKIN work injury to any part of the boiler or system. That is one of the strongest features of the GUARANTEE BOND.

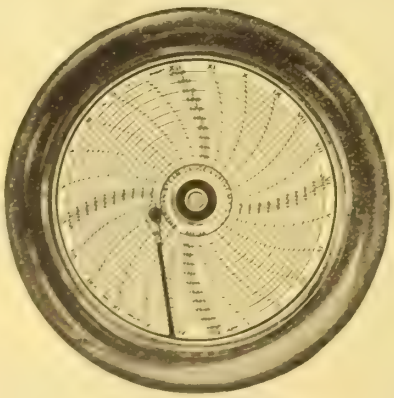
METLSKIN cannot contaminate the steam. It may be used safely in any plant where live steam comes in contact with the manufactured product.

If you are a skeptic, a doubter, ask for the booklet, GUARANTEE BOND, prices, etc. You will be interested, we know.

CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED

ST. JOHN QUEBEC MONTREAL OTTAWA HAMILTON TORONTO
WINDSOR WINNIPEG SASKATOON CALGARY VANCOUVER VICTORIA

American Recording Gauges



Help to maintain Uniform Pressures and to make permanent Records of Efficiency.

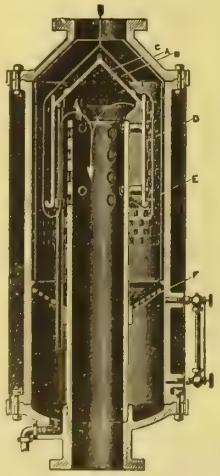
Send us details of your needs

Canadian Agents: Canadian Fairbanks-Morse Co., Limited
MONTREAL, TORONTO, QUEBEC, ST. JOHN

AMERICAN STEAM GAUGE & VALVE MFG. CO.
New York, Chicago, BOSTON, Atlanta, Pittsburg

III IMPORTANT THINGS

TO CONSIDER ABOUT A SEPARATOR.



I. THE PLAN—Is it sensible, will it work, no matter how large the Separator or how well made?

II. THE SIZE—Is it big enough regardless of plan, will it hold a good dose of water?

III. THE CONSTRUCTION—Is it strong enough, are flanges heavy, how will it look by the side of a nicely finished engine? Send for catalog and note these points in

Sweet's Separators

DIRECT SEPARATOR COMPANY
820 Geddes Street - SYRACUSE, N.Y

General Sales Agents:
Canadian Fairbanks-Morse Company, Limited
St. John, Montreal, Quebec, Ottawa, Toronto, Hamilton, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria

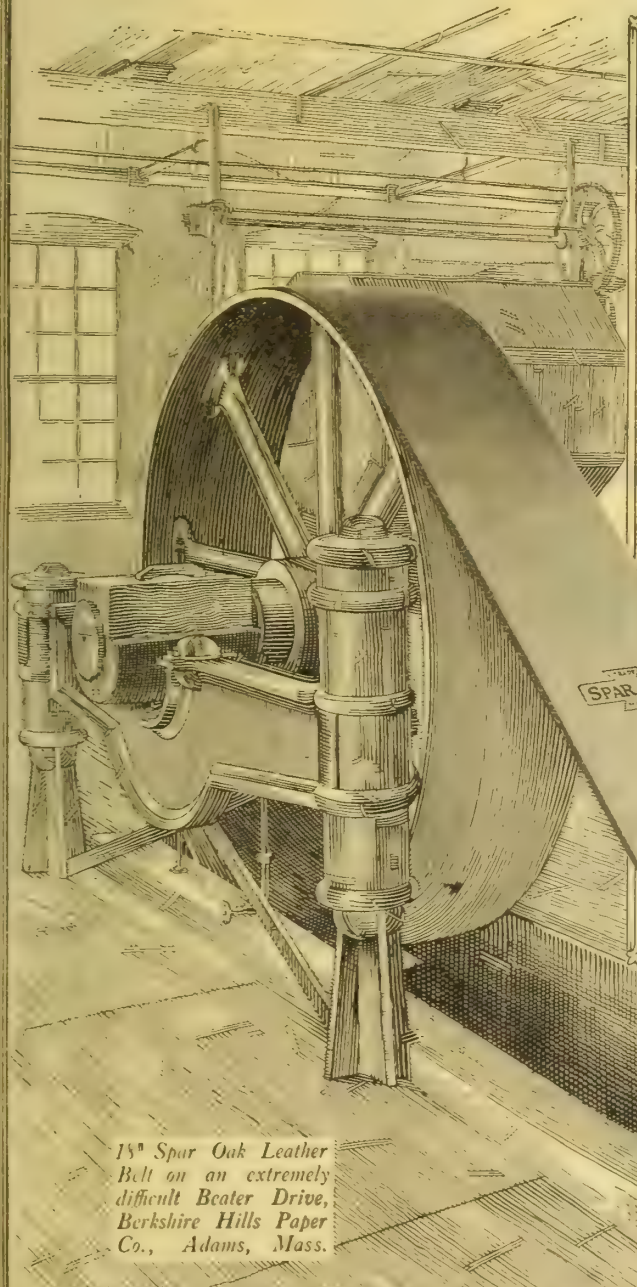
THE CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED.

GRATON & KNIGHT

Standardized Series

LEATHER BELTING

Tanned by us for belting use



15" Spar Oak Leather Belt on an extremely difficult Beater Drive, Berkshire Hills Paper Co., Adams, Mass.

BRUISING DRIVES

Constant trouble-maker drives become highly efficient when equipped with SparOak—that double service belt.

The pulley surface of SparOak Belting is Graton & Knight Spartan Leather—the highest frictional value ever attained in belting. The outside is finest quality of heavy Oak-tanned center stock. The combination gives a belt that not only grips the pulley at high speed with fluctuating loads, but stands the mauling of hard service conditions.

If you have a troublesome, bruising drive, don't delay in learning about SparOak. For a whole class of belting dilemmas it is the answer.

Send for our new book—"Standardized Leather Belting," which describes the character and application of SparOak and others of our Standardized Series.

The Graton & Knight Manufacturing Company

Worcester, Massachusetts, U.S.A.

Oak Leather Tanners and Belt Makers.
Lace Leather, Packings and Specialties.

Canadian Graton & Knight, Ltd., Montreal. Canadian Representatives: The Canadian Fairbanks-Morse Co., Ltd., St. John, Montreal, Ottawa, Toronto, Hamilton, Quebec, Calgary, Saskatoon, Vancouver, Windsor, Winnipeg, Victoria.

GRATON AND KNIGHT

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

DURABLA

DURABLA
TRADE MARK REGISTERED

Durabla is a Giant in Strength

Many of the largest industries have adopted Durabla Gasket Material as a Standard for all new Construction Work and Repairs, using it on Steam, Air, Oil, Ammonia, Benzol and Alkalies at various temperatures and pressures, on All Flanges where a Permanently Tight Joint is required.

Claims of Superiority are easily made—comparative tests establish facts.

Durabla Manufacturing Company
NEW YORK
Distributors for Canada:
The Canadian Fairbanks-Morse Co., Limited
Montreal, Toronto, St. John, Quebec, Ottawa, Hamilton, Winnipeg, Saskatoon, Calgary, Edmonton, Vancouver, Victoria

P&C CO

Valves and Asbestos-Packed Cocks

Send for Catalog

PRATT & CADY COMPANY, INC.
HARTFORD, CONN.

Canadian Representatives

The Canadian Fairbanks-Morse Company, Limited
Halifax St. John Quebec Montreal Ottawa Toronto Hamilton
Windsor Winnipeg Saskatoon Calgary Vancouver Victoria

Consult Power House Buyers' Directory

If what you want isn't advertised in this issue, consult our Buyers' Directory. If it isn't listed in our Directory, write us and we will give you the information.

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

The Boys Are Going Over To Do Their Part In the Greatest Struggle of History

It is therefore necessary that those left behind do the work that those who have gone would have performed if they were here.

It is evident that all unnecessary work be avoided, as for instance, the constant repacking of rods and globe valves when by using a better quality of packing the longer service may be obtained.

"PALMETTO"

is a packing that is made essentially for long service and any engineer who uses it will tell you so.

BRAIDED—round and square for rods.
TWIST—for globe and other small valves.

Working samples of both sent you without charge to prove the long service quality.

GREENE, TWEED & CO.

Sole Manufacturers

109 DUANE ST., NEW YORK

The Canadian Fairbanks-Morse Co., Limited, St. John, Toronto, Quebec, Hamilton, Montreal, Ottawa, Vancouver, Victoria.

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

We like the way General Manager B——— mentioned the

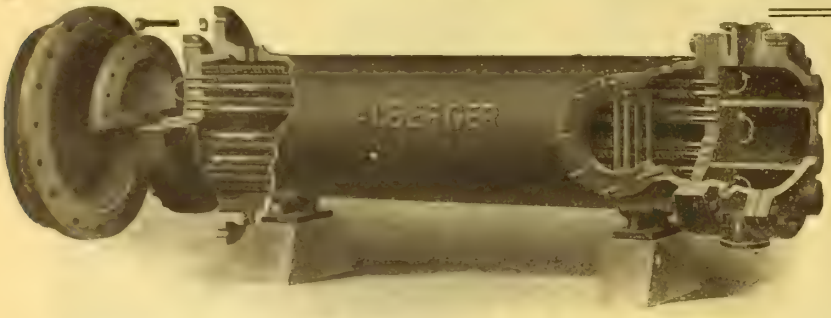
Alberger MULTI-HEAD Heater

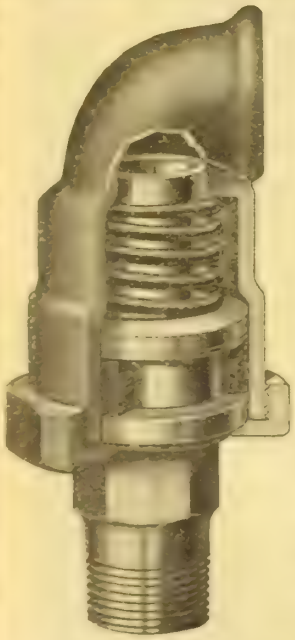
He had acknowledged the absence of all trouble common to most water heaters. Not a tube had clogged (the corrugations prevent clogging). Not a tube had buckled or split. (On the one hand the "floating" heads eliminate the danger from contraction or expansion strains; on the other hand, Alberger pure copper tubes, unlike brass tubes, do not split when subjected to temperature changes.) "And as your heater provides hot water as fast as it can be drawn, it is quite satisfactory," he told us.

The Alberger Heater transmits 50% more heat than plain tube heaters of corresponding size. **Bulletin 201 explains fully.**

ALBERGER HEATER COMPANY, BUFFALO, N.Y.

GENERAL SALES AGENT:
CANADIAN FAIRBANKS-MORSE COMPANY, Limited
St. John Montreal Ottawa Toronto Hamilton Quebec Calgary
Windsor Vancouver Winnipeg Victoria





Tuxeda SWING JOINTS

Provide one of the easiest ways to save coal

Every pound of steam that escapes through a leaky connection represents a certain amount of coal wasted. Do you know that an average leak will waste 3,400 pounds of steam a month? Investigate your flexible steam connections at once and then investigate the Tuxeda Swing Joint.

A Guaranteed Solution for Your Flexible Connection Problems

Send for Bulletin "A" to

FRANKLIN WILLIAMS, INC.

New York City

General Sales Agents: Canadian Fairbanks-Morse Co., Ltd.

FOR Steam or Air Drill, Pneumatic Tools, Boiler Flue Cleaning, Syphon Connections, Suction Lines.

For all kinds of Oil, Gasoline, Paints, Hydraulics, Gas.

"PENFLEX" METAL HOSE

INTERLOCKING

An all Metal Flexible Hose. Manufactured in Bronze or Galvanized Steel. Will withstand highest pressures. Is unsurpassed for durability and pressure resisting qualities.

Large Stock Carried in Canada

Pennsylvania Flexible Metallic Tubing Co.

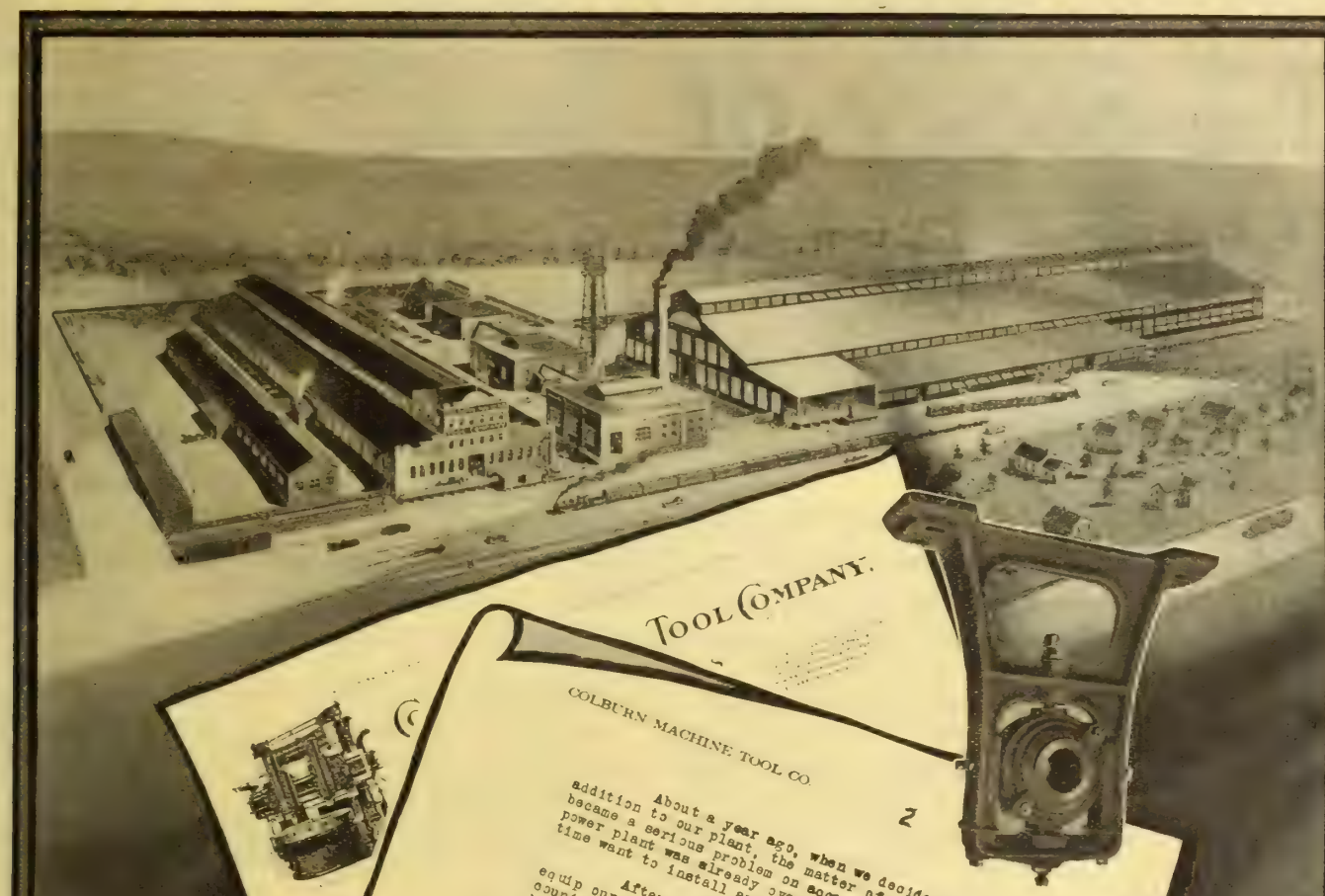
Philadelphia, Pa.

Canadian Agents:

The Canadian Fairbanks-Morse Co., Limited

St. John, Quebec, Montreal, Ottawa, Toronto, Hamilton, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED.



TOOL COMPANY.

COLBURN MACHINE TOOL CO.

About a year ago, when we decided to build an addition to our plant, the matter of furnishing power became a serious problem on account of the fact that our power plant was already overloaded and we did not at that time want to install any more power units.

After compiling considerable data we decided to equip our new addition with S.K.F. ball bearing line and countershaft hangers. The self aligning feature of S.K.F. bearings appealed to us as being superior to other makes. We were greatly pleased with the results obtained from this installation, and immediately put in hangers on one of our old line shafts; also countershafts for large grinders and automatic screw machines, with the result that after adding considerable new, heavy machinery, we are experiencing no more trouble with our power plant, having ample capacity to run our shop 21-3/4 hours per day.

The actual saving on a large Landis grinder countershaft is 50%, others running from 20 to 40%, and line shaft from 15 to 25%. These savings were all proven by actual motor tests.

We estimate that the saving in cost of maintenance and shut downs due to hot and worn out bearings alone, will pay for the installations in a few years time. Had we not adapted this method of saving power, it would have meant the purchase of an entire new power unit, costing several thousand dollars.

We are replacing all line and countershafts with S.K.F. hangers throughout our plant as rapidly as we can arrange to put them in.

Yours very truly,

COLBURN MACHINE TOOL CO.

W. M. Breckenridge
Treasurer.

HMB/S Enc.

S.K.F. eliminates shutdown and expense due to hot and worn-out bearings

CANADIAN SKF COMPANY, LIMITED
TORONTO, ONT. MONTREAL, QUE.

Agents for SKF Transmission Bearings:

The CANADIAN FAIRBANKS-MORSE Co., Limited

St. John, Quebec, Montreal, Ottawa, Toronto, Hamilton, Windsor, Winnipeg, Saskatoon, Calgary, Vancouver, Victori

The Story of War Under the Earth

THE German sappers had discovered and broken into a Canadian tunnel. They had planted a machine gun at their end and sent a shower of bullets down the dark, narrow passage whenever the Canadians made any effort to enter their underground galleries. The story of how two Canadians nailed steel snipers' shields to the front of a push cart and shoved it ahead of them up to the very teeth of the gun, and how they dropped a can of deadly explosive, hopped on to the cart, and let it coast back down the tunnel, while bullets rattled on the shield like hail and, finally, how the explosive blew up the machine gun and its crew and blocked the passage again—this remarkable story is told by Lieut. C. W. Tilbrook (who was one of the two) in the course of an article, "An Underground Tank," in October MACLEAN'S.

Recently a Toronto newspaper declared editorially that the public was tiring of war books and war stories because of the sameness of them. The newspaper was right. But the public literally devours any story of the war that is new. The series of articles that Lieut. Tilbrook has done for MACLEAN'S have been read with an astonishing amount of interest *because they are different from anything that the public has yet read.*

Warfare in the tunnels is a terrible business—grim, silent, cruel. It is a strangely technical phase of warfare and the "sappers" go about their business with queer instruments that might have figured in a Jules Verne phantasy. To read of underground fighting, as Lieut. Tilbrook tells of it, is to get a vision of a new kind of war altogether—something gripping, fearsome and mystifying.

"An Underground Tank," is the best of his series. But, after all, it is only one feature in a long array that makes the October issue of MACLEAN'S one of unparalleled interest.

A STRANGE CHANGE IN WOMAN'S WORLD. By Agnes C. Laut.
The new status of women, arising out of the war, is treated in the powerful style of this famous writer, who came from the Canadian West. It introduces a new thought.

CONSCRIPTION AFTER THE WAR. By Brigadier-General A. C. Critchley.
A young Canadian who rose from Lieutenant to General in three years and originated the "Critchley Method" of military training, tells what he thinks about the need for compulsory service after the war.

THE LIFE OF MARY PICKFORD. By Arthur Stringer.
The second of a series of articles on Canada's most famous woman. No expense has been spared to produce the beautiful illustrations specially posed for the photographs.

THE FOUR FACTIONS AT OTTAWA. By J. K. Munro.
That the House will split into four, more or less, distinct groups is the guess of the author, a trained political observer. He outlines the reasons humorously, pungently and impartially. It is a political article on new lines and will be found refreshing.

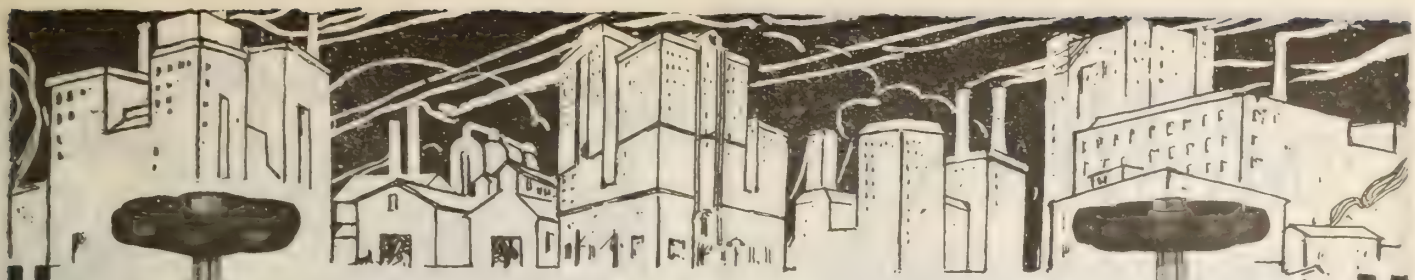
BONEHEAD BILL—Another Service Poem.
Robert W. Service, most popular of poets, sends all his war verse to MACLEAN'S. In "Bonehead Bill" he depicts the grief of a soldier for his fallen foe.

THE EVENTS OF A MAD WORLD.
are summed up in the "Review of Reviews" which gives reprints of the best articles from the magazines of the world. All the best and most important articles are selected—five dollars' worth for twenty cents!

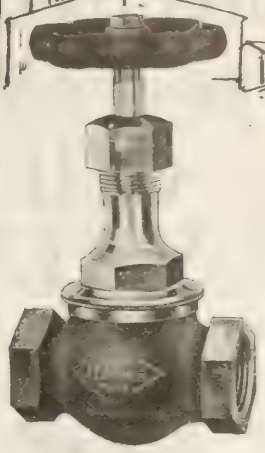
OCTOBER MACLEAN'S

20c. per Copy, $2.00 per Year. **Now on Sale at all News Dealers**

THE MACLEAN PUBLISHING COMPANY, LIMITED
143-153 UNIVERSITY AVENUE, TORONTO



Jenkins Bros. Valves



EVEN an apparently insignificant hiss of steam past a poorly seating valve will cause a material fuel loss per year. Multiply this figure by the number of valves in the average plant and the loss becomes appalling.

Dependable valve service is essential—more so now than ever before in view of the great scarcity of fuel.

No matter what the type of building or plant, the best valve service is necessary. Installing good valves at the start saves repair and replacement charges and the labor costs of re-installations later.

Whether you require valves for industrial plants, public or private buildings, **Jenkins Bros.' Valves** should be your choice. You can rely upon them under conditions where other valves would fail.

They will hold absolutely tight under steam, water, air and gas pressure for very long periods of service without attention. The design is heavier than the usual commercial standard pattern of other makes, enabling us to guarantee them for 175-lb. steam or 250-lb. water-working pressure. All are fitted with renewable Jenkins discs made of a softer composition than the metal and which will seat perfectly tight in spite of inequalities or rough spots in the metal surfaces. When worn the discs may be replaced at trifling cost and the valves will become as tight as when new. The composition of the discs is varied to suit the particular requirements of each class of service.

Furnished in brass or iron body, in globe, angle, cross, check, Y or blow-off, hose whistle and other patterns.

TRADE JENKINS MARK
Jenkins Bros

Jenkins Bros. LIMITED

Head Office and Works:
103 St. Remi Street,
Montreal, Canada

Agencies in all the
Principal Countries
of the World

European Branch:
6 Great Queen Street,
London, W.C.2, England

TRADE JENKINS MARK
Jenkins Bros

TRADE
JENKINS
MARK
Jenkins Bros

For 54 years Genuine Jenkins Valves have rendered faithful service in over 103 industries.

Every genuine Jenkins Valve bears the diamond trademark—the seal of an iron-clad guarantee.

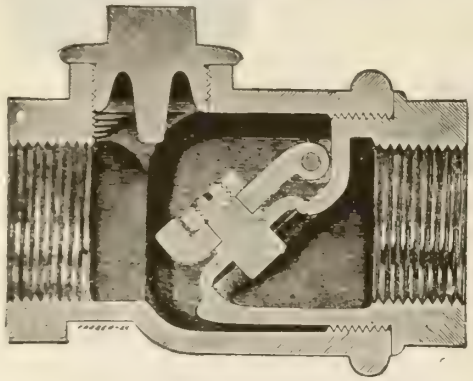
The Genuine

"McSHANE"

Straightway Swinging

CHECK VALVES

Sectional View



BRASS OR IRON

SCREWED OR FLANGED

For use Upright
or Horizontally

Always Ready for Inspection

Suitable for Pressures
up to 250 lbs.

T. McAVITY & SONS

LIMITED

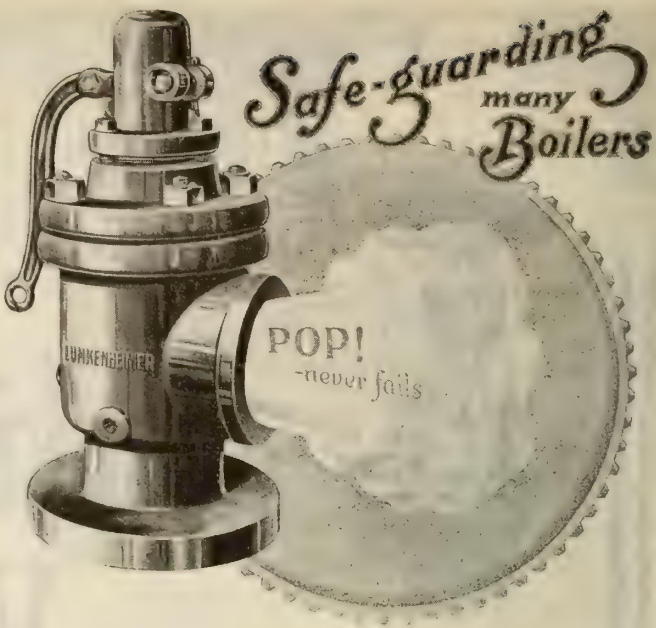
Wholesale and Retail Hardware
Brass and Iron Founders

ST. JOHN, N.B.
CANADA

Montreal
T. McA. Stewart
157 St. James St.

Toronto
Harvard Turnbull & Co.
207 Excelsior Life Bldg.

Winnipeg Vancouver London, England
Kurban, South Africa
Established 1834



LUNKENHEIMER Pop Safety Valves

have demonstrated their reliability through many years of satisfactory service on all types of boilers.

Rigid tests under live steam and their careful adjustment to meet the individual service conditions is assurance that they will efficiently perform the functions for which they are intended.

Their remarkable durability, due to correct design and high quality materials, is a source of economy in many boiler plants. Provision is made for the renewal of all the parts, and users are urged to take advantage of this feature when occasion requires. It not only saves time and money, but also aids in the CONSERVATION OF EQUIPMENT, a vital factor to our success in the war.

Our "WAR-PERIOD" Appeal
ENGINEERING APPLIANCES ARE PRIME WAR ESSENTIALS
Stocks of distributors and facilities of manufacturers must be adjusted to care for essential needs. Lunkenheimer patrons are earnestly requested to assist in the common cause by confining their War Period specifications to requirements for essential plants, craft, vehicles, or equipment
On to Victory
THE LUNKENHEIMER CO.
CINCINNATI

THE LUNKENHEIMER CO.
"QUALITY"

Largest Manufacturers of
High Grade Engineering Specialties
in the World.

CINCINNATI, O., U.S.A.

New York Chicago Boston London

4-14-43

The MacLean Business & Class Publications in Canada

TO SELL or buy from Canada such lines as machinery, hardware, food products, dry goods, books and stationery, paper, printing machinery and supplies and general merchandise of almost every description, raw or manufactured, use or consult the MacLean Business and Class Publications, as per list below. For special information, write the publishers. Concerning the quality of the MacLean publications, let this copy of POWER HOUSE which you hold in your hands speak for all. The MacLean list of 14 publications is as follows:—

The Canadian Grocer (Est. 1886)
Serving the Grocery, Provision and Foodstuffs Trades. Published weekly.

Hardware nad Metal (Est. 1889)
Serving the Hardware, Stove and Metal-working Trades. Published weekly.

Dry Goods Review (Est. 1889)
Serving the Dry Goods Trade generally; Wholesale, Retail, Manufacturing and Department Stores. Published monthly.

Men's Wear Review (Est. 1898)
Serving the Manufacturers of Clothing, Underwear, Shirts, Collars, Neckwear, Footwear, Hats and Caps and Allied Sundries, and their Retail Distributors. Published monthly.

Canadian Machinery (Est. 1905)
Serving the Machinery, Metal-working, Iron and Steel, Foundry and Allied Trades. Published weekly.

The Power House (Est. 1907)
Serving the Operating and Consulting Engineers and Power Superintendents. Devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power; and to the operation of Refrigerating Machinery. Published monthly.

Bookseller and Stationer (Est. 1884)
Serving the Book, Stationery, Fancy Goods and Associated Trades. Published monthly.

The Sanitary Engineer (Est. 1907)
Serving the Manufacturers of Sanitary, Heating and Ventilating Machinery, Systems and Equipments, and those installing them. Published semi-monthly.

Marine Engineering of Canada (Est. 1910)
Serving the Marine Engineering, Merchant and Shipbuilding Trades. Published monthly.

Canadian Foundryman (Est. 1909)
Serving Foundries and the Pattern-making, Plating and Polishing Trades. Published monthly.

Printer and Publisher (Est. 1892)
Serving the Publishing, Printing, Paper-making and Allied Trades. Published monthly.

The Financial Post (Est. 1907)
Serving the Business, Investment and Financial Interests of Canada. Published weekly.

MacLean's Magazine (Est. 1896)
A popular family and literary magazine; the most important in its field in Canada. Published monthly.

The Farmers' Magazine (Est. 1910)
Serving the agricultural and rural communities of Canada. The only farm and country life publication in Canada having extensive national circulation. Published semi-monthly.

This fact may interest you: namely, the MacLean organization is the largest concern of its kind in the British Empire. The output of its mechanical department every working day is the equivalent of a 125-page publication of the size and type of this copy of *Power House*.

Our London Office, 88 Fleet Street, E.C.

Also at New York Boston Chicago Montreal Winnipeg

For over 20 years the MacLean Publishing Company has maintained a fully-staffed London office, and has rendered British and Continental manufacturers, shippers, and traders an invaluable service in many directions.

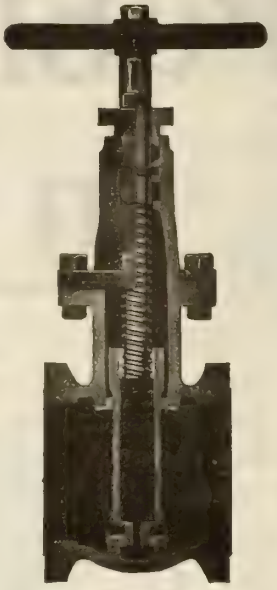
Specimen copies of the MacLean publications will be cheerfully forwarded to all asking for them. Address us at London or Toronto.

The MacLean Publishing Co., Limited

143-153 University Avenue Toronto, Canada

KERR
("New KEYSTONE" Pattern) GATE VALVES

If you have not used any of these New Pattern Valves, specify "KERR" in your next order. We want you to get acquainted with the most reliable valve on the market.



If you have been using them, we are confident that our satisfaction will bring us your repeat orders. These valves will never cause you or your customer the slightest trouble. Their high quality is consistent.

When you buy a "KERR" Valve you get a guaranteed article that is backed by a reliable firm. Many of the largest distributers of valves in Canada have sold "KERR" Valves for over 25 years, and are still recommending them as the "Best Valve." Write us for particulars.

Kerr Engine Co., Ltd., Valve Specialists **Walkerville, Ont.**

HOMESTEAD
LEAK-PROOF CONSTRUCTION

THE Homestead Quarter Turn Valve is closed at the top and at the bottom—leakage is impossible. It has a metal to metal seat, which is protected from wear while the pressure is passing through.

The Homestead is limited to a quarter-turn in operation by means of a travelling cam, which also serves to hold the plug to the seat.

The many features of Homestead Quarter-Turn Valves make them the most serviceable valves you can use.

Made in Straightway, Threeway and Fourway patterns, for all conditions of service.

Send for Catalog

Homestead Valve Mfg. Co.

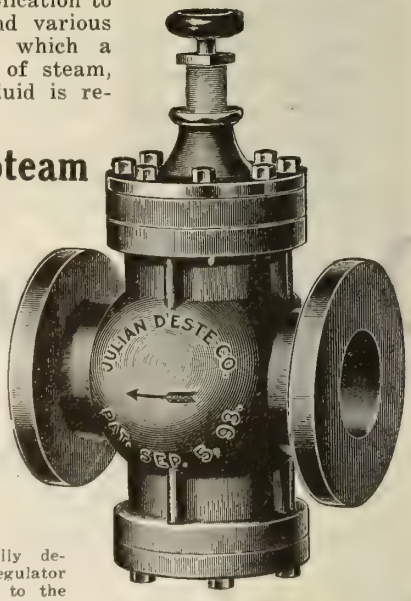
Homestead, Pa.

CURTIS Engineering Specialties

Universality!

For universal application to all the varied and various conditions under which a reduced pressure of steam, water or other fluid is required the

Improved Steam Pressure Regulator



has no equal.
It is compact and self-contained, without levers, weights or projections.
No glands or packing; no drip or leak of steam or water. Suitable for any boiler pressure; made entirely of metal: is a lock valve, very simple and sensitive.
Send for leaflet fully descriptive of this Regulator (contains price list) to the manufacturers.

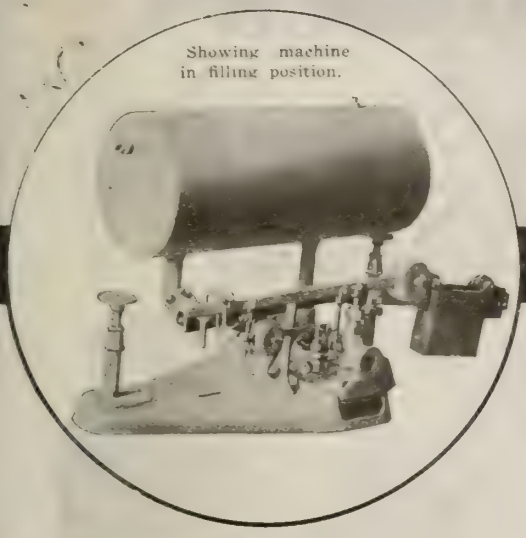
MANUFACTURED BY THE

JULIAN D'ESTE COMPANY

Main Office, 26 Canal St., Boston, Mass.

Agencies: 216 FULTON ST., NEW YORK CITY; 174 N. MARKET. ST., CHICAGO, ILL.

A system backed up by nearly 30 years Unparalleled Success Throughout the U.S. and Canada and the Known World



Showing machine in filling position.

Showing machine in discharging position.

Use Your Condensation

Feed it to your boilers

MUCH HOTTER THAN PUMPS WILL HANDLE IT

Morehead Back to Boiler SYSTEM

Saves coal—stops sluggish circulation—and works steam heated equipment at top capacity

What are you doing with your condensation? Are you letting it cool down to accommodate a pump, and thereby wasting valuable heat units?

If you are the Morehead Back to Boiler System will more than pay for itself the first year.

Automatically the Morehead System picks up every bit of the condensation which is now allowed to clog in your steam lines—and rushes it right back to the boilers while it is hot, for use over again in the production of steam.

Every heat unit saved means a saving in fuel.

The Morehead System will enable you to produce more steam from less coal—and boosts production by keeping the steam lines constantly drained of all condensation.

MOREHEAD TRAPS are being used everywhere on heating, drying and cooking propositions of every kind from straight pipe work to fan stacks and under vacuum conditions, without regard to the difference in pressures between the apparatus drained and that carried on to the boiler and **without regard to location of the apparatus drained, whether above or below the water line in the boiler.**

Write us your conditions, and we will have our engineers study the situation in your plant, and give you some very valuable advice absolutely free.

Machines specially built for either high or low pressures and absolutely guaranteed.

Ask for catalog.

Canadian Morehead Manufacturing Co.

Woodstock, Ontario

ECONOMICALLY WE CONSUME LESS THAN 10% OF THE STEAM USED IN PUMPS AND HANDLE THE WATER AT ANY TEMPERATURE

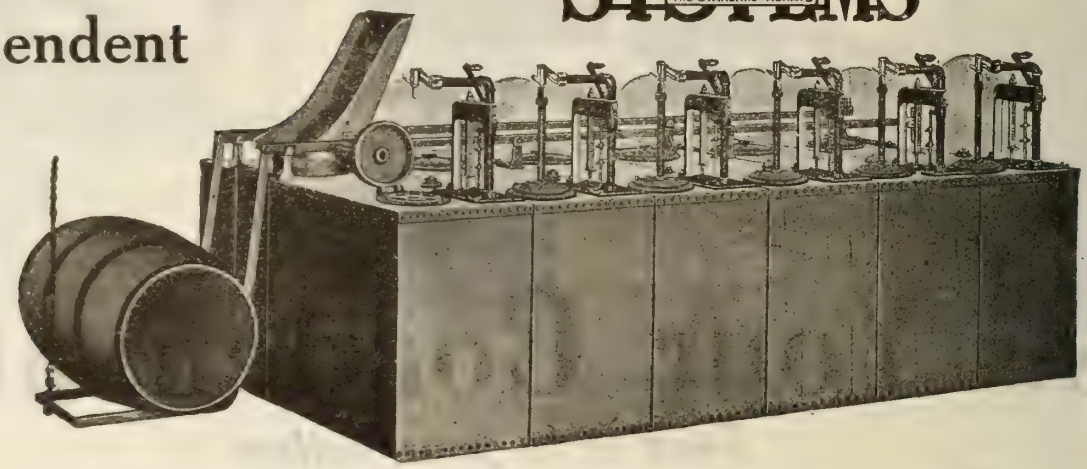
A word to the wise Superintendent

who knows

"the Office" doesn't realize the enormous quantities of oils WASTED

BOWSER
ESTABLISHED 1885

Oil Storage SYSTEMS
THE STANDARD ALWAYS



Battery of Figure 64 Units

The next time the president of your Company steps into the machine shop or power plant, speak to him about the tremendous oil waste charged against you as a formidable operating expense, but which you cannot prevent so long as you do without a Bowser Oil Storage System.

Explain the reason for so great a waste. Definitely mention seepage, evaporation, absorption, countless spills and drips.

Show him the oil-soaked floor—a fire menace every hour of the day and night.

Finally hand him the Bowser Book on Oil Storage Equipment. If he doesn't thank you on the instant, he will a short time later when he discovers that Bowser Equipment has cut the oil bill in half or more.

Write to-day for the Bowser Book and Full Particulars of Bowser Engineering Consultation Service.

S. F. Bowser & Co., Inc.
TORONTO, ONTARIO, CANADA

Sales Offices in All Centers *Representatives Everywhere*

There's no guesswork about the Johns-Manville Underground System of Insulation

IT is the most definite system of underground distribution there is. Definite because its efficiency is known to be 90% or more based on the saving over bare pipe. Definite, too, because every detail in underground transmission practice has been met in the structural details of its design and in the materials employed.

We do not argue that there are no other systems that will transmit steam or other fluids underground but we can prove to anyone interested that for mechanical durability, maintenance and thermal efficiency and from an investment viewpoint it is the system where a dollar spent goes furthest in ultimate economy. Write for the booklet that gives all the facts.

The Canadian H. W. Johns-Manville Co. Limited

Montreal Toronto Vancouver Winnipeg
Hamilton London Ottawa

Different from all other steam traps

THE Johns-Manville Steam Trap has just three parts —body, discharge bushing, and ball; only one moving part, the ball. No complicated mechanism to adjust or repair—no air binding, no steam leakage. Controlled not by levers and counterweights but by unchanging physical laws, this trap is sure and continuous in operation and practically foolproof.

The details are interesting—just write for the steam trap bulletin. Or better yet, test a trap out for yourself—it is the best way we know of selling them.

JOHNS-MANVILLE SERVICE
COVERS THE CONTINENT

Johns-Manville

If any advertisement interests you, tear it out now and place with letters to be answered.

Becoming a Bigger Man

WHAT is the difference between some men you know and others known to you? Why are some men earning $3,000 a year and some $30,000? You can't put it down to heredity or better early opp ortunities, or even better education. What, then, is the explanation of the stagnation of some men and the elevation and progress of others?

We are reminded of a story. A railroad man, born in Canada, was revisiting his home town on the St. Lawrence River. He wandered up to a group of old-timers who sat in the sun basking in blissful idleness. "Charlie," said one of the old men, "they tell me you are getting $20,000 a year," "Something like that," said Charlie. "Well, all I've got to say, Charlie, is that you're not worth it."

A salary of $20,000 a year to these do-nothing men was incredible. Not one of the group had ever made as much as $2,000 a year, and each man in the company felt that he was a mighty good man.

Charlie had left the old home town when he was a lad. He had got into the mill of bigger things. He developed to be a good man, a better man, the best man for certain work. His specialized education, joined to his own energy and labor sent him up, up, up. To put it in another way: Charlie had always more to sell, and the world wanted his merchandise—brain, skill and ability. Having more to sell all the time, he got more pay all the time.

Charlie could have stayed in the old home town; could have stagnated like others; could have been content with common wages. In short, Charlie could have stayed with the common crowd at the foot of the ladder. But Charlie improved himself and pushed himself, and this type of man the Goddess of Fortune likes to take by the hand and lead onward and upward. Almost any man can climb higher if he really wants to try. None but himself will hold him back. As a matter of fact, the world applauds and helps those who try to climb the ladder that reaches towards the stars.

The bank manager in an obscure branch in a village can get out of that bank surely and swiftly, if he makes it clear to his superiors that he is ready for larger service and a larger sphere. The humble retailer can burst the walls of his small store, just as Timothy Eaton did, if he gets the right idea and follows it. It is not a matter of brain or education so much as of purpose joined to energy and labor. The salesman or manager or bookkeeper or secretary can lift himself to a higher plane of service and rewards if he prepares himself diligently for larger work and pay. The small manufacturer, the company director, the broker—all can become enlarged in the nature of their enterprise and in the amount of their income—by resolutely setting themselves about the task of growing to be bigger-minded men.

Specialized information is the great idea. This is what the world pays handsomely for. And to acquire specialized information is really a simple matter, calling for the purposeful and faithful use of time. This chiefly.

One does not have to stop his ordinary work, or go to a university, or to any school. One can acquire the specialized information in the margin of time which is his own—in the after-hours of business. Which means: If a man will read the right kind of books or publications, and make himself a serious student at home, in his hours—the evening hours or the early morning hours—he can climb to heights of position and pay that will dazzle the inert comrades of his youth or day's work.

IF business—BUSINESS—is your chosen field of work, we counsel you to read each week THE FINANCIAL POST. It will stimulate you mentally. It will challenge you to further studious effort. It will give you glimpses into the world of endeavor occupied by the captains of industry and finance. With the guidance of the POST, and with its wealth of specialized information, you, a purposeful man, aiming to go higher in life and pay, will find yourself becoming enlarged in knowledge and ambition, and will be acquiring the bases and facts of knowledge which become the rungs of the ladder you climb by.

It is the first step which costs. But this cost is trivial—a single dollar. We offer you the POST for four months for a dollar. Surely it is worth a dollar to discover how right we are in our argument. If yoou have the will to go higher in position and pay, sign the coupon below.

THE MACLEAN PUBLISHING COMPANY, LIMITED,
—143-153 University Avenue, Toronto.

Send me THE FINANCIAL POST for four months for one dollar.

Money to be enclosed remitted

Signed .....

P H .....

Team Work

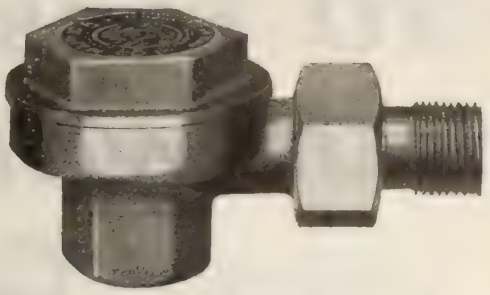
The boiler room and the office must work together to save coal. Proper firing, soot-free boilers, leak-proof packings—all these help. But this good work is offset when the heating system is clogged up with air and water. Then, a hotter fire only makes the system pound and knock—and lowers the coal pile instead of raising the temperature. Suggest to your employer that Dunham Radiator Traps be used.

The DUNHAM HEATING SERVICE

C. A. DUNHAM CO., LTD., TORONTO, CANADA

Branch Offices:

Halifax Montreal Ottawa Winnipeg Vancouver Calgary



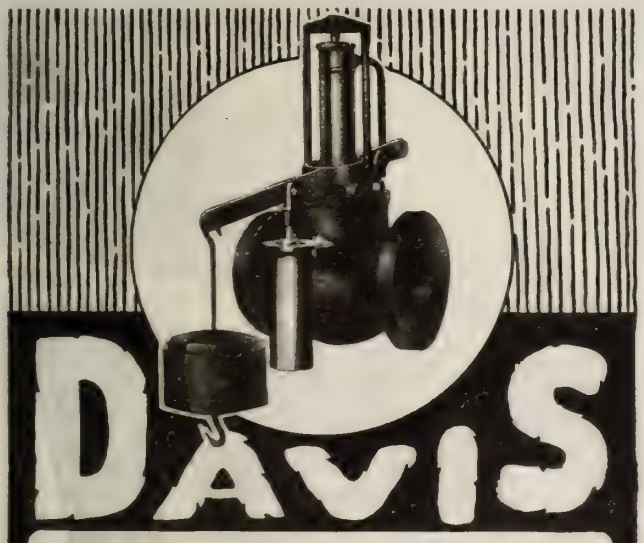
The Dunham Radiator Trap

is furnished with special roughing in measurements to replace imitating devices.

GIVES STEAM A CHANCE TO CIRCULATE

By automatically relieving the radiator of the air and water, the Dunham Radiator Trap removes the back pressure so that the steam can circulate freely through the entire radiator. Less coal is required to put the steam through the system—and all radiators heat up **noiselessly.** The simplicity of the Dunham Radiator Trap makes it possible to change over existing installations without extensive alterations.

Send for all the details now!



DAVIS

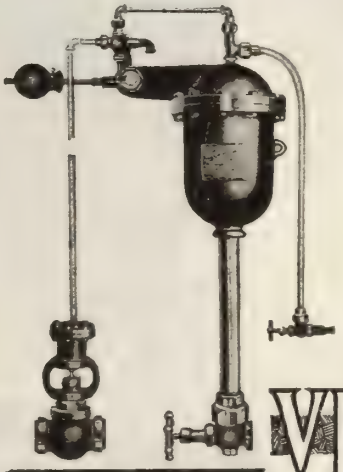
Pressure Regulators

are trouble-savers as well as steam-savers. They automatically reduce any pressure—steam, air or water—to any desired lower pressure. No springs, no diaphragm, no delicate parts—just a steady, sturdy reducing valve that can be relied on at all times and under all conditions.

Write for the new Davis booklet showing the pressure regulator and all the other Davis Steam Savers. Address the G. M. Davis Regulator Co., 434 Milwaukee Ave., Chicago. Branches in principal cities.

DAVIS VALVE SPECIALTIES

STEAM SAVERS SINCE 1875



Keeps the Water Within ¼" of Middle Gauge

This VIGILANT

Automatic Feed-Water Regulator

It does precisely **that,** automatically, perfectly, regardless of the load or firing. Therefore it is a positive protection from all high and low water accidents.

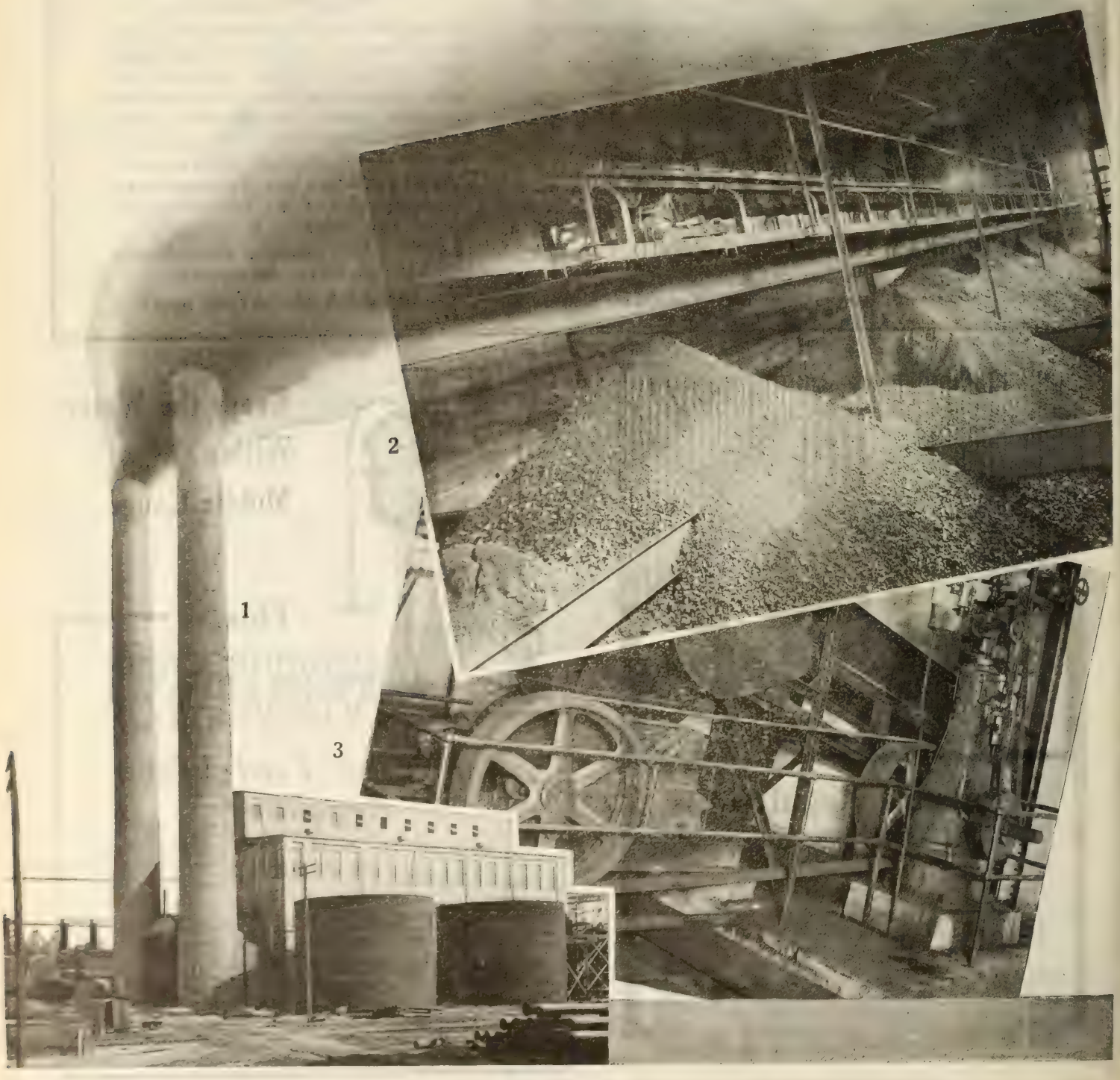
Incidentally—and this we can also prove—the Vigilant Feed-water Regulator saves 3 to 17 per cent. on fuel costs.

Ask us to send you catalog.

The Chaplin-Fulton Manufacturing Company
28 Penn Avenue : : Pittsburgh, Pa.

If any advertisement interests you, tear it out now and place with letters to be answered.

70 Tons of Coal Per Hour with the Jeffrey Carrier



"The Jeffrey System will Solve Your Coal and Ash Handling Problems"

1

The new power plant of the Solar Refining Company, Lima, Ohio, where a Jeffrey 24-in. x 24-in. Carrier is handling about 70 tons of crushed coal per hour. The vertical lift is 66 ft. while the horizontal run is 107 ft. Only 8 to 10 horsepower required for full capacity of carrier.

2 Showing the upper run of the Carrier at the Solar Plant. Note the readily adjusted Traveling Tripper. The bucket design gives greatest capacity for complete discharge of material with minimum wear and shock.

3 The lower run of the Carrier showing a Jeffrey 30-in. x 30-in. Single Roll Crusher which delivers a uniform product to the Carrier for the stokers.

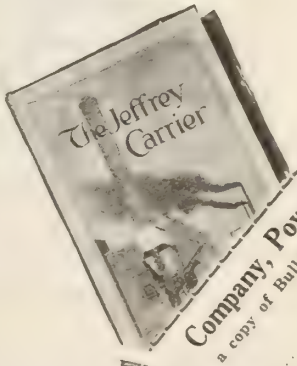
The New Jeffrey Carrier will solve your Coal and Ash Handling problem and save money at the same time. War-time wages and labor scarcity make the present time especially appropriate for labor conservation. Let us convince you of the merits of the Jeffrey Carrier.

Bulletin No. 237 will give you complete data on the New Jeffrey Carrier. It gives detail views that prove Simplicity and Rugged Construction and shows many important installations.

Write NOW for your copy.

The Jeffrey Mfg. Company

Canadian Branch and Warerooms: Montreal



The Jeffrey Mfg. Company, Power Bldg., Montreal
Kindly send me a copy of Bulletin on the new Jeffrey Carrier.
Name .....
Address .....

If any advertisement interests you, tear it out now and place with letters to be answered.

Superior Quality---
Superior Service

The World's Best

OILS

Numidian Cylinder Oil

Velox Engine Oil

Preferred by the leading power plants of the country. They go farthest and prove more efficient than any other oils of their kind on the market.

Give them a trial and you'll quickly appreciate why they are in constant demand. Prices upon request—quick deliveries.

C. C. SNOWDON

Oils Refiner, Manufacturer and Importer, Pennsylvania Lubricating and Refined Oils, Gasoline, Potato Scale Powder, Liquid Soap, Disinfectants, Polish, Waste, Oil Tanks, etc.
Winnipeg—Cor. Notre Dame and Pine Streets, P.O. Box 1984. **Vancouver**—823 Powell Street. **Calgary**—1810-1840 Eleventh St. East, P.O. Box 1384. P.O. Drawer 166. **Edmonton**—Cor. 13th Ave. and 83rd St., P.O. Box 977.

100% EFFICIENCY

can be obtained in your Fire Brick Construction by using

ADAMANT
Fire Brick
CEMENT

because it welds the bricks together, preventing the loss of hot gases and the infiltration of cold air, also INCREASES the general Furnace Efficiency.

A large stock on hand for immediate shipments.

THOMSON-GORDON, LIMITED
Packings, Engineers' Supplies
Hamilton, Ont.

BOILER INSPECTION

The Steam Boiler Act, Chapter 252 R.S.O., 1914 With Amendments Chapter 58—6, George V.

STEAM BOILERS.

All Steam boilers constructed for use in Ontario must be built from designs which have been approved and allotted a registration number by the Steam Boiler Branch.

Used boilers, boilers sold or exchanged, and unregistered boilers brought into the Province must be inspected prior to being put into operation.

Notice of repairs to steam boilers, stating the nature and extent of same, must be sent to the Steam Boiler Branch, and should such repairs be considered extensive by the Chief Boiler Inspector, the boilers will require to be inspected.

In each and every case the inspections must be made by Inspectors authorized to inspect boilers under the Steam Boilers Act, who are employed only by the Steam Boiler Branch of the Department of Public Works. Official certificates with the maximum working pressure stated thereon are issued to the owners of the boilers so inspected.

STEAM PIPING.

Drawings and Specifications of all high pressure steam piping must be approved and registered by the Steam Boiler Branch before any work of installation is commenced. The drawings submitted should show clearly the dimensions and layout of the main steam lines. Full particulars should be given as to the material used in the construction of the piping, and all valves and other fittings used in connection therewith must be of approved make.

Any deviation from the above requirements shall be deemed a violation of the Steam Boilers Act.

All communications in this respect should be addressed to the Steam Boiler Branch, Department of Public Works, Parliament Buildings, Toronto.

HON. F. G MACDIARMID, Minister of Public Works and Highways
W. A. RIDDELL, M.A. Ph.D., Supt. Trades & Labour Branch

D. M. MEDCALF,
Chief Inspector of Steam Boilers.

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

Laco Lamps Are At Least Fifty Per Cent Better

Two Ways to Obtain 3000 Hours Light:—

3 "Ordinary" 40-Watt Tungsten Lamps (supposed to burn 1000 hours each) at 38c - **$1.14**

2 LACO 40-Watt Tungsten Lamps (guaranteed to burn 1500 hours each) at 40c - **$ .80**

A Saving of 34c on First Cost Alone

and probably *more*---for tests have proved that very few lamps, other than Laco, will live up to their expected life, even though it be only 1000 hours---whereas Laco lamps frequently exceed even their exceptional guarantee.

Savings on other Styles and Sizes are as Great

The Laco 1500-Hour Guarantee Makes Laco the Cheapest Lamp to Buy

The Finance Minister Says, "Economize" You Can Do It With LACO

SAVE MONEY—BUY LACO LAMPS—THEY OUTLIVE ALL LAMPS

LACO
QUALITY GUARANTEES

LACO LAMPS both **tungsten** and **nitro** are guaranteed to have a life, after installation, of

1,500 hours except the 60 watt nitro, life of which is guaranteed to be 1,000 hours.

Lamps burning less than guaranteed number of hours will be replaced on basis of hours they burn.

Full allowance will be made for loose base lamps or lamps turning white when installed.

Full allowance will be made for lamps broken in transit providing the breakage exceeds five per cent of the invoice value of the entire shipment.

REDUCES RENEWAL COSTS AND LABOR EXPENSE INSTALLING NEW LAMPS

The Power Controller Says, "Save Electricity" You Can Do It With LACO

No Other Lamp is Guaranteed for More Than 1000 Hours

Laco Lamps are also Guaranteed to give the Candle-power United States Standard Specifications Provide

LACO LAMPS

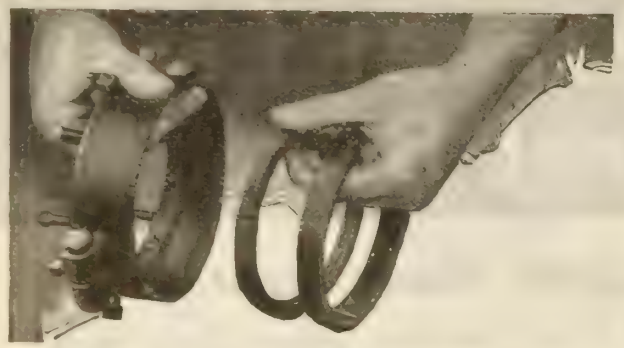
Are Sold at the Fairest Possible Price, and are Worth Every Cent of Their Cost

Without Expense to you, our nearest office will have laboratory tests made of any of your lamps to prove our claims.

Canadian Laco-Philips Co., Limited

Montreal Toronto Winnipeg Vancouver

If any advertisement interests you, tear it out now and place with letters to be answered.



There's a Big Waste in Little Leaks

Do you know that a one-tenth inch pipe-joint leak at 150 lbs. pressure will waste steam in a year at a cost to-day of approximately $825? Figure it out for yourself. Leak one-tenth inch; pressure 150 lbs.; 9 lb. steam per lb. coal; coal $5.50 ton; 10 hours per day; 300 days per year.

And it's such an unpatriotic waste in these days of coal conservation—such a needless and careless waste at any time—for the leak can be stopped in a few minutes' time with a YARWAY (formerly Simplex) PIPE JOINT CLAMP.

More than 13,000 leaks have been stopped since this effective clamp was first placed on the market. Millions of dollars have been saved. The saving in coal can only be guessed.

The Yarway (formerly Simplex) can be attached in a few minutes by any workman. The principle can be seen from the illustration shown here.

If there is a pipe-joint leak in any of your lines, tell us the size and we will send you a Yarway for 30 days' trial. Instead of returning it, you will probably be as enthusiastic over its success as the man who said of a Yarway Clamp, "It's worth its weight in gold."

Write To-day

YARNALL WARING CO.
CHESTNUT HILL PHILADELPHIA

YARWAY PIPE-JOINT CLAMP

Formerly the SIMPLEX

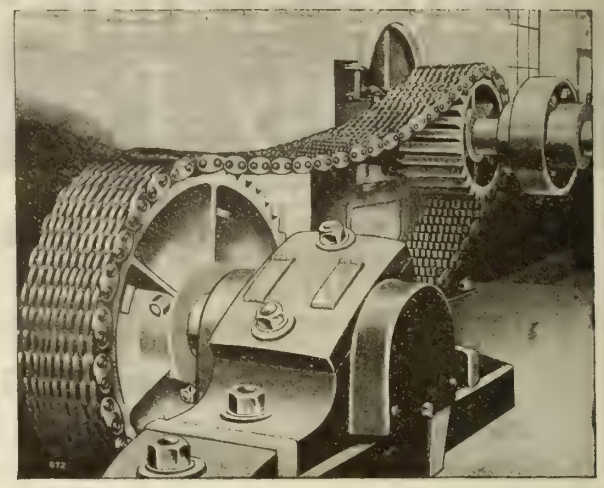
1
2
3

Canadian Representatives Carrying Stock

A. McLELLAN
301 Read Bldg., Montreal

CUNNINGHAM HDWE. CO.
New Westminster, B.C.

JAS. ROBERTSON CO.
Montreal



COVENTRY NOISELESS CHAINS

For all kinds of power transmission — Main and Countershaft Drives, Pumps, Fans, Air Compressors, and at all times 98 per cent. of power being transmitted.

Write for our handbook C-3 on chain gearing, post free for the asking.

Head Office and Works:

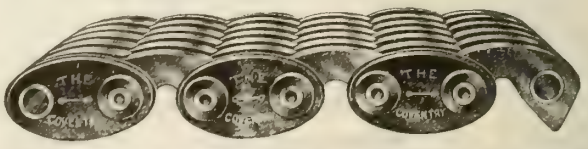
"THE COVENTRY" CHAIN CO., LTD.
COVENTRY, ENGLAND

Cables: Chains, Coventry.

Codes: A.B.C., 4th and 5th editions. Western Union.

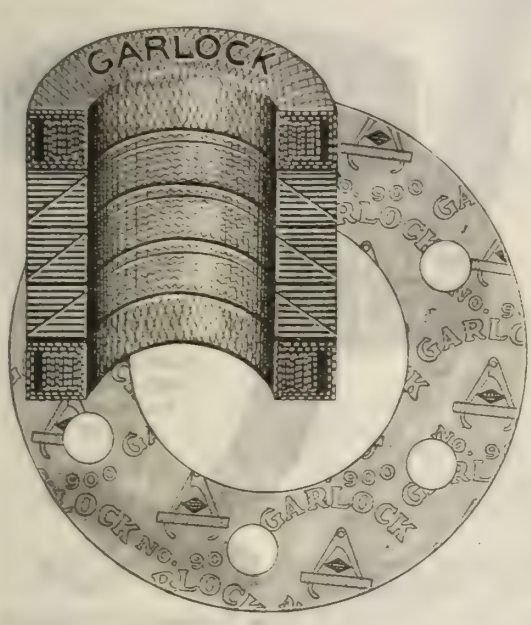
London Office: 47 Victoria St., S.W. 1.

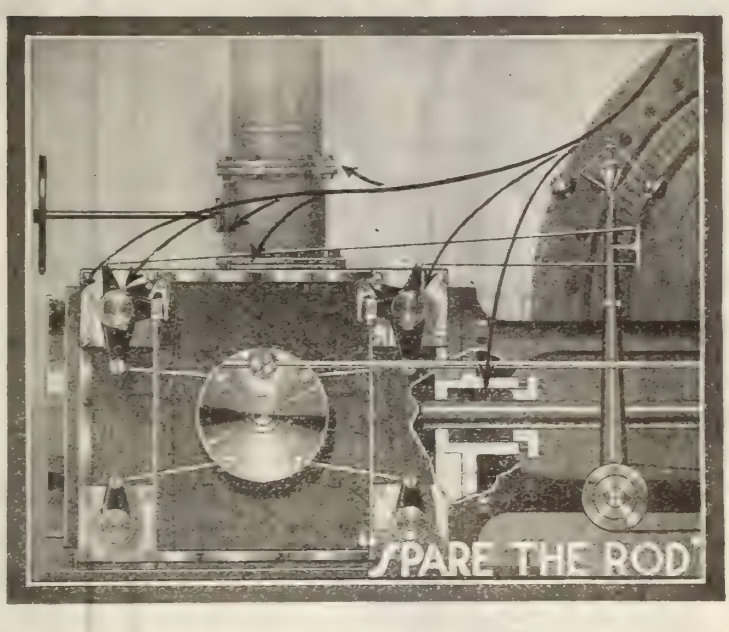
Agencies in all the principal countries in the World.



If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

GARLOCK PACKINGS





Pointers On a Well Packed Engine

For high pressure piston rods and valve stems use Garlock No. 200.
For medium pressure piston rods and valve stems use Garlock No. 446.
For worn or scored piston rods and valve stems use Garlock No. 336.
For vibrating piston rods, or rods not running true, use Garlock No. 550.
For cylinder heads, flange and other joints use Garlock Gasket No. 950.

Garlock Packings are made in over two hundred styles and combinations to meet every known requirement. We will assume entire responsibility in selecting the proper styles or combinations of our packings to work successfully and economically under any stated condition; and if goods are not fully satisfactory to purchaser we will refund promptly the cost of same. A card will bring our catalog which illustrates and describes our various styles of packings.

THE GARLOCK PACKING COMPANY

HAMILTON :-: ONTARIO

BRANCHES:

Montreal, Que.—409 Shaughnessy Bldg. **Toronto, Ont.—404 Continental Life Bldg.**
Winnipeg, Man.—Galt Bldg. **Calgary, Alta.—211 Eighth Avenue W.**

That belt must be slipping, George! It's too loose on the pulleys!"
No it isn't, Uncle. If it slipped at all, it wouldn't stay on the pulleys a minute!"

THE new Superintendent was different. For the first few days he just walked through the plant and looked at things. Down in the engine room he took the speed of the engine. Up in the shop he took the speed of the main shaft. Then he did some figuring. These are the figures:

Driving pulley 8 feet diameter.
Speed 80 rev. per minute.
Driven pulley 4 feet diameter.
Speed should be 160 rev. per minute.
Speed actually.. 155 rev. per minute.
Loss ..... 5 rev. per minute.
5 ÷ 160 = 3% approximately.
8 ft. × 3.1416 × 80 rev. per minute = about 2,000 feet per minute the belt travels.
3% of 2,000 feet = 60 feet per minute LOST.
Pulley centres at 20 feet, so belt length approximately 60 feet.

This meant that once every minute his belt was useless, **for the loss in feet per minute due to slipping was more than the length of the belt itself!**

In a ten-hour day this loss would be 36,000 feet, so that every day the engine had to give that belt a free ride of nearly 7 miles! And the firm paid the bills at the coal pile and machines, at the bearings, pulleys and in the belt itself. It didn't look right.

The plant had over one hundred belts. If they all slipped, the firm must be losing hundreds of dollars a year in power, time and equipment which might better be saved

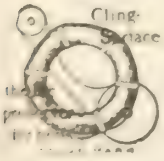
* * * * * *

The new Superintendent never did things on impulse, or merely on someone else's say-so. Back in his experience he had **used** CLING-SURFACE, the treatment which PREVENTS SLIPPING, and allows the usual drive to be run easy or slack under full load. He knew that it makes constant tension unnecessary, preserves and makes the belts thoroughly pliable and waterproof; that it is not sticky, contains no rosin or anything harmful, and is safe, easy and economical to use.

So he had every belt treated, and the effect was seen at once. His slipping stopped, he had more and steadier power, and not a belt has been taken up since that time.

This is fact; we can prove it on your drives to YOUR satisfaction. Just ask for THE PLAN 10,000 firms have found

And remember, use CLING-SURFACE and you won't need belt dressings.



Cling-Surface Co.

1057 Niagara Street
Buffalo New York

John Crane

Accurately cut rings for large rods, plungers, etc.

How "John Crane" SOFT FLEXIBLE METALLIC PACKING IS MADE

"John Crane," you see, is DIFFERENT, is FAR BETTER, is more SCIENTIFICALLY constructed and is more PRACTICAL than the shredded, braided, twisted, granulated, shot, poured and segmental types of metallic packing.

Engineers all over the country are rapidly adopting, approving and recommending "John Crane" as STANDARD EQUIPMENT.

If your rods are NEW "John Crane" will KEEP them new. If they are GOOD—"John Crane" will KEEP them good. If your rods are BAD it is a sure sign that they are NOT packed with "John Crane."

Write for our demonstration proposition, made entirely at our own risk.

Crane Packing Company

Box 241, Windsor, Ont.
General Office and Factory, Chicago, Ill.

NEW YORK—121 Park Row Building.
PITTSBURGH—102 May Bldg. PHILADELPHIA—507 Colonial Trust Building.

"VULCABESTON" RED FIBRE STEAM PACKING

"VULCABESTON" RED FIBRE STEAM PACKING

You Are Seeking

a packing that doesn't constantly remind you of its presence by causing trouble—one that can be safely forgotten once it's placed?

VULCABESTON

Red Fibre Sheet Packing

"VULCABESTON" RED FIBRE STEAM PACKING

is that kind of packing—it can be depended upon every time. Vulcabeston is made of **long-fibre** asbestos and is absolutely reliable under any and all conditions because scientifically correct in composition and manufacture.

"VULCABESTON" RED FIBRE STEAM PACKING

We sell miles of it to people who know by experience what it will do. Better proof of merit could not be asked. Try Vulcabeston Red Fibre Sheet Packing.

The Johns-Pratt Company

Hartford, Conn., U.S.A.

Montreal, Que., Ross & Greig; Toronto, Ont., James Morrison Brass Mfg. Co., Ltd.; Vancouver, B.C., Fleck Bros, Ltd.; Winnipeg, Man., Crane Co.

19-18

J-P J-P

The Quality of D. K. McLarens' Leather Belting never varies—because every hide that we buy must come from the choicest steers—and we hold fast to the

Genuine-British Oak-Tanning Process

a process that gives leather remarkable strength, flexibility, and durability.

D. K. McLarens' Leather Belting

will conserve your power

It hugs the pulley with a grip that reduces slip, and consequent loss of power, to a Minimum.

Everywhere in Canada are enthusiastic users of D. K. McLarens' Belting. Let us put you in touch with several in your own town. Write to-day.

D·K·McLAREN
LIMITED

Head Office and Factory
351 St. James St., Montreal, P.Q.

TORONTO, ONT.
194 King St., West

VANCOUVER, B.C.
849 Beatty St.

ST. JOHN, N.B.
90 Germain St.

Dominion Belting Company, Limited
Hamilton, Canada

Sole manufacturers of the celebrated "MAPLE LEAF" Brand Stitched Cotton Duck Belting and Belt Dressing.

The demand for our products has steadily increased because the standard of quality has been maintained.

We make only one grade, the best that can be produced.

"MAPLE LEAF" is the strongest, truest running, most economical and efficient belt on the market for transmission of power, conveying, etc.

Being thoroughly waterproof it is suitable for running in wet or dry places. **"MAPLE LEAF"** Belt Dressing is different to others offered in that it is equally good for all kinds of belting, leather, rubber or Balata, as well as our own make.

Write us for prices, and if desired we will be pleased to furnish samples and further information.

A trial order will convince you of their utility.

DOMINION BELTING CO. Ltd., Hamilton, Canada-Quebec Branch: 51 Duluth Bldg., Montreal

TRADE MARK

MAGNOLIA ANTIFRICTION METAL

TRADE MARK

FOR MOTOR BEARINGS

INTERNATIONAL UNION OF STEAM AND OPERATING ENGINEERS
Local Union No. 20

New York, April 20, 1918.

Magnolia Metal Company, New York, N.Y.

Gentlemen:—I have been chief engineer of the Metropolitan Realty Building, 216-218 William Street and 18-20 Rose Street, New York City, from February, 1898, to May, 1912, during which time I have always used MAGNOLIA METAL. Previous to my using MAGNOLIA METAL I always had trouble with bearings on motors throughout the building. They were continually wearing out with the result that the armature of heavier motors pulling up against the pole piece which necessitates re-babbitting of bearings. I re-babbitted the bearings on all motors with MAGNOLIA METAL—some of these motors are running night and day for practically over fifteen years, and what was especially remarkable on my recent visit to the building was the fact that the 50-horsepower motors which drove line shafts by heavy double belting showed no noticeable wear and bearings were in perfect condition just as they were fifteen years ago.

I also had main and outboard bearings of Fishkill Landing Corliss Engine, which is 300-horsepower, re-babbitted in 1901—said engine has run every day since that time, and find main bearings, quarter boxes, etc., in perfect condition to-day.

I can, therefore, justly testify to the value of MAGNOLIA METAL.

Very respectfully yours,
M. MURPHY,
Business Representative, Engineers Local No. 20

PRACTICAL ENGINEER POCKET BOOK
Over 600 Pages

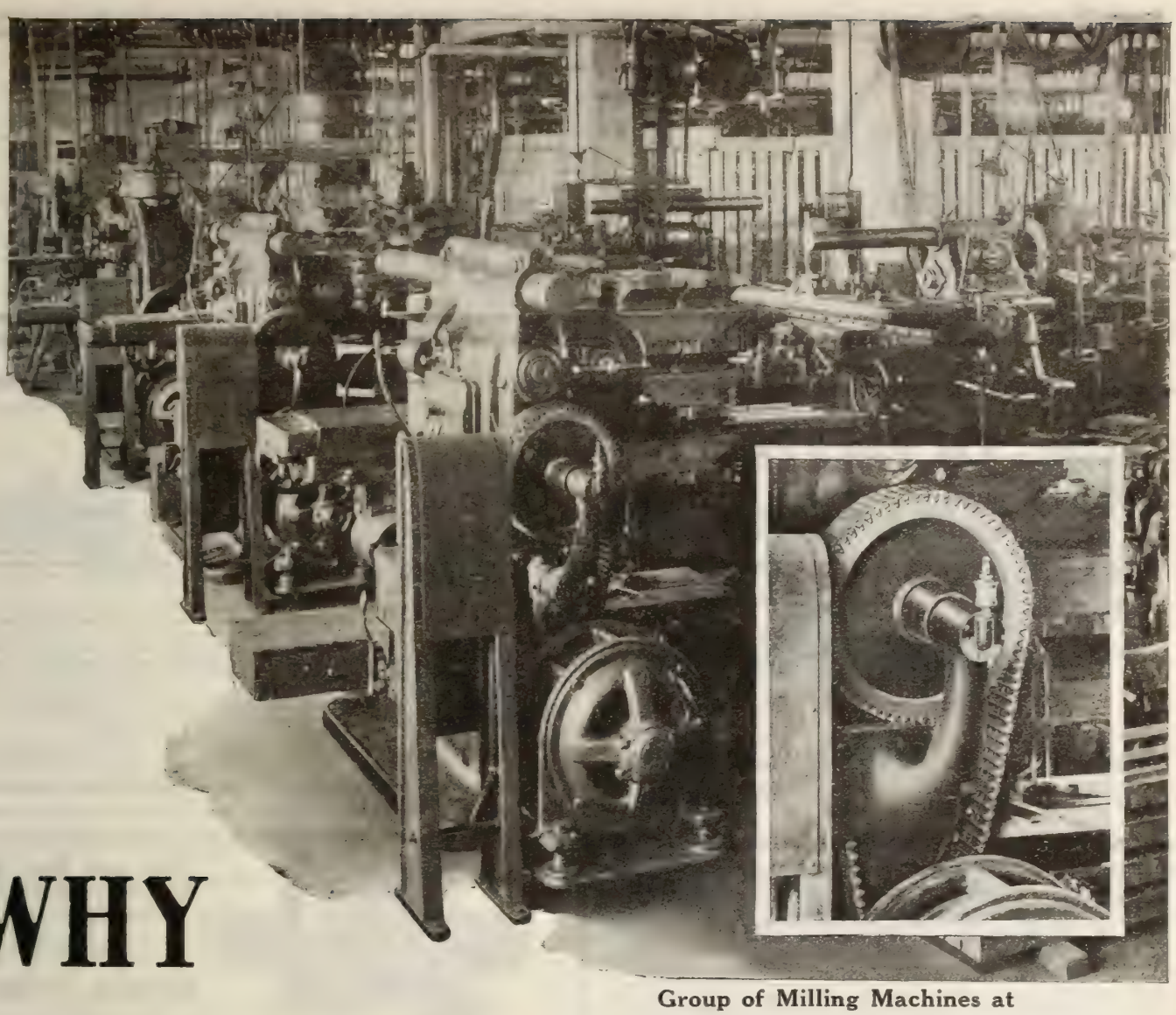
A valuable reference work imported from England and sold as an advertising medium at the low price of 40c post paid.

Address Montreal Office

SOLD BY LEADING DEALERS EVERYWHERE OR BY

MAGNOLIA METAL CO.

OFFICE AND FACTORY:
225 St. Ambroise Street, MONTREAL



WHY

Group of Milling Machines at

Do Modern Shops Use "Morse"?

Machine Tools driven through "Morse" Silent Chains are positively connected to motor —instantaneous motion, no slip, no backlash. 99 per cent. efficient, compact, flexible, positive.

"MORSE" Drives have every quality of

EFFICIENT, POWER TRANSMISSION

STRENGTH SIMPLICITY ENDURANCE SILENCE

Conserve Power *Before Buying Pulleys and Belting investigate, know the facts* **Increase Production**

Are you under your conditions producing maximum output with minimum cost?

MORSE CHAIN CO. Largest Manufacturers of Silent Chains in the World ITHACA, N.Y.

MORSE ENGINEERING SERVICE ASSISTANCE WITHOUT OBLIGATION

Address Nearest Office

BOSTON, Mass .....141 Milk Street
CHICAGO, Ill. .....Merchants Loan & Trust Bldg.
CLEVELAND, OHIO .....421 Engineers Bldg.
DETROIT, Mich. .....1003 Woodward Ave.
GREENSBORO, N.C. .....805 Ashboro Street
NEW YORK CITY .....50 Church St.
PITTSBURGH, Pa. .....Westinghouse Bldg.
SAN FRANCISCO, Cal. ... Monadnock Bldg.
ATLANTA, Ga. ..Earl F. Scott, M.E., 702 Chandler Bldg.
CANADA .....Jones & Glassco, Reg'd Montreal, St. Nicholas Bldg. Toronto, Traders' Bank Building.
MINNEAPOLIS, Minn. .....Strong-Scott Mfg. Co. 413 Third St., S.
ST. LOUIS, Mo..Morse Engineering Co., Chemical Bldg.
Licensees for Europe and Eastern Hemisphere, The Westinghouse Brake Co., Ltd., 82 York Road, King's Cross, London, N.

HINTS TO BUYERS

DOMINION COAL COMPANY LIMITED

"Dominion" and "Springhill" BITUMINOUS STEAM and GAS COALS

GENERAL SALES OFFICE

112 St. James St. Montreal

NOTICE

TO

Stationary and Hoisting Engineers

Everyone operating a STATIONARY steam plant of 50 h.p. or over in the Province of Ontario must hold a Stationary Engineer's Certificate from the Board of Stationary and Hoisting Engineers. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary and Hoisting Engineers' Act.

Everyone operating a HOISTING steam plant working at a pressure of 20 pounds or over, irrespective of horse power, and used for hoisting in structural operations or excavating purposes, in the Province of Ontario, must hold a Hoisting Engineer's Certificate from the Board of Stationary and Hoisting Engineers. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary and Hoisting Engineers' Act.

Application forms for obtaining STATIONARY or HOISTING Engineers' Certificates, may be had upon applying to the Chairman.

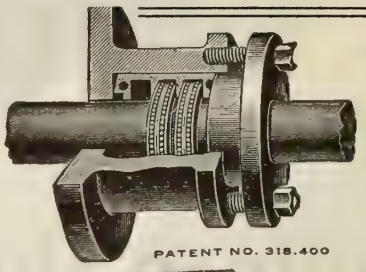
HON. F. G. MACDIARMID, Minister of Public Works and Highways.
W. C. McGHIE, Chairman of Board.
W. A. RIDDELL, M. A. PH. D., Superintendent, Trades & Labour Branch.

NATIONAL BOILER GIRTH SEAM PROTECTOR

If your Boiler is not Fire-cracked it eventually will, **prevent this** by putting on a National Boiler Protector. You will save cost in repairs and prolong life of the boiler. All new boilers should be Protected.

Write us for particulars.

NATIONAL BOILER PROTECTOR CO.
New Toronto Address
Room 24 Lombard Bldg.



PATENT NO. 318,400

PAT. NO. 500,899
" " 534,104
" " 602,328
" " 654,541
" " 654,542
" " 725,368
" " 774,490
" " 775,193
" " 775,194
" " 791,300
" " 805,669

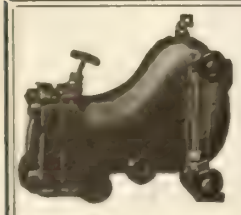
PAT. NO. 829,116
" " 830,530
" " 856,103
" " 878,238
" " 894,537
" " 895,791
" " 898,066
" " 905,103
" " 934,629
" " 979,206
" " 1000,75

Why not Buy the Best, when in market for Packing?

HOLMES' Metallic Packing Is Guaranteed 3 Years

Lasts many times longer. 30 days' trial. Less oil. No cutting. Easily applied to any Steam Engine, Air Compressor or Gas Engine. Satisfaction or no pay. Write us.

HOLMES METALLIC PACKING CO., Wilkes-Barre, Pa.
Incorporated 1897



McDANIEL IMPROVED STEAM TRAP

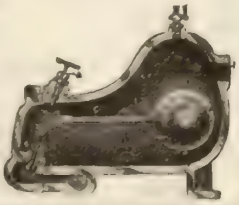
FOR HIGH OR LOW PRESSURE.

Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

MAY WE SEND ONE FOR TRIAL?

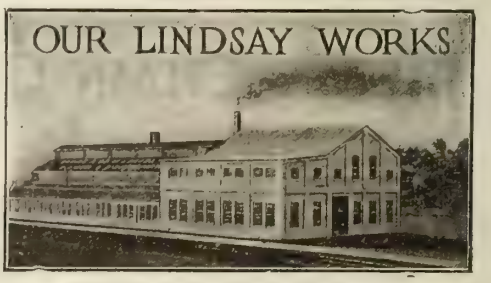
Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators.

SEND FOR CATALOGUE.



THE GARTH COMPANY
26 Craig Street MONTREAL, CAN.
WATSON & McDANIEL CO.
No. 146 N. 7th Street, PHILADELPHIA, Pa.

Water Turbines, Hydraulic Governors, Centrifugal Pumps



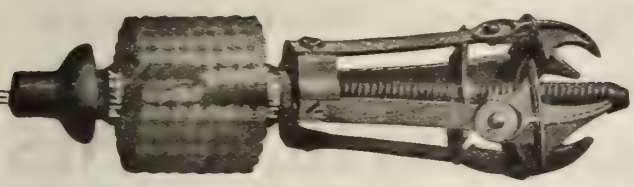
Boving Hydraulic & Engineering Co., Limited
Lindsay, Ontario

CONSERVATION

PLIBRICO JOINTLESS AND PLIBRICO-BOND HIGH TEMPERATURE

will enable you to get maximum results from Steamboilers by making a jointless, air-proof lining and conserving heat.
STORMTIGHT plastic and liquid CEMENTS will prevent all losses from leaks in roofs or walls.
LAPIDOLITH concrete hardener will eliminate damage to machinery by concrete dust.

Mill Supply Dept. BEVERIDGE PAPER CO., LTD., Montreal



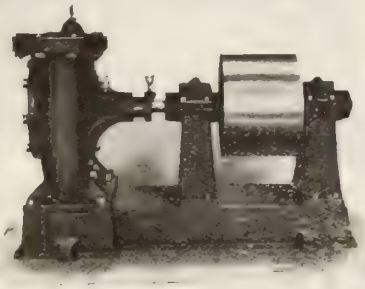
Looks like a good tool and it's just a little better than it looks. Adopted as standard by thousands of engineers who know from experience that it always gets results.

Pilleys Combination Flue Brush and Scraper

is adjustable to the tube—scrapes and brushes thoroughly in one operation. Guaranteed against defective materials and that wires will not pull out or lay over. For sale by leading Canadian jobbers.

Eastern Office: 71 Fulton St., New York.

PILLEY PACKING & FLUE BRUSH MFG. CO.
623 South Third Street ST. LOUIS, MO.



Send that PUMP inquiry to

The Smart-Turner Machine Co.
LIMITED
HAMILTON, CANADA

IT IS IMPORTANT!

If you have something to dispose of in goods or service that as many buyers as possible get to know you and your product. This can be accomplished through

Canadian Foundryman
143 University Avenue, Toronto

THE LADD VERTICAL WATER TUBE BOILER

The Goldie-McCulloch Co., Ltd.
Galt, Ontario

Canadian licencees under patents 162401 and 162402 dated May 4, 1915.

The George T. Ladd Company,
Pittsburgh, Pa.

Owners and manufacturers for the United States.

Write for new Catalogue No. 17.

Banish Ladders — Operate Valves from the Floor—

It's quicker, cheaper and safer. A pull on the chain of a

Babbitt
—Adjustable—
SPROCKET RIM
with Chain Guide

opens or closes a valve quicker than you can do it by spinning the wheel with your hands.

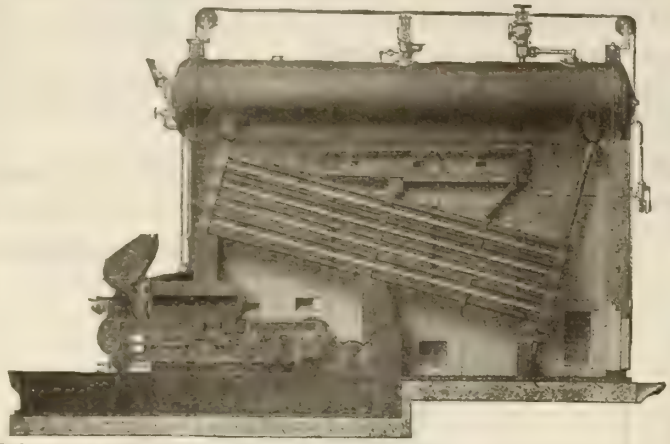
At your dealers, or write us.

BABBITT STEAM SPECIALTY CO.
New Bedford, Massachusetts

93-21

"ALL BRITISH"
"B.&W." PATENT WATER TUBE STEAM BOILERS

HIGHEST ECONOMY, SAFETY, DURABILITY. OVER 20,000,000 H.P. IN USE.



Babcock & Wilcox Patent Water Tube Steam Boiler, Superheater and Mechanical Stoker.

ALSO

Steam Superheaters
Mechanical Stokers
Coal-Handling Machinery
Piping, Feed Water Heaters
Water Softeners and Purifiers
and **ELECTRIC CRANES**

BABCOCK & WILCOX, Limited

HEAD OFFICE FOR CANADA - COLLEGE ST. (ST. HENRY), MONTREAL
TORONTO OFFICE, TRADERS BANK BUILDING

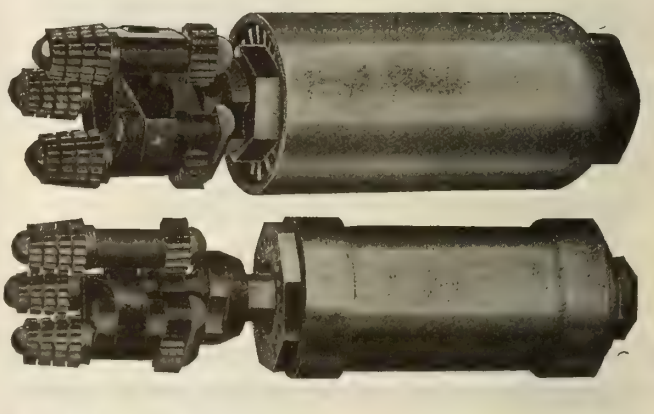
BABCOCK & WILCOX LIMITED

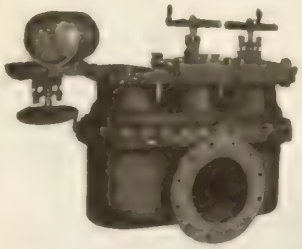
LAGONDA
BOILER TUBE CLEANERS

The latest Lagonda Water and Air-Driven Boiler Tube Cleaners are the most powerful and efficient tube cleaners made. They develop higher speed and greater power than has heretofore been secured with any Turbine Cleaner, and their use will materially shorten the time required in cleaning boilers.

These new Lagonda Cleaners are built for all sizes of tubes, either straight or curved, and they can be driven by water, air or steam.

Ask for Catalog L.





LAGONDA Multiple Water Strainers

The Lagonda Multiple Water Strainer in your water supply main will remove all objectionable solid matter and insure constant and economic conditions of pump and condenser operation. They are easily and quickly cleaned, without interruption of water supply, and take up small floor space. **Ask for Catalog R-2.**

BABCOCK & WILCOX LIMITED

St. Henry, MONTREAL
Branch Office: Traders Bank Building, Toronto

POWER HOUSE BUYERS' DIRECTORY

If what you want is not listed here write us, and we will tell you where to get it. Let us suggest that you consult also the advertisers' index facing the inside back cover, after having secured advertisers' names from this directory. The information you desire may be found in the advertising pages This department is maintained for the benefit and convenience of our readers. The insertion of our advertisers names under proper headings is gladly undertaken, but does not become part of an advertising contract.

AIR COCKS
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

AIR VALVES
Mueller Mfg. Co., H., Sarnia, Ont.

AMMETERS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. H. W. Johns-Manville Co., Toronto, Ont.

AMMONIA VALVES AND FITTINGS
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Frick Co., Waynesboro, Franklin Co., Pa.
Homestead Valve Mfg. Co., Pittsburgh, Pa.
York Mfg. Co., York, Pa.

AMMONIA PURIFIERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Mfg. Co., York, Pa.

AMMONIA TANKS
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford, Ont.

ARCHES, COMBUSTION CHAMBER
Canadian Fairbanks-Morse Co., Ltd. Montreal.

ASH CARRYING SYSTEMS
Babcock & Wilcox, Ltd. Montreal.
Waterous Engine Works Co., Brantford, Ont.

ASBESTOS SPECIALTIES
Durabla Mfg. Co., New York, N.Y.
Garlock Packing Co., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

AUTOMATIC ICE RECORDING DOORS AND CHUTES
Jamison Cold Storage Door Co., Hagerstown, Md.

BABBITT AND ANTI-FRICTION METAL
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Hoyt Metal Co., Toronto.
Magnolia Metal Co, Montreal.
Wm. C. Wilson & Co., Toronto.

BALL BEARINGS
Can. S K F Co., Toronto, Ont.

BALLCOCKS
D'Este Co., Julian, Boston, Mass.

BATTERIES AND ACCESSORIES
Can. H. W. Johns-Manville Co., Toronto, Ont.

BELT CEMENT
Graton & Knight Mfg. Co., Montreal.

BELT DRESSING
Cling Surface Co., Buffalo.
Dominion Belting Co., Hamilton, Ont.
Graton & Knight Mfg. Co., Montreal.

BELT LACING, LEATHER
Graton & Knight Mfg. Co., Montreal.

BELT TIGHTENERS
Waterous Engine Works Co., Brantford, Ont.

BELT PULLEYS
Waterous Engine Works Co., Brantford, Ont.

BELTING, BALATA
Federal Engineering Co., Toronto, Ont.

BELTING, LINK
Graton & Knight Mfg. Co., Montreal.
Waterous Engine Works Co., Brantford, Ont.

BELTING, STITCHED COTTON DUCK
Dominion Belting Co., Hamilton, Ont.

BELTING, LEATHER
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Garlock Packing Co., Hamilton, Ont.
Graton & Knight Mfg. Co., Montreal.
D. K. McLaren Ltd., Montreal.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

BELTING, RUBBER
Can. H. W. Johns-Manville Co., Toronto, Ont.
Jeffrey Manufacturing Co., Montreal.
Thomson-Gordon, Ltd., Hamilton, Ont.

BELTING, WOVEN COTTON
Federal Engineering Co., Toronto, Ont.

BINS, COAL, COKE AND ORE
Jeffrey Manufacturing Co., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford, Ont.

BLOWERS
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Coppus Eng. & Equip. Co., Worcester, Mass.
Green's Economiser, Ltd., Toronto.

BOILER COVERING
Beveridge Paper Co., Montreal, Que.

BOILER COMPOUNDS
Beveridge Paper Co., Montreal, Que.
Can. Economic Lubricant Co., Montreal, Que.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Metlskin Mfg. Co., Rochester, N.Y.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Wm. C. Wilson & Co., Toronto.

BOILER COMPOUND FEEDERS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Morehead Mfg. Co., Woodstock.
Lunkenheimer Co., Cincinnati, O.

BOILER FEED PUMPS
American Steam Pump Co., Battle Creek, Mich.
Boring Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Steam Boiler Equipment Co., Toronto, Ont.
Darling Bros., Ltd., Montreal, Que.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Laurie & Lamb, Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

BOILER FEED REGULATORS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Beveridge Paper Co., Montreal, Que.
Mason Regulator & Engineering Co., Montreal.

BOILER MOUNTINGS
Babcock & Wilcox, Ltd. Montreal.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Ltd., Montreal, Que.
Inglis Co., The John, Toronto, Ont.
Lunkenheimer Co., Cincinnati, O.
Mason Regulator & Engineering Co., Montreal.

BOILER PRESERVATIVES
Johns-Pratt Co., The, Hartford, Conn.
Metlskin Co., Inc., Rochester, N.Y.

BOILER HOUSE ACCESSORIES
Babcock & Wilcox, Ltd. Montreal.
Cole, Ltd., Geo. W., Toronto.
Green's Economiser, Ltd Toronto.
Mason Regulator & Engineering Co., Montreal.

BOILER SEAM PROTECTOR
National Boiler Seam Protector Co., Montreal.

BOILER SETTINGS
Beveridge Paper Co., Montreal.
Gates, John W., St. James St., Montreal.

BOILERS, HORIZONTAL, RETURN, TUBULAR AND WATERTUBE
Babcock & Wilcox, Ltd. Montreal.
Cole, Ltd., Geo. W., Toronto.
Goldie & McCulloch Co., Galt.
Frick Co., Waynesboro, Franklin Co., Pa.
Inglis Co., The John, Toronto, Ont.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Jones Underfeed Stoker Co., Toronto.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Ladd, The Geo. T., Co., Pittsburgh, Pa.
McAvity, T., & Sons, Ltd., St. John, N.B.
Waterous Engine Works Co., Brantford, Ont.

BOILERS, MARINE, LOCOMOTIVE AND VERTICAL
Babcock & Wilcox, Ltd. Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Goldie & McCulloch Co., Galt.
Inglis Co., The John, Toronto, Ont.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
John McDougall Caledonian Iron Works, Montreal.
Waterous Engine Works Co., Brantford, Ont.

BOXES, FUSE AND METER
Johns-Pratt Co., The, Hartford, Conn.

BRASS FOUNDERS
McAvity, T., & Sons, Ltd., St. John, N.B.
D'Este Co., Julian, Boston, Mass.
Mueller Mfg. Co., H., Sarnia, Ont.

BRINE COOLERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

BRINE TANKS
Frick Co., Waynesboro, Franklin Co., Pa
MacKinnon, Holmes & Co., Sherbrooke, Que
Waterous Engine Works Co., Brantford, Ont.
York Manufacturing Co., York, Pa.

BUSHINGS
Steel Mill Packing Co., Windsor, Ont.

CABLE
Wm. C. Wilson & Co., Toronto.

CALORIMETERS
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y
Taylor Instrument Co., Rochester, N.Y.

CANS, OILY WASTE
Jas. Morrison Brass Mfg. Co., Toronto.

CAST IRON FITTINGS
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.

CASTINGS, BRASS AND IRON
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Lunkenheimer Co., Cincinnati, O.
John McDougall Caledonian Iron Works Co. Ltd., Montreal.
McAvity, T., & Sons, Ltd., St. John, N.B.
Mueller Mfg. Co., H., Sarnia, Ont.
Waterous Engine Works Co., Brantford, Ont.
Wood & Co., R. D., Philadelphia, Pa.

CELLAR DRAINERS
Morrison Brass Mfg. Co., James, Toronto, Ont.
Mueller Mfg. Co., H., Sarnia, Ont.

CEMENT HARDNER & WATERPROOFER
Beveridge Paper Co., Montreal, Que.

CEMENT, HIGH TEMPERATURE
Beveridge Paper Co., Montreal.
Gates, John W., St. James St., Montreal.
Green's Economiser, Ltd., Toronto.

CEMENT, PIPE JOINT
Wm. C. Wilson & Co., Toronto.

CEMENT MACHINERY
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Waterous Engine Works Co., Brantford, Ont.

CEMENT, INSULATING, REFRACTORY
Green's Economiser, Ltd., Toronto.

CHAIN DRIVES
Coventry Chain Co., Coventry, England.
Morse Chain Co., Ithaca, N.Y.

CHAIN WHEELS
Babbitt Steam Specialty Co., New Bedford, Mass.

CHIMNEYS, RADIAL BRICK
Green's Economiser, Ltd., Toronto, Ont.

CHIMNEYS, STEEL
Babcock & Wilcox, Ltd. Montreal
MacKinnon, Holmes & Co., Sherbrooke, Que.

CHUTES, COAL
Can. Allis-Chalmers, Ltd., Toronto, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.

CLEANERS, BOILER TUBE
Babcock & Wilcox, Ltd., Montreal.
Can. H. W. Johns-Manville Co., Toronto.
Cole Ltd., Geo. W., Toronto.
Beveridge Paper Co., Montreal, Que.
Garlock Packing Co., Hamilton, Ont.
Green's Economiser, Ltd., Toronto.
Liberty Mfg. Co., Pittsburgh, Pa.
Laurie & Lamb, Montreal, Que.
Pierce & Co., Wm. B., Buffalo, N.Y.
Pilley Packing & Flue Brush Mfg. Co., St. Louis, Mo.
Roto Co., Hartford, Conn.

CLOCKS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.

CLOSETS
Mueller Mfg. Co., H., Sarnia, Ont.

CLUTCHES
Waterous Engine Works Co., Brantford, Ont.

COAL
Dom. Coal Co., Montreal

COAL AND ASH CONVEYORS
Babcock & Wilcox, Ltd. Montreal.
Jeffrey Manufacturing Co., Montreal.
Waterous Engine Works Co., Brantford, Ont.

COAL HANDLING MACHINERY
Babcock & Wilcox, Ltd. Montreal.
Green's Economiser, Ltd., Toronto, Ont.
Jeffrey Manufacturing Co., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford, Ont.

COAL HOLE COVERS
Can. Allis-Chalmers, Ltd., Toronto, Ont.

COILS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

COLD STORAGE INSULATION
Armstrong Cork & Insulation Co., Montreal, Que.
Beveridge Paper Co., Ltd., Montreal, Que.

COMMUTATOR TRUING DEVICES
Jordan Bros., Inc., New York, N.Y.

CONDENSERS
Alberger Heater Co., Buffalo, N.Y.
American Steam Pump Co., Battle Creek, Mich.
Boring Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Allis-Chambers, Ltd., Toronto, Ont.
Darling Bros., Ltd., Montreal, Que.
Goldie & McCulloch Co., Galt.
Laurie & Lamb, Montreal.
John McDougall Caledonian Iron Wks., Montreal.
Waterous Engine Works Co., Brantford.

CONDENSERS, AMMONIA AND STEAM
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

CONSULTING ENGINEERS
Walter J. Francis, Montreal.
Laurie & Lamb, Montreal.

COLD STORAGE DOORS AND WINDOWS
Jamison Cold Storage Door Co., Hagerstown, Md.

COMPRESSORS, AIR
American Steam Pump Co., Battle Creek, Mich.
Can. Allis-Chambers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.

Darling Bros., Ltd., Montreal, Que.
Inglis Co., The John, Toronto, Ont.
Laurie & Lamb, Montreal.
Mussens, Ltd., Co., Sherbrooke, Que.
Smart-Turner Machine Co., Ltd., Hamilton.
Taylor Instrument Co., Rochester, N.Y.

COMPRESSORS, GAS
Can. Allis-Chalmers, Ltd., Toronto, Ont.

CONDUITS
Can. H. W. Johns-Manville Co., Toronto, Ont.

CONDENSATION RECEIVER
Cole, Ltd., Geo. W., Toronto.
Davis Regulator Co. G. M., Chicago.

CONDENSER AND SMOKESTACK PAINTS
Bowser & Co., Inc., S. F., Montreal, Que.

CONNECTIONS, FLANGED
Jefferson Union Co., lexington, Mass.
Dart Union Co., Ltd., Toronto, Ont.

CONTRACTORS' STRUCTURAL STEEL
Canadian Fairbanks-Morse Co., Ltd., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.

CONVEYOR MACHINERY
Babcock & Wilcox, Ltd. Montreal.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Jeffrey Manufacturing Co., Montreal.
Waterous Engine Works Co., Brantford.

COOLER DOORS
Jamison Cold Storage Door Co., Hagerstown, Md.

CORK INSULATION
Armstrong Cork & Insulation Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.

COTTON HOSE
Garlock Packing Co., Hamilton, Ont.

COUNTERS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

COUNTERSHAFTS
Can. Bond Hanger & Coupling Co., Alexandria, Ont.

COUPLINGS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Beveridge Paper Co., Montreal, Que.
Jeffrey Manufacturing Co., Montreal.
McAvity & Sons, T., St. John, N.B.

COUPLINGS, BOILER, FLANGED PIPE, JOINT PIPE, UNION, STEAM PIPE
Jefferson Union Co., Lexington, Mass.
Dart Union Co., Ltd., Toronto, Ont.

COUPLINGS, SHAFT
Can. Bond Hanger & Coupling Co., Alexandria, Ont.

CRANES, ALL KINDS
Babcock & Wilcox, Ltd. Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

CRANES, ELECTRIC
Babcock & Wilcox, Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

CRANES, HAND POWER
Babcock & Wilcox, Ltd., Montreal.
Boving Hydraulic & Eng., Co., Ltd., Lindsay, Ont.
Frick Co., Waynesboro, Franklin Co., Pa.
Smart-Turner Machine Co., Ltd., Hamilton.

CRANES, OVERHEAD TRAVELLING
Babcock & Wilcox, Ltd., Montreal.
Boving Hydraulic & Eng., Co., Ltd., Lindsay, Ont.
Smart-Turner Machine Co., Ltd., Hamilton.

CRANES, POST JIB
Babcock & Wilcox, Ltd., Montreal.

CRANES, SWING JIB
Babcock & Wilcox, Ltd., Montreal.

CRANES, WALL
Babcock & Wilcox, Ltd., Montreal.

CRANK AND CROSSHEAD PIN OILERS
Lunkenheimer Co., Cincinnati, O.

CRIMPS, LEATHER
Graton & Knight Mfg. Co., Montreal.

CRUSHING MACHINERY
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Jeffrey Mfg. Co., Columbus, Ohio.

CYLINDER OIL
E. H. Kellogg & Co., New York.

DAMPER REGULATORS
Babcock & Wilcox, Ltd., Montreal.
Darling Bros., Ltd., Montreal, Que.
G. M. Davis Regulator Co., Chicago.
D'Este Co., Julian, Boston, Mass.
Elliott Co., Pittsburgh, Pa.
Mason Regulator Co., Boston, Mass.
Jas. Morrison Brass Mfg. Co., Toronto.

DISCS, FIBRE
Beveridge Paper Co., Ltd., Montreal, Que.
Johns-Pratt Co., The, Hartford, Conn.

DISCS, LEATHER
Graton & Knight Mfg. Co., Montreal.

DISTILLING APPARATUS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

DOORS, COLD STORAGE AND FREEZER
Jamison Cold Storage Door Co., Hagerstown, Md.

DOUBLE PIPE CONDENSERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

DRAFT APPARATUS SYSTEMS, MECHANICAL
Green's Economiser, Ltd., Toronto.

DRYING MACHINERY
Canadian Fairbanks-Morse Co., Ltd., Montreal.

DYNAMOS
Canadian Fairbanks-Morse Co., Ltd., Montreal.

ECONOMIZERS
Babcock & Wilcox, Ltd., Montreal.
Green's Economiser, Ltd., Toronto.

EJECTORS
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.
Smart-Turner Machine Co., Ltd., Hamilton.

ELECTRICAL ACCESSORIES AND MACHINERY
Can. H. W. Johns-Manville Co., Toronto, Ont.
Beveridge Paper Co., Ltd., Montreal, Que.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Economy Fuse & Mfg. Co., Montreal, Que.
MacGovern & Co., Inc., New York.

ELECTRICAL SUPPLIES
Can. General Electric Co., Toronto, Ont.
Can. H. W. Johns-Manville Co., Toronto, Ont.

ELEVATORS
Beveridge Paper Co., Montreal, Que.
MacKinnon, Holmes & Co., Sherbrooke, Ont.
John MacDougall Caledonian Iron Works, Montreal.

ELEVATING MACHINERY
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Beveridge Paper Co., Montreal, Que.
Goldie & McCulloch Co., Galt.
Hamilton Mfg. Co., Wm., Peterboro, Ont.
Jeffrey Mfg. Co., Montreal.
Waterous Engine Works Co., Brantford.

ENAMELWARE
H. Mueller Mfg. Co., Sarnia, Ont.

ENGINEERS' SUPPLIES
Beveridge Paper Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Ltd., Montreal, Que.
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.
Jas. Morrison Brass Mfg. Co., Toronto.

ENGINES, AUPTOMATIC AND DROP VALVE
Frick Co., Waynesboro, Franklin Co., Pa.
Waterous Engine Works Co., Brantford.

ENGINES, CORLISS AND ROCKING VALVE
Frick Co., Waynesboro, Franklin Co., Pa.
Goldie & McCulloch Co., Galt.
Green's Economiser, Ltd., Toronto.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Waterous Engine Works Co., Brantford.

ENGINES, DIESEL
Can. Allis-Chalmers, Ltd., Toronto, Ont.

ENGINES, GAS AND GASOLINE
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Laurie & Lamb, Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

ENGINES, STEAM
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Can. Sirocco Co., Windsor, Ont.
Goldie & McCulloch Co., Galt.
Hamilton Mfg. Co., Wm., Peterboro, Ont.
Inglis Co., The John, Toronto, Ont.
Laurie & Lamb, Montreal.
John MacDougall Caledonian Iron Works, Montreal.
Waterous Engine Works Co., Brantford.

ENGINES, HOISTING, LOGGING, CABLE-WAY
Can. Allis-Chalmers, Ltd., Toronto, Ont.

ENGINES, MARINE
Canadian Fairbanks-Morse Co., Ltd., Montreal.
The John MacDougall Caledonian Iron Works Co., Ltd., Montreal.

ENGINES, SAW MILL
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Laurie & Lamb, Montreal.
Waterous Engine Works Co., Brantford.

ENGINES, SINGLE COMPOUND AND TRIPLE EXPANSION
Canadian Griscom-Russell Co., Ltd., Montreal.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
John MacDougall Caledonian Iron Works Co., Ltd., Montreal.
Kerr Engine Co., Walkerville.
Waterous Engine Works Co., Brantford.

ENGINES, VERTICAL
Laurie & Lamb, Montreal.

ENGINEERING BOOKS
MacLean Publishing Co., Toronto.

EXHAUSTERS
Green's Economiser, Ltd., Toronto.

EXHAUST HEADS
Darling Bros., Ltd., Montreal, Que.
Direct Separator Co., Syracuse, N.Y.
Jas. Morrison Brass Mfg. Co., Toronto.
Franklin Williams Co., New York.
Watson & McDaniel Co., Philadelphia.

EXPANSION JOINTS
Alberger Heater Co., Buffalo, N.Y.
Direct Separator Co., Syracuse, N.Y.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.

FANS, VENTILATING
Coppus Engr. & Equip. Co., Worcester, Mass
Green's Economiser, Ltd., Toronto.
Sturtevant Co. of Canada, B. F., Galt, Ont.

FEED WATER HEATERS
Alberger Heater Co., Buffalo, N.Y.
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Ltd., Montreal, Que.
Elliott Co., Pittsburgh, Pa.
The John MacDougall Caledonian Iron Works Co., Ltd., Montreal.
Waterous Engine Works Co., Brantford.

FEED WATER REGULATORS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Chaplin, Fulton Mfg. Co., Pittsburgh, Pa.
Beveridge Paper Co., Montreal, Que.
Elliott Co., Pittsburgh, Pt.
Green's Economiser, Ltd., Toronto, Ont.
Laurie & Lamb, Montreal.

FIBRE, VULCANIZED
Beveridge Paper Co., Montreal, Que.

FILTERS
Bowser & Co., Inc., S. F., Toronto, Ont.
The John MacDougall Caledonian Iron Works Co., Ltd., Montreal.
Laurie & Lamb, Montreal.

FILTERS, WATER
Darling Bros., Ltd., Montreal, Que.
Frick Co., Waynesboro, Franklin Co., Pa.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Scaife & Sons, Wm. B., Pittsburgh, Pa.
York Mfg. Co., York, Po.

FIREBRICK—JOINTLESS
Beveridge Paper Co., Montreal, Que.

FIRE BRICK, PLASTIC
Gates, John W., St. James St., Montreal.

FIREPROOF COLD STORAE DOORS AND WINDOWS
Jamison Cold Storage Door Co., Hagerstown, Md.

FITTINGS, AIR, AUTOMOBILE, GAS, HYDRAULIC, PIPE, PIPE FLANGED, SCREWED PIPE, STEAM
Jefferson Union Co., Lexington, Mass.
Dart Union Co., Ltd., Toronto, Ont.
H. Mueller Mfg. Co., Sarnia, Ont.

FLANGED STEAM FITTINGS
Direct Separator Co., Syracuse, N.Y.
McAvity, T., & Sons, Ltd., St. John, N.B.

FLANGES
Dart Union Co., Ltd., Toronto, Ont.
Jefferson Union Co., Lexington, Mass.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.

FLOORING COMPOSITION
Armstrong Cork & Insulation Co., Montreal Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.

FLUE CLEANERS
Babcock & Wilcox, Montreal.
Green's Economiser, Ltd., Toronto, Ont.
Liberty Mfg. Co., Pittsburg, Pa.
Pilley Packing and Flue Brush Mfg. Co., St. Louis, Mo.
William B. Pierce Co., Buffalo, N.Y.
Roto Co., Hartford, Conn.
Wm. C. Wilson & Co., Toronto.

FLUE GAS ANALYSIS INSTRUMENTS
Green's Economiser, Ltd., Toronto, Ont.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Uehling Instrument Co., New York.
Penberthy Injector Co., Windsor, Ont.

FLUES, GAS AND SMOKE
Green's Economiser, Ltd., Toronto.

FLUMES, STEEL
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.

FREEZER DOORS
Jamison Cold Storage Door Co., Hagerstown, Md.

FRICTION LEATHERS
Graton & Knight Mfg. Co., Montreal.

FUEL AND OIL PUMPS AND MEASURING SYSTEMS
Imperial Oil, Ltd., Toronto.

FURNACES, BOILER
Gates, J. W., Montreal, P.Q.
Green's Economiser, Ltd., Toronto.

FURNACES, SMOKELESS
Babcock & Wilcox, Montreal.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Detroit, Mich.

FURNACE GRATE BARS
Beveridge Paper Co., Montreal, Que.

FUSES
Can. H. W. Johns-Manville Co., Toronto, Ont.
Economy Fuse & Mfg. Co. of Canada, Montreal.
Johns-Pratt Co., The, Hartford, Conn.

GAS ANALYSIS INSTRUMENTS, ETC.
Green's Economiser, Ltd., Toronto, Ont.
Penberthy Injector Co., Windsor, Ont.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Uehling Instrument Co., New York, N.Y.

GASKETS, RUBBER, ASBESTOS
Can. H. W. Johns-Manville Co., Toronto, Ont.
Durabla Mfg. Co., New York, N.Y.
Frick Co., Waynesboro, Franklin Co., Pa.
Garlock Packing Co., Hamilton, Ont.
Johns-Pratt Co., The, Hartford, Conn.
Sarco Co., Inc., New York, N.Y.
Thomson-Gordon, Ltd., Hamilton, Ont.

GASKETS, LEAD, COPPER AND LEATHER
Graton & Knight Mfg. Co., Montreal, Que.
Shell Bar Boico Supply Co., Toronto, Ont.
Sarco Co., Inc., New York, N.Y.
Wm. C. Wilson & Co., Toronto, Ont.

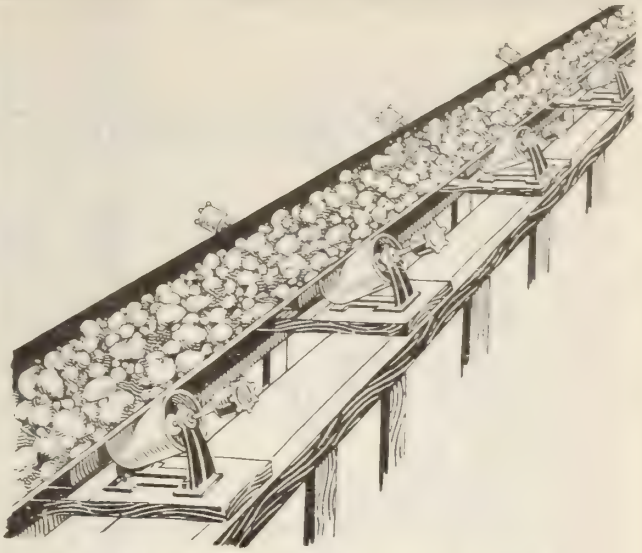
ELECTRICAL SAFETY AND ECONOMY

ECONOMY
Renewable
FUSES

Cut Annual Fuse Maintenance Cost 80%

Economy "Drop Out" Renewal Links are responsible for this saving.
A "Drop Out" Renewal Link restores a blown Economy Fuse to its original efficiency.
A sustained arc is impossible.
It's the work of a moment for even a novice to replace the link and renew the fuse.
First in its field—first in efficiency.
Order from your dealer.
Write for Catalogue 24.

Economy Fuse & Mfg. Co.
of Canada, Ltd.
Unity Bldg. - Montreal
Manufacturers in Canada of S.& C. H gh Potential Fuses—to 150,000 volts



SCANDINAVIA BELTING

For Belt Conveyors

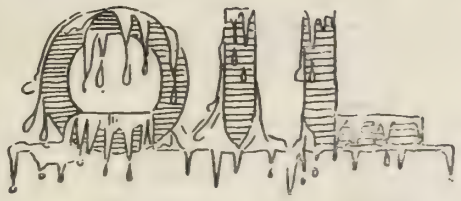
This belt will give good and long service as a conveyor and can be kept continually in service until the whole fabric is worn out. This solid woven belt does not fall down when its work is only partly done by the plies opening up—there are no plies and no joints.

This belt is particularly well adapted for carrying broken stone, ore, coal, quenched coke, etc. We can refer to large plants who have been giving repeat orders for this belting for years, having found this the most satisfactory material.

When you need a new belt for your conveyor please let us have the opportunity of quoting.

Federal Engineering Co., Limited
172 John Street - TORONTO

USED



Made Pure and Clean

Made so clean and so pure that you can use it over and over on the finest bearings, every drop preventing friction—none wasted.
In this way will the

ANDERSON
Pressure Filter

many times return its cost. For actually more than half of all the oil you buy is saved instead of wasted—once you have this Anderson Pressure Filter to cleanse and purify the used oil in the one effective way—the way refineries treat crude oil.

Catalogue explains.

THE V. D. ANDERSON CO.
West 96th St., Cleveland, Ohio

GAS PRODUCER PLANTS
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal
Laurie & Lamb, Montreal.

GASOLINE
Imperial Oil, Ltd., Toronto.

GAUGE COCKS
Canadian Fairbanks-Morse Co., Ltd., Montreal
Garlock Packing Co., Hamilton, Ont.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.
W. J. Wall, Montreal.

GAUGE GLASSES
Wm. C. Wilson & Co., Toronto.

GAUGES, AMMONIA, OIL, GAS, AIR
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y

GAUGES, PRESSURE, VACUUM, DRAFT AND RECORDING, AND MICROMETER
Babcock & Wilcox, Montreal.
Green's Economiser, Ltd., Toronto.
Lunkenheimer Co., Cincinnati, O.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.

GAUGES, WATER
Babcock & Wilcox, Montreal.
Jenkins Bros., Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
Penberthy Injector Co., Windsor, Ont.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y

GEARS, FIBRE CUT
Beveridge Paper Co., Ltd., Montreal, Que.

GEARS, CUT, WORM, MORTISE
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
The John McDougall Caledonian Iron Works Co. Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

GENERATORS, STEAM TURBO
Can. General Electric Co., Toronto, Ont.
Laurie & Lamb, Montreal.

GENERATORS AND CONVERTORS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. General Electric Co., Toronto, Ont.

GOVERNORS, ENGINE
Escher Wyss & Co., Montreal, Que.
McAvity, T., & Sons, Ltd., St. John, N.B.
Waterous Engine Works Co., Brantford.

GRAPHITE, BOILER
Wm. C. Wilson & Co., Toronto.

GRATES, DUMPING, ROCKING, STATIONARY
Babcock & Wilcox, Montreal.
Can. Steam Boiler Equipment Co., Toronto, Ont.
Galt Foundry Co., Galt, Ont.
Mason Regulator & Engineering Co., Montreal.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Waterous Engine Works Co., Brantford.

GREASE CUPS
Albany Lubricating Co., New York City.
Detroit Lubricator Co., Walkerville.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

GREASE AND OIL EXTRACTORS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Elliott Co., Pittsburgh, Pa.
Laurie & Lamb, Montreal.

GREASES
Albany Lubricating Co., New York City.
Can. Economic Lubricant Co., Montreal, Que.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Wm. C. Wilson & Co., Toronto.

HAND LEATHERS OR PADS
Graton & Knight Mfg. Co., Montreal.

HANGERS
Can. General Electric Co., Toronto, Ont.
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Can. S K F Co., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Goldie & McCulloch Co., Galt.
Waterous Engine Works Co., Brantford.

HEATERS
Alberger Heater Co., Buffalo, N.Y.
Babcock & Wilcox, Ltd., Montreal.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
Laurie & Lamb, Montreal.
McAvity & Sons, T., St. John, N.B
Scaife & Sons, Wm. B., Pittsburgh, Pa
Waterous Engine Works Co., Brantford.

HEATERS, EXHAUST STEAM
Can. Allis-Chalmers, Ltd., Toronto, Ont

HEATERS, METERING
Can. Allis-Chalmers, Ltd., Toronto, Ont

HOISTS, GRIP
Jordan Bros., Inc., New York, N.Y.

HOISTING AND CONVEYING MACHINERY
Babcock & Wilcox, Ltd., Montreal.
Waterous Engine Works Co., Brantford.

HOSE, METALLIC
Pennsylvania Flexible Metallic Tubing Co., Boston, Mass.

HOSE, STEAM, SUCTION AND WATER
Canadian Fairbanks-Morse Co., Ltd., Montreal
Garlock Packing Co., Hamilton, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

HYDRANTS
Wood & Co., R. D., Philadelphia, Pa.

HYDRAULIC ACCUMULATORS
Smart-Turner Machine Co., Ltd., Hamilton.

HYDRAULIC MACHINERY
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
John McDougall Caledonian Iron Wks., Montreal.

HYDRAULIC PRESSES
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

ICE MAKING MACHINERY
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Frick Co., Waynesboro, Franklin Co.
Linde Canadian Refrigeration Co., Montreal.
York Mfg. Co., York, Pa.

INDICATORS, ELECTRIC—ALL TYPES
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Uehling Instrument Co., New York, N.Y.

INDICATORS, STEAM AND GAS ENGINE
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Canadian Fairbanks-Morse Co., Montreal.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Green's Economiser, Ltd., Toronto.
Uehling Instrument Co., New York, N.Y.

INDICATORS—AMMONIA, HYDRAULIC
Can. Detroit Lubricator Co., Walkerville, Ont.

INDICATORS, SPEED
L. S. Starrett Co., Athol, Mass.

INJECTORS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

INSTRUMENTS, RECORDING
Green's Economiser, Ltd., Toronto.
Taylor Instrument Companies, Rochester, N.Y.

INSULATING BRICK
Armstrong Cork & Insulation Co., Montreal, Que
Beveridge Paper Co., Ltd., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.

INSULATING COMPOUNDS
Johns-Pratt Co., The, Hartford, Conn.

INSULATORS
Beveridge Paper Co., Ltd., Montreal, Que.
Johns-Pratt Co., The, Hartford, Conn.

IRON FILLER
Can. H. W. Johns-Manville Co., Toronto, Ont.

KILNS
Green's Economiser, Ltd., Toronto.

LACE LEATHERS
Graton & Knight Mfg. Co., Montreal.
Wm. C. Wilson & Co., Toronto.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Can. B. K. Morton Co., Toronto, Montreal.
Crane Packing Co., Chicago, Ill.

LAMPS, ARC
Canadian Fairbanks-Morse Co., Montreal.
Can. General Electric Co., Toronto, Ont.
Can. H. W. Johns-Manville Co., Toronto, Ont.

LAMPS, ELECTRIC
Wm. C. Wilson & Co., Toronto.

LAMPS, INCANDESCENT
Canadian Fairbanks-Morse Co., Montreal.
Can. General Electric Co., Toronto, Ont.
Can. H. W. Johns-Manville Co., Toronto, Ont
Can. Laco-Philips Co., Ltd., Toronto, Ont.

LAMPS, NITRO
Can. Laco-Philips Co., Ltd., Toronto, Ont.

LAMPS, TUNGSTEN AND NITRO
Can. General Electric Co., Toronto, Ont.
Can. Laco-Philips Co., Ltd., Toronto, Ont.

LEATHER STRAPPING
Graton & Knight Mfg. Co., Montreal.

LININGS, FIRE BRICK, STEEL STACK
Green's Economiser, Ltd., Toronto.

LUBRICANTS
Albany Lubricating Co., New York City.
Canadian Economic Lubricant Co., Montreal.

LUBRICATORS, CYLINDER CUTTING COMPOUNDS
Albany Lubricating Co., New York City.
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

LUBRICATORS, FORCE FEED
Can. Detroit Lubricator Co., Walkerville, Ont.
Darling Bros., Montreal.
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

LUBRICATORS, PLAIN
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

MACHINERY INSULATION
Armstrong Cork & Insulation Co., Montreal, Que
Beveridge Paper Co., Ltd., Montreal, Que.

MANGENESITE PASTE
Wm. C. Wilson & Co., Toronto.

MECHANICAL STOKERS
Babcock & Wilcox, Ltd., Montreal.
Green's Economiser, Ltd., Toronto.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Dertoit, Mich.

METERS, ELECTRIC
Can. H. W. Johns-Manville Co., Toronto, Ont.

METERS, STEAM
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Green's Economiser, Ltd., Toronto.

METERS, WATER
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Green's Economiser, Ltd., Toronto, Ont.
McAvity & Sons, T., St. John, N.B.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.

MIXING VALVES
Mueller Mfg. Co., H., Sarnia, Ont.

MILL AND MINING MACHINERY
Canadian Fairbanks-Morse Co., Montreal.
Engineering and Machine Works of Canada, Ltd. St. Catharines, Ont.
Goldie & McCulloch Co., Galt.
Waterous Engine Works Co., Brantford.

METER TESTERS
Mueller Mfg. Co., H., Sarnia, Ont.

MOTORS
Canadian Fairbanks-Morse Co., Montreal.
Can. General Electric Co., Toronto, Ont.
Green's Economiser, Ltd., Toronto.

OAKUM
Wm. C. Wilson & Co., Toronto.

OFFICE RAILINGS
Jas. Morrison Brass Mfg. Co., Toronto.

OIL CUPS
Albany Lubricating Co., New York City.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

OILER, COMPOUND FEEDERS
Lunkenheimer Co., Cincinnati, O.

OILERS, GAUGE
Lunkenheimer Co., Cincinnati, O.

OILERS, MULTIPLE
Can. Detroit Lubricator Co., Walkerville, Ont.
Lunkenheimer Co., Cincinnati, O.

OIL FILTERS AND CIRCULATING SYSTEMS
Bowser & Co., Inc., S. F., Toronto, Ont.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
Jas. Morrison Brass Mfg. Co., Toronto.

OIL SEPARATORS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
Direct Separator Co., Syracuse, N.Y.
Elliott Co., Pittsburgh, Pa.
Leitch Co., Arthur S., Toronto, Ont.
Liberty Mfg. Co., Pittsburgh.
Jas. Morrison Brass Mfg. Co., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.

OILS, QUENCHING
Imperial Oil, Ltd., Toronto.

OILING SYSTEMS
Albany Lubricating Co., New York City.
Bowser & Co., Inc., S. F., Toronto, Ont.
Lunkenheimer Co., Cincinnati, O.

OILS, CYLINDER
Imperial Oil, Ltd., Toronto.

OILS, LUBRICATING
Albany Lubricating Co., New York City.
Can. Economic Lubricant Co., Montreal, Que.
Kellogg & Co., E. H., New York, N.Y.
Wm. C. Wilson & Co., Toronto.

OILS, ENGINE
Imperial Oil, Ltd., Toronto.

PACKING, ASBESTOS
Johns-Pratt Co., The, Hartford, Conn.

PACKING ENGINE
Garlock Packing Co., Hamilton, Ont.
Johns-Pratt Co., The, Hartford, Conn.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING FIBRE
Beveridge Paper Co., Ltd., Montreal, Que.
Can. B. K. Morton Co., Montreal, Que.
Johns-Pratt Co., The, Hartford, Conn.
Wm. C. Wilson & Co., Toronto.

PACKING, HYDRAULIC
Can. H. W. Johns-Manville Co., Toronto, Ont.
Crane Packing Co., Chicago, Ill.
Durabla Manufacturing Co., New York.
Garlock Packing Co., Hamilton, Ont.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

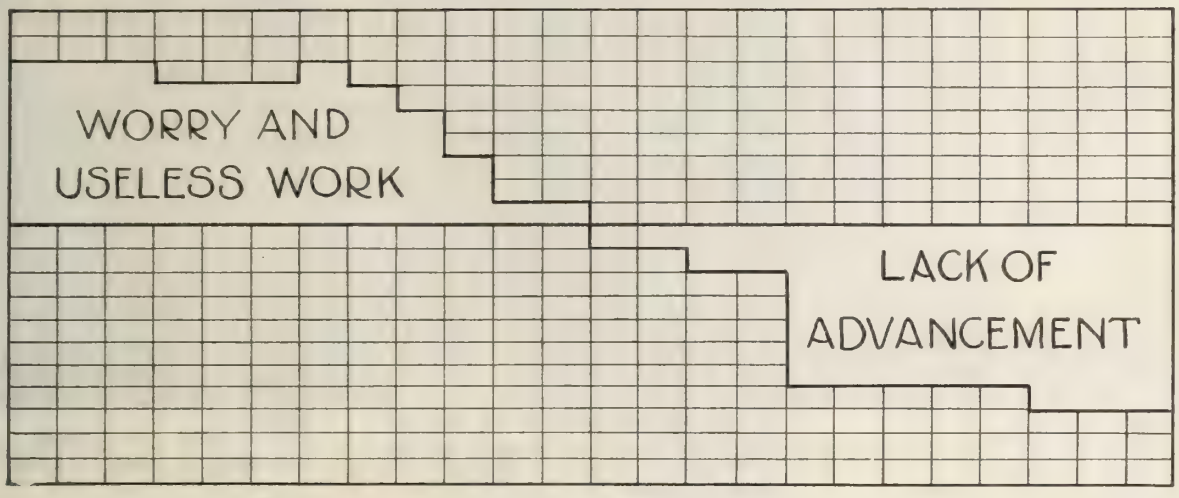
PACKING, METALLIC
Can. H. W. Johns-Manville Co., Toronto, Ont.
Crane Packing Co., Chicago, Ill.
Greene, Tweed & Co., New York.
Holmes Metallic Packing Co., Wilkesbarre, Pa
Steel Mill Packing Co., Windsor, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, ROD
Can. H. W. Johns-Manville Co., Toronto, Ont
Crane Packing Co., Chicago, Ill.
Garlock Packing Co., Hamilton, Ont.
Steel Mill Packing Co., Windsor, Ont.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, SHEET
Can. H. W. Johns-Manville Co., Toronto, Ont
Durabla Manufacturing Co., New York.
Garlock Packing Co., Hamilton, Ont.
Jenkins Bros., Ltd., Montreal.
Johns-Pratt Co., The, Hartford, Conn.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, AMMONIA, STEAM AND WATER
Can. H. W. Johns-Manville Co., Toronto, Ont
Crane Packing Co., Chicago, Ill.
Garlock Packing Co., Hamilton, Ont.
Greene, Tweed & Co., New York.
Johns-Pratt Co., The, Hartford, Conn.
Steel Mill Packing Co., Windsor, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

Let the C.A.S.E. Smooth Out Your Load Curve



Remove The Peaks of Worry And Unproductive Labor And Build Up The Valleys By Working For Your Advancement

A man who is thoroughly grounded in the practice of his profession, who is free from personal worry and trouble, overcomes the many difficulties besetting the path of the operating engineer with little labor and in a manner ensuring his advancement.

The successful man owes his success to a wise appreciation of the advantages and mutual help offered by association with those in the same field of endeavor. To join an association having for its objectives the welfare of the engineer in things mental and material, his advancement in knowledge and skill, his protection by provision for sickness and distress is to take advantage of an opportunity indispensable to all who hope to better themselves.

If you are interested in such an organization and live where less than fifteen engineers are located, send for a copy of our constitution and application blanks for admission to nearest branch lodge. If there are more than fifteen engineers in your community, get together and send for particulars regarding formation of a branch lodge.

J. H. HALE, General Secretary,

Canadian Association of Stationary Engineers

230 Caroline Street Hamilton, Ont.

If any advertisement interests you, tear it out now and place with letters to be answered.

PACKING, LEATHER
Garlock Packing Co., Hamilton, Ont.
Graton & Knight Mfg. Co., Montreal.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING PISTON
Crane Packing Co., Chicago, Ill.

PACKING, VALVE STEM
Crane Packing Co., Chicago, Ill.
Johns-Pratt Co., The, Hartford, Conn.

PAINTS
Wm. C. Wilson & Co., Toronto.

PAPER, INSULATING, ETC.
Beveridge Paper Co., Montreal, Que.

PENSTOCKS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
MacKinnon, Holmes & Co., Sherbrooke, Que.

PILLOW BLOCKS
Can. Bond Hanger & Coupling Co., Alexandria Ont.
Waterous Engine Works Co., Brantford.

PIPE COILS
Frick Co., Waynesboro, Pa.
York Mfg. Co., York, Pa.

PIPE COVERINGS, STEAM, BRINE, AMMONIA AND ICE WATER
Armstrong Cork & Insulation Co., Montreal, Que.

PIPE, CAST IRON
Wood & Co., R. D., Philadelphia, Pa.

PIPE STEEL
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

PIPE VISES AND CUTTERS
Armstrong Mfg. Co., Bridgeport, Conn.

PIPE, GAS
Can. Allis-Chalmers, Ltd., Toronto, Ont.

PIPES, WATER
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont

PIPING AND FITTINGS
Frick Co., Waynesboro, Franklin Co., Pa.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
York Mfg. Co., York, Pa.

PIPING, STEAM
Babcock & Wilcox, Ltd., Montreal.

PLATE WORK
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd. St. Catharines, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

PLUG COCKS
Homestead Valve Mfg. Co., Pittsburgh, Pa.

PLUMBING SUPPLIES
Mueller Mfg. Co., H., Sarnia, Ont.
Wm. C. Wilson & Co., Toronto.

POWER PUMPS
American Steam Pump Co., Battle Creek, Mich
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
The John McDougall Caledonian Iron Works Co. Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
Waterous Engine Works Co., Brantford.
Garlock Packing Co., Hamilton, Ont.
Laurie & Lamb, Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.

POWER, TRANSMISSION MACHINERY
American Pulley Co., Philadelphia, Pa.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Goldie & McCulloch Co., Galt.
Jeffrey Manufacturing Co., Montreal.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
MacGovern & Co., New York.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Morse Chain Co., Ithaca, N.Y.
Waterous Engine Works Co., Brantford.

PRESSES
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

PRESSURE, BLOWERS, CENTRIFUGAL
Can. Sirocco Co., Windsor, Ont.

PULLEYS
American Pulley Co., Philadelphia, Pa.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Jeffrey Manufacturing Co., Montreal.
Waterous Engine Works Co., Brantford

PULP MILL MACHINERY
Rawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Hamilton Co., Wm., Peterboro, Ont.
Jeffrey Manufacturing Co., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que
Waterous Engine Works Co., Brantford.

PUMPING MACHINERY
American Steam Pump Co., Battle Creek, Mich
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Beveridge Paper Co., Montreal, Que.
Laurie & Lamb, Montreal
McAvity & Sons, T., St. John, N.B.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
Waterous Engine Works Co., Brantford.

PUMPING MACHINERY, ELECTRICAL
Beveridge Paper Co., Montreal, Que.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Jeffrey Manufacturing Co., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

PUMPS, AIR
American Steam Pump Co., Battle Creek, Mich
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Montreal.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co. Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

PUMPS, ACID
Beveridge Paper Co., Montreal, Que.

PUMPS, CONTRACTORS'
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Beveridge Paper Co., Montreal, Que.
McAvity & Sons, T., St. John, N.B.
Smart-Turner Machine Co., Hamilton, Ont.

PUMPS, ELECTRICAL
American Steam Pump Co., Battle Creek, Mich
Beveridge Paper Co., Montreal, Que.

PUMPS, FEED WATER
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Beveridge Paper Co., Montreal, Que.

PUMP GOVERNORS AND REGULATORS
Darling Bros., Montreal.
G. M. Davis Regulator Co., Chicago.
D'Este Co., Julian, Boston, Mass.
Elliott Co., Pittsburgh, Pa.
Mason Regulator Co., Boston, Mass.
Smart-Turner Machine Co., Hamilton, Ont.
Watson & McDaniel Co., Philadelphia.

PUMP STRAINERS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Darling Bros., Ltd., Montreal.
Liberty Mfg. Co., Pittsburgh, Pa.
Smart-Turner Machine Co., Hamilton, Ont.

PUMPS, HAND AND POWER
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Darling Bros., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.

PUMPS, CENTRIFUGAL
American Steam Pump Co., Battle Creek, Mich
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Darling Bros., Montreal
Hamilton Co., Wm., Peterboro, Ont.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co. Ltd., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Waterous Engine Works Co., Brantford.

PUMPS, DUPLEX
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Beveridge Paper Co., Montreal, Que.

PUMPS, GEARED, COMPOUND
American Steam Pump Co., Battle Creek, Mich
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Montreal.
Inglis Co., The John, Toronto, Ont.
The John McDougall Caledonian Iron Works Co. Ltd., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.

PUMPS, ELECTRICAL
Bawden Pump Co, Toronto.

PUMPS, HYDRAULIC, PRESSURE
American Steam Pump Co., Battle Creek, Mich
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Darling Bros., Montreal.
Inglis Co., The John, Toronto, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.

PUMP LEATHERS
Beveridge Paper Co., Ltd., Montreal, Que.
Graton & Knight Mfg. Co., Montreal.

PUMPS, OIL
American Steam Pump Co., Battle Creek, Mich
Bowser & Co., Inc., S. F., Toronto, Ont.
Can. Detroit Lubricator Co., Walkerville, Ont.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Smart-Turner Machine Co., Hamilton, Ont.

PUMPS, STEAM TURBO
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Darling Bros., Montreal.
Escher Wyss & Co., Montreal, Que.

PUMP TANK, RECEIVER
American Steam Pump Co., Battle Creek, Mich.
Beveridge Paper Co., Montreal, Que.
Smart-Turner Machine Co., Hamilton, Ont.

PUMPS, STEAM
American Steam Pump Co., Battle Creek, Mich.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
Inglis Co., The John, Toronto, Ont.
Laurie & Lamb, Montreal.
Leitch Co., Arthur S., Toronto, Ont.
McAvity & Sons, T., St. John, N.B.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.

PUMPS, TRIPLEX
Smart-Turner Machine Co., Hamilton, Ont.

PUMPS, VACUUM
American Steam Pump Co., Battle Creek, Mich.
Beveridge Paper Co., Montreal, Que.
Laurie & Lamb, Montreal.
Leitch Co., Arthur S., Toronto, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.

PYROMETERS
Green's Economiser, Ltd., Toronto.
Jas. Morrison Brass Mfg. Co., Toronto.
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.

RADIATOR TRAPS
Beveridge Paper Co., Montreal, Que.
Sarco Co., Inc., New York, N.Y.

RADIATOR AIR VENTS
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

RAGS
Wm. C. Wilson & Co., Toronto.

REBOILERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

RECEIVERS, AIR
Can. Allis-Chalmers, Ltd., Toronto, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.

RECORDING INSTRUMENTS
Can. H. W. Johns-Manville Co., Toronto, Ont.
Green's Economiser, Ltd., Toronto.
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.

REFRIGERATOR DOORS, WINDOWS, ETC.
Jamison Cold Storage Door Co., Hagerstown, Md.

REFRIGERATING MACHINERY
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Griscom-Russell Co., Ltd., Montreal.
Frick Co., Waynesboro, Franklin Co., Pa.
Linde Canadian Refrigeration Co., Montreal.
Vilter Mfg. Co., Milwaukee, Wis.
York Mfg. Co., York, Pa.

REFUSE DESTRUCTOR
Canadian Griscom-Russell Co., Ltd., Montreal.
Laurie & Lamb, Montreal.

REGULATORS, PRESSURE
Chaplin-Fulton Mfg. Co., Pittsburgh, Pa.
D'Este Co., Julian, Boston, Mass.
Jas. Morrison Brass Mfg. Co., Toronto.
Taylor Instrument Co., Rochester, N.Y.

REGULATORS, TEMPERATURE
Sarco Co., Inc., New York, N.Y.
Taylor Instrument Co., Rochester, N.Y.

RETORTS
MacKinnon Steel Co., Sherbrooke, Que.

REVOVLING DOORS FOR HARDENING ROOMS
Jamison Cold Storage Door Co., Hagerstown, Md.

ROOFING
Wm. C. Wilson & Co., Toronto.

ROOFINGS—RUBBER, PLASTIC, LIQUID
Beveridge Paper Co., Montreal, Que.

ROPE
Wm. C. Wilson & Co., Toronto.

ROPE PRESERVATIVE
Cling Surface Co., Buffalo.

ROTARY CONVERTERS
Canadian Fairbanks-Morse Co., Montreal.

RUBBER HOSE
Can. H. W. Johns-Manville Co., Toronto, Ont.
Garlock Packing Co., Hamilton, Ont.
Liberty Mfg. Co., Pittsburg, Pa.
Thomson-Gordon, Ltd., Hamilton, Ont.

SAFES
Canadian Fairbanks-Morse Co., Montreal.
Goldie & McCulloch Co., Galt.

SCALE REMOVERS
Babcock & Wilcox, Ltd., Montreal.
Beveridge Paper Co., Ltd., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Green's Economiser, Ltd., Toronto, Ont.
Roto Co., Hartford, Conn.
William B. Pierce Co., Buffalo, N.Y.
Snowdon, C. C., Calgary, Alta.

SEAM PROTECTORS, GIRTH
National Boiler Protector Co. of Canada, Montreal, Que.

SHAFTING
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Waterous Engine Works Co., Brantford.

SHAKING AND DUMPING GRATES
Babcock & Wilcox, Ltd., Montreal.
Galt Foundry Co., Galt, Ont.
Waterous Engine Works Co., Brantford.

SMELTER LININGS
Beveridge Paper Co., Montreal, Que.

SMOKE BOXES, STACKS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Green's Economiser, Ltd., Toronto.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

SMOOTH-ON
Wm. C. Wilson & Co., Toronto.

SPECIAL MACHINERY
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Waterous Engine Works Co., Brantford.

SPEED INDICATORS
Schaeffer & Budenburg Mfg. Co., Brooklyn, N.Y.
L. S. Starrett Co., Athol, Mass.

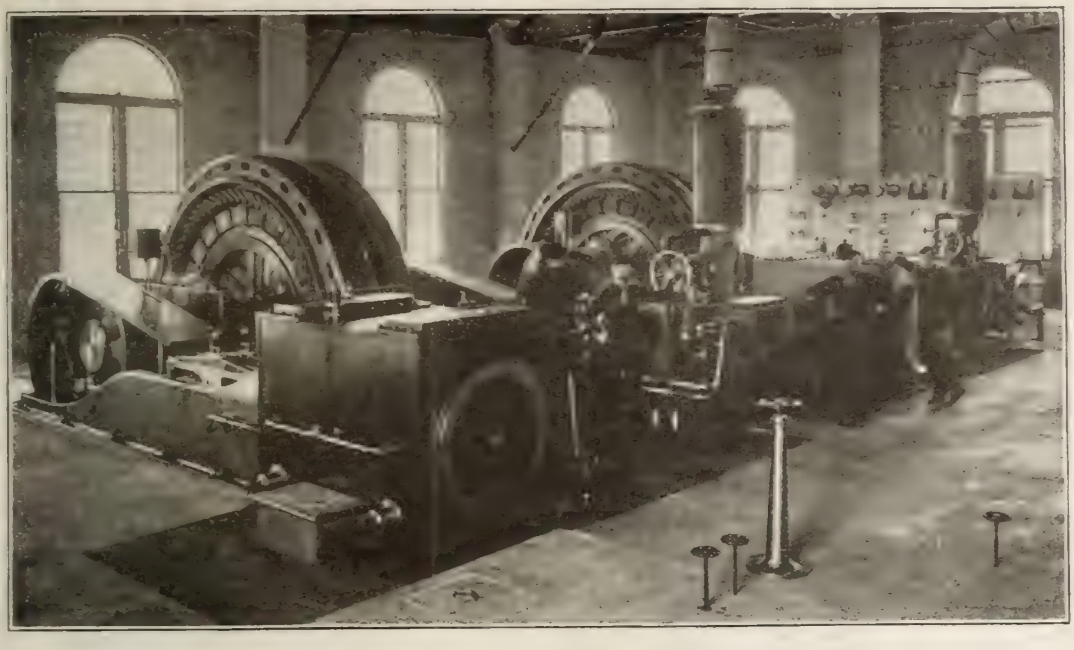
SPLICE PROTECTORS
Jordan Bros., Inc., New York, N.Y.

SPROCKET CHAIN ATTACHMENTS
Waterous Engine Works Co., Brantford.

SPROCKET RIMS
Babbitt Steam Specialty Co., New Bedford, Mass.

SPUR WHEELS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Montreal.

25 Cycle Engine Generator Sets For Sale



1—250 KW.
1—300 KW.

25 Cycle
3 phase
Westinghouse
Generators
Direct
connected to
McIntosh &
Seymour Cross
Compound
Gridiron Valve
Engines 150
R.P.M.

These units were in use only seven months and are in first class condition. Write for further particulars and quotations.

Power Plant Equipment Co., Dominion Bank Building **Toronto, Ont.**

Albany Grease

has just rounded out a half century of usefulness. Its incomparable record of lubrication service during the past 50 years stamps it as a most efficient and economical lubricant. For

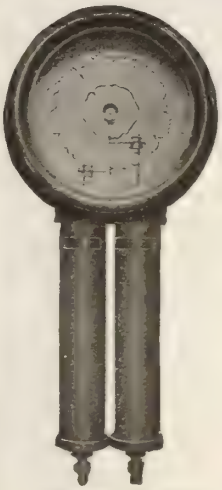
50 YEARS

Albany Grease has been used by engineers on the bearings of engines, motors, pumps, compressors, line shafting and all their other equipment. If you are not using Albany Grease send for samples and try it.

ALBANY LUBRICATING COMPANY
708-10 Washington Street
NEW YORK, U.S.A.
Established 1868

UEHLING WASTE METER

COMBINED
CO_2 AND TEMPERATURE RECORDER



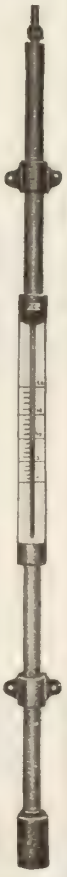
Record of CO_2 and stack temperature on one chart.

Does your fireman know how much fuel he is wasting? Do you know?

The **Uehling CO_2 Recorder** makes a complete 24 hr. record of your combustion efficiency and the **CO_2 indicator at the Boiler Front** holds the fireman responsible.

Get more **Steam** per pound of **Coal** and reduce your annual fuel consumption.

Let us know the number and size of your boilers and coal consumed per year, upon receipt of which information we will be glad to send you full particulars.



CO_2 Indicator for Boiler Front

Let us hear from you. We are pioneers in the manufacture of Indicators and Recorders for Power Plant purposes.

Send for our Bulletin No. 110.

Uehling Instrument Company
2008 Empire Building **New York City**

Hamilton Co., Wm., Peterboro, Ont.
Waterous Engine Works Co., Brantford.

STACKS, STEEL
Babcock & Wilcox, Ltd., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.

STAND PIPES, STEEL
MacKinnon, Holmes & Co., Sherbrooke, Que.

STAYBOLTS, FLEXIBLE
Can. Allis-Chalmers, Ltd., Toronto, Ont.

STEAM SEPARATORS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Darling Bros., Montreal.
Direct Separator Co., Syracuse, N.Y.
D'Este Co., Julian, Boston, Mass.
Elliott Co., Pittsburgh, Pa.
Leitch Co., Arthur S., Toronto, Ont.
Penberthy Injector Co., Windsor, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Watson & McDaniel Co., Philadelphia.

STEAM SPECIALTIES
Alberger Heater Co., Buffalo, N.Y.
Canadian Fairbanks-Morse Co., Montreal.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
D'Este Co., Julian, Boston, Mass.
Liberty Mfg. Co., Pittsburg, Pa.
Lunkenheimer Co., Cincinnati, O.
Mason Regulator & Engineering Co., Montreal.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor.
Watson & McDaniel Co., Philadelphia.

STEAM TRAPS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Anderson Co., Y. D., Cleveland, O.
Canadian Fairbanks-Morse Co., Montreal.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
Davis Regulator Co., G. M., Chicago.
D'Este Co., Julian, Boston, Mass.
Dunham Co., Ltd., C. A., Toronto, Ont.
Elliott Co., Pittsburgh, Pa.
J. T. Long, St Adam St., Montreal, Que.
Can. Morehead Mfg. Co., Woodstock.
Mason Regulator & Engineering Co., Montreal
Sarco Co., Inc., New York, N.Y.
Watson & McDaniel Co., Philadelphia.

STEEL BARRELS
Smart-Turner Machine Co., Hamilton, Ont.

STEEL DRUMS
Smart-Turner Machine Co., Hamilton, Ont.

STEEL TANKS
Babcock & Wilcox, Ltd., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works, Brantford, Ont.

STOKERS
Babcock & Wilcox, Ltd., Montreal.
Detroit Stoker Co., Detroit, Mich.
Galt Foundry Co., Galt, Ont.
Green's Economiser, Ltd., Toronto.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Dertoit, Mich.

STRAINERS
Babcock & Wilcox, Ltd., Montreal.
Beveridge Paper Co., Montreal, Que.
Elliott Co., Pittsburgh, Pa.

STRUCTURAL STEEL WORK
Babcock & Wilcox, Ltd., Montreal.
MacKinnon, Holmes & Co., Ltd., Sherbrooke Que.

SUPERHEATERS, STEAM
Babcock & Wilcox, Ltd., Montreal.
Green's Economiser, Ltd., Toronto.

SWING JOINTS
Franklin Williams Co., New York.

SWITCHBOARDS
Can. General Electric Co., Toronto, Ont.

SWITCHES AND SWITCH BOXES
Can. H. W. Johns-Manville Co., Toronto, Ont.

TACHOMETERS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Can. H. W. Johns-Manville Co., Toronto, Ont.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y

TANKS, BLOW-OFF
Darling Bros., Montreal.
John McDougall Caledonian Iron Works, Montreal
Waterous Engine Works Co., Brantford.

TANKS, FREEZING, STORAGE AND WATER COOLING
Frick Co., Waynesboro, Franklin Co., Pa.

TANKS, OIL
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Bowser & Co., Inc., S. F., Toronto, Ont.
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

TANKS, WATER
Inglis Co., The John, Toronto, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

TAPPING MACHINES
Mueller Mfg. Co., H., Sarnia, Ont.

TECHNICAL BOOKS
MacLean Publishing Co., Toronto.

THERMOMETERS
Green's Economiser, Ltd., Toronto, Ont.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.

THERMOSTATS
Sarco Co., Inc., New York, N.Y.

TOOLS
Mueller Mfg. Co., H., Sarnia, Ont.

TRANSFORMERS
Can. General Electric Co., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.

TRANSMISSION MACHINERY
American Pulley Co., Philadelphia, Pa.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Goldie & McCulloch Co., Galt, Ont.
Jeffrey Manufacturing Co., Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Waterous Engine Works Co., Brantford.

TRAPS, STEAM AND WATER-LINE
Beveridge Paper Co., Montreal, Que.
D'Este Co., Julian, Boston, Mass.

TRUCKS, FACTORY
Beveridge Paper Co., Ltd., Montreal, Que.
Canadian Fairbanks-Morse Co., Montreal.

TUBE CLEANERS
Babcock & Wilcox, Ltd., Montreal.
Elliott Company, Pittsburgh, Pa.
Green's Economiser, Ltd., Toronto, Ont.
Liberty Mfg. Co., Pittsburgh, Pa.
Pelley Packing and Fine Brush Mfg. Co., St. Louis, Mo.

TURBINES, HORIZONTAL AND VERTICAL SHAFT
Barber & Sons, Charles, Meaford, Ont.

TUBE CUTTERS
Babcock & Wilcox, Ltd., Montreal.
Liberty Mfg. Co., Pittsburg, Pa.

TUBES, BOILER
Babcock & Wilcox, Ltd., Montreal.

TUBE EXPANDERS
Babcock & Wilcox, Ltd., Montreal.
Liberty Mfg. Co., Pittsburg, Pa.

TUBING, FELXIBLE METALLIC
Pennsylvania Flexible Metallic Tubing Co., Cleveland, O.

TURBINE OIL
Kellogg & Co., E. H., New York, N.Y.

TUNGSTEN LAMP (Vacuum and Gas Filled Types)
Penberthy Injector Co., Windsor, Ont.
Can. Laco-Phillips Co. of Toronto, Ont

TURBINE WATER WHEELS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.

TURBINES, STEAM
Belliss & Morcom, Birmingham, Eng.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Coppus Engr. & Equip. Co., Worcester, Mass.
Escher Wyss & Co., Montreal, Que.
Laurie & Lamb, Montreal.
John McDougall Caledonian Iron Works, Montreal

UNIONS
Canadian Fairbanks-Morse Co., Montreal.
Dart Union Company, Toronto.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.

UNIONS, BALL JOINT, COMBINATION, FLANGED PIPE, GROUND JOINT, MALLEABLE IRON, FLANGE, PIPE, SWING
Jefferson Union Co., Lexington, Mass.
Dart Union Company, Ltd., Toronto, Ont.

VACUUM GOVERNORS
Smart-Turner Machine Co., Ltd., Hamilton.
Canadian Steam Boiler Equipment Co., Toronto
Beveridge Paper Co., Montreal, Que.
G. M. Davis Regulator Co., Chicago.
Leitch Co., Arthur S., Toronto, Ont.

VACUUM REGULATING VALVES
Can. Steam Boiler Equipment Co., Toronto, Ont.
Darling Bros., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

VACUUM TRAPS
Can. Morehead Mfg. Co., Woodstock, Ont.
Cole, Ltd., Geo. W., Toronto.

VALVE DISCS
Wm. C. Wilson & Co., Toronto.

VALVE LEATHER
Beveridge Paper Co., Ltd., Montreal, Que.
Graton & Knight Mfg. Co., Montreal.

VALVE RESEATING MACHINES
Darling Bros., Montreal.

VALVES
Babcock & Wilcox, Ltd., Montreal.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Can. Steam Boiler Equipment Co., Toronto, Ont.
Frick Co., Waynesboro, Franklin Co., Pa.
Beveridge Paper Co., Montreal, Que.
G. M. Davis Regulator Co., Chicago.
D'Este Co., Julian, Boston, Mass.
Homestead Valve Mfg. Co., Pittsburg.
Jenkins Bros., Montreal.
Kerr Engine Co., Walkerville, Ont.
Liberty Mfg. Co., Pittsburg, Pa.
Lunkenheimer Co., Cincinnati, O.
Mason Regulator & Engineering Co., Montreal.
Mason Regulator Co., Boston, Mass.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor.
Pratt & Cady, Hartford, Conn.
Victoria Foundry Co., Ottawa, Ont.
Watson & McDaniel Co., Philadelphia.
Wm. C. Wilson & Co., Toronto.
Wood & Co., R. D., Philadelphia, Pa.
York Manufacturing Co., Philadelphia.

VALVES, ACID RESISTING
Homestead Valve Mfg. Co., Pittsburg.
McAvity & Sons, T., St. John, N.B.
Victoria Foundry Co., Ottawa, Ont.

VALVES, BACK PRESSURE
Can. Allis-Chalmers, Ltd., Toronto, Ont.

VALVES, BLOW-OFF
Babcock & Wilcox, Ltd., Montreal.
Canadian Fairbanks-Morse Co., Montreal.
Beveridge Paper Co., Montreal, Que.
Elliott Co., Pittsburg, Pa.
Homestead Valve Mfg. Co., Pittsburg.
Jenkins Bros., Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Watson & McDaniel Co., Philadelphia.
Yarnall-Waring Co., Philadelphia, Pa

VALVE CHAIN WHEEL
Babbitt Steam Specialty Co., New Bedford, Mass.

VALVES, FOOT
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Smart-Turner Machine Co., Ltd., Hamilton.

VALVES, GATE
Babcock & Wilcox, Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.

VALES, HYDRAULIC
Yarnall-Waring Co., Philadelphia, Pa

VALVES, MULTIPORT
Can. Allis-Chalmers, Ltd., Toronto, Ont.

VALVES, NON-RETURN STOP
Canadian Fairbanks-Morse Co., Montreal.

VALVES, RELIEF
American Steam Gauge & Valve Mfg. Co., Boston Mass.
McAvity & Sons, T., St. John, N.B.

VALVES, REDUCING
Beveridge Paper Co., Montreal, Que.
D'Este Co., Julian, Boston, Mass.
Leitch Co., Arthur S., Toronto, Ont.
Liberty Mfg. Co., Pittsburg, Pa.
Mason Regulator Co., Boston, Mass.
Jas. Morrison Brass Mfg. Co., Toronto.
Mueller Mfg. Co., H., Sarnia, Ont.
Watson & McDaniel Co., Philadelphia.

VALVES, RADIATOR
Jenkins Bros., Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.

VALVES, POP
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.

VALVES, PUMP
Beveridge Paper Co., Ltd., Montreal, Que.
Canadian Fairbanks-Morse Co., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

VALVES, SAFETY THROTTLE
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Detroit Lubricator Co., Walkerville, Ont.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.

WATER SCAIFE AND WE-FU-GO
PURIFICATION SYSTEMS
SOFTENING & FILTRATION
FOR BOILER FEED AND ALL INDUSTRIAL USES
WM. B. SCAIFE & SONS CO. PITTSBURGH, PA.

Don't buy that New Electrical Apparatus Just Yet

WE can supply you with high-grade apparatus that has been slightly used and discarded through no fault of its own, at an **immense saving in cost.** For instance, in many cases we take over entire plants simply because of changed conditions such as increased capacity, change of system, etc.

EVERYTHING IS OVERHAULED AND REFINISHED BY US AND **GUARANTEED** AS GOOD AS NEW, BOTH ELECTRICALLY AND MECHANICALLY.

Our catalogs of offerings should be in the hands of every power plant superintendent each time they are gotten out, and it will be worth while for anyone interested in this class of power plant equipment to be on our mailing list to receive **all** offerings.

Nearly all of the principal power, lighting and street railway plants in the United States are our customers.

WRITE FOR OUR LATEST CAT ALOG of **Power House Equipment, Street Cars, Motors, Hoists, Compre ssors, etc.**

MACGOVERN & COMPANY, Inc.

114 Liberty St., New York City

The Wrench of 25% Greater Efficiency

TRIMO PIPE WRENCH

Two new features have been recently added to the Trimo Pipe Wrench, namely Nut-Guards, in all sizes, and unbreakable steel frames, in leading sizes.

The Nut-Guards prevent the accidental rotation of the nut while in use.

These improvements add 25% to the usefulness of the tool.

The Trimo Pipe Wrench is made with wood handles in 4 sizes, 6-in., 8-in., 10-in., 14-in. and in steel handles in all sizes, 6-in. to 48-in. inclusive.

All Trimo Pipe Wrench parts are interchangeable.

The inserted jaw in the handle can be readily replaced when worn, thus adding to the life of the tool.

Nut with Nut-Guards

Inquiries from Importers and Dealers Solicited. Send for Catalogue No. 55.

TRIMONT MANUFACTURING CO.

Cable Address: Triwrench
Code: Western Union

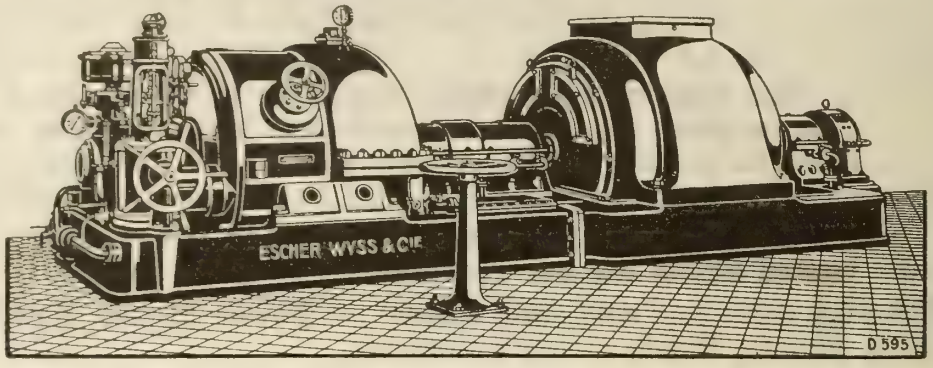
Roxbury (Boston) Mass., U.S.A

Starrett Speed Indicator
Every Engineer Needs A Starrett Speed Indicator
It is a great convenience to have a speed indicator in your pocket, for you can then tell instantly the exact speed of every machine. It costs only a trifle. Buy a Starrett to-day from your dealer.
Send for Catalog No. 21CD
The L. S. Starrett Co.
The World's Greatest Tool Makers
ATHOL, MASS.
NEW YORK, LONDON, CHICAGO
42-850
STARRETT
TOOLS

Escher Wyss & Co., S.A. ZURICH (Switzerland)

Montreal Office: 112 Coristine Building

Zoelly-Steam Turbines



Zoelly-Rotary-Compressors

15/18

ADVERTISING INDEX

A

Albany Lubricating Co. 101
Alberger Heater Co. 70
American Steam Gauge & Valve Mfg. Co. 66
American Steam Pump Co. ... 58
Anderson Co., V. D. 97
Armstrong Cork & Insulation Co. 11

B

Babbitt Steam Specialty Co. .. 93
Babcock & Wilcox 94
Barber & Sons, Charles 64
Beveridge Paper Co. 93
Boiler Inspection Dept. 84
Boving Hydraulic & Eng. Co... 92
Bowser, S. F., & Co. 78
Bernitz Method Co. 53

C

Can. Allis-Chalmers Co. 57
Can. Assoc. Stationary Engrs. 99
Can. Detroit Lubricator Co. ... 62
Can. Economic Lubricant Co. 60
Can. Fairbanks-Morse Co. .... Front cover and page
Can. General Electric Co. ... 83
Can. H. W. Johns-Manville Co. 79
Can. Laco-Philips Co., Ltd. ... 85
Can. Morehead Mfg. Co. 77
Can. S K F Co. 71
Can. Steam Boiler Equipment Co. 4
Chaplin-Fulton Mfg. Co. 81
Classified Ads. 54
Cling-Surface Co. 88
Cole, Ltd., Geo. W. 55
Coppus Engr. & Equip. Co. 8
Coventry Chain Co. 86
Crane Packing Co. 88

D

Darling Bros. 62
Dart Union Co. 59
Davis Regulator Co. 81
D'Este Co., Julian 76
Direct Separator Co. 66
Dominion Belting Co. 90
Dominion Coal Co. 92
Dunham & Co., C. A. 81
Durabla Mfg. Co. 68

E

Economy Fuse & Mfg. Co. of Canada 97
Elliott Co. 47
Engineering & Mach. Works of Canada, Ltd. 2
Escher Wyss & Co. 104

F

Federal Engineering Co. 97
Financial Post of Canada 80
Francis & Co., Walter J. 55
Frick Co. 11

G

Galt Foundry Co. 5
Garlock Packing Co. 87
Garth Co. 92
Gates, John W. 55
Goldie & McCulloch Co. 16
Graton & Knight Mfg. Co. .. 67
Greene, Tweed & Co. 69
Green's Economizer, Ltd. 56

H

Holmes Metallic Packing Co.. 92
Homestead Valve Mfg. Co. 76
Hoyt Metal Co. 6

I

Imperial Oil Co. 3
Inglis Co., John...Inside back cover

J

Jamison Cold Storage Door Co. 12
Jefferson Union Co. 61
Jeffrey Mfg. Co. 82, 83
Jenkins Bros. 73
Johns-Pratt Co., The 88
Jones Underfeed Stoker Co. ... 4
Jordan Bros., Inc. 9

K

Kellogg & Co., E. H. 55
Kerr Engine Co. 76

L

Ladd Co., The Geo. T. 93
Laurie & Lamb 13
Leitch Co., The Arthur S. ... 6
Liberty Mfg. Co. 51
Linde Canadian Refrigeration Works Co. 10
Long & Co., J. T. 54
Lunkenheimer Co. 74

M

MacGovern & Co. 103
MacKinnon Steel Co. 51
MacLean's Magazine 72, 75
Magnolia Metal Co. 90
Mason Regulator Co. 6
Mason Regulator & Engr. Co... 7
McAvity & Sons, T. 74
McDougall Caledonian Iron Works Co. 14
McGhie, W. C. 92
McLaren Ltd., D. K. 89
MacKinnon Steel Co. 55
Metlskin Co., Inc. 66
Morrison Brass Mfg. Co., Jas. Outside back cover
Morse Chain Co. 91
Mueller Mfg. Co. 63
Murphy Iron Works 9

N

National Boiler Seam Protector Co. 92

P

Pennsylvania Flexible Metallic Tubing Co. 70
Pierce Mfg. Co., Wm. B. ..... Inside front cover
Pilley Packing & Flue Bush Mfg. Co. 93
Power Plant Equipment Co. .. 101
Pratt & Cady Co., Inc. 68

R

Roto Co. 58

S

Sarco Co., Inc. 55
Scaife & Sons Co., Wm. B.... 102
Schaffer & Budenberg Mfg. Co. 9
Shell-Bar, Boico Supply, Ltd.... 2
Smart-Turner Mach. Co. 93
Snowdon, C. C. 84
Starrett, L. S., Co. 103
Steel Mill Packing Co. 58

T

Taylor Instrument Co. 60
Thomson-Gordon, Ltd. 84
Trimont Manufacturing Co. ... 103

U

Uehling Instrument Co. 101

V

Vilter Mfg. Co. 10

W

Wall, W. J. 55
Waterous Engine Works Co. .. 1
Watson & McDaniel Co. 84
Williams & Co., J. H. 54
Williams Co., Franklin 70
Wood & Co., R. D. 54

Y

Yarnall-Waring Co. 86
York Mfg. Co. 12

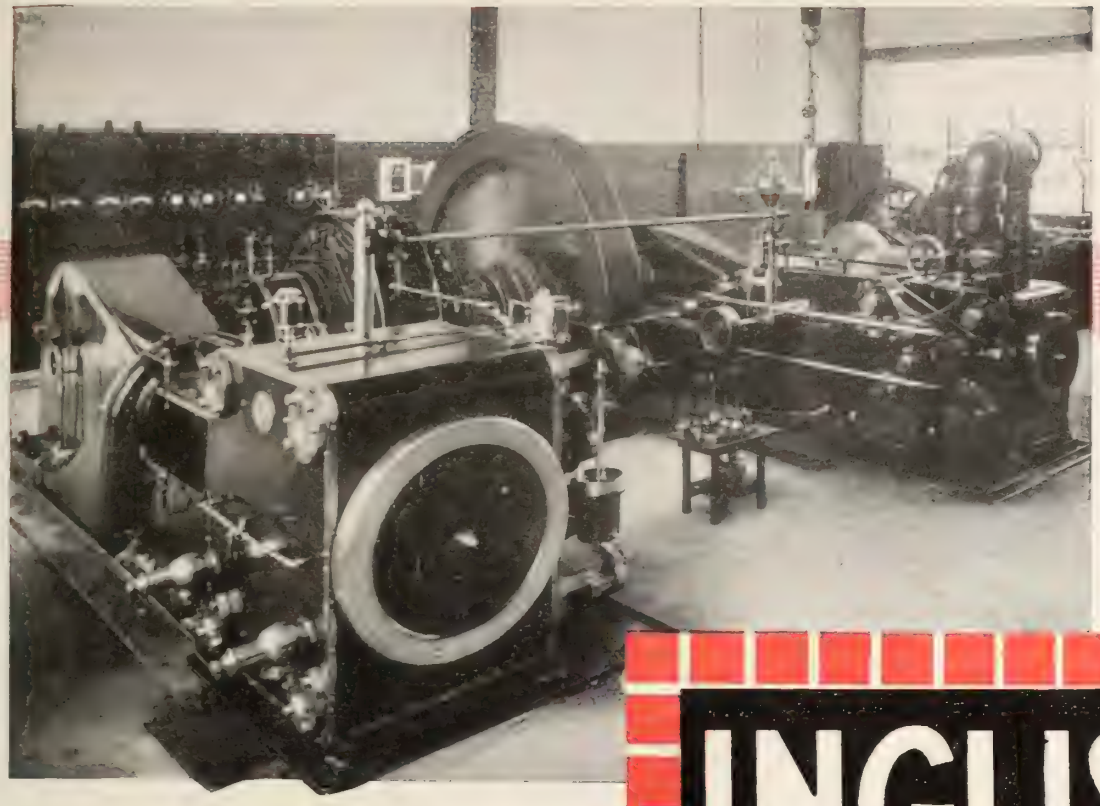


Photo shows Inglis Corliss Engine at Canadian Kodak Company's plant, Mount Dennis (near Toronto), Ont.

This ideal "Corliss" has cylinders 18 in. and 30 in. by 30 in. stroke, running at 150 r.p.m. It is direct connected to a 300 k.w. Canadian Westinghouse 3-wire, 125-250 volt, d.c. compound wound generator.

The Engine operates at a steam pressure of 150 pounds, with 5 pounds back pressure. Valve Gear is operated by double wrist plates set for long range cut-off, the governor controlling both high and low pressure cylinders. Flywheel is 11 ft. in diameter and weighs 22,000 pounds.

Put your engine problems in our hands.

Firms big and small all through Canada are doing so with the best of results. Tell us of your special requiremeents and Inglis experts will go into the details immediately with you.

The John Inglis Company

LIMITED

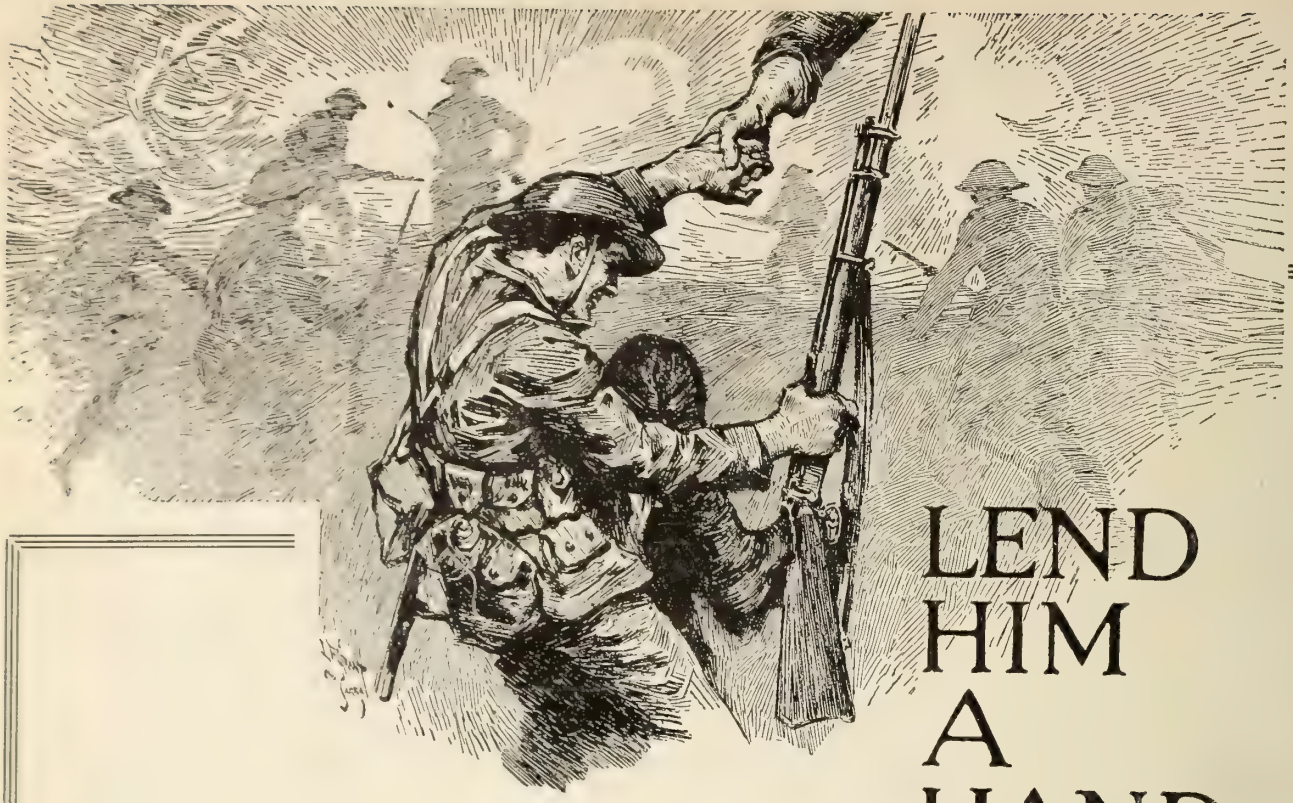
ENGINEERS AND BOILERMAKERS

14 Strachan Avenue Toronto, Canada

INGLIS Engines

Boilers for all Services

INGLIS BOILERS have been successfully meeting all Canadian Industrial demands for over half a century. Built to last and give efficient and economical service.



LEND HIM A HAND

WE dare not delay the VICTORY now. Canadian lives are at stake, our own safety, the safety of the whole world. If we are not to prolong the slaughter and the suffering, if we are not to risk defeat, or an inconclusive peace, we must act quickly; we must put forth our every effort now.

The army is doing its part. We are going to do our share to maintain an army large enough so that, with our Allies, we can drive the German hordes back across the Rhine—so that we can win the decisive VICTORY that will make Canadian freedom safe, and establish a just and lasting peace.

But the whole nation must take part. Our army in France is looking to us to furnish it, in ever greater abundance, the ordnance, the munitions, the supplies that will make VICTORY possible. We must not fail.

The Victory Loan is our share in the winning of this war. Upon it depends the safety and success of Canadian soldiers in France.

Lend Him a Hand!
Buy! Buy! Buy Till It Hurts

This Space Donated to the Fight for Humanity by

JAMES MORRISON BRASS MFG. CO.

93-97 ADELAIDE STREET W., TOONTO

POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power; and to the operation of Refrigerating Machinery.

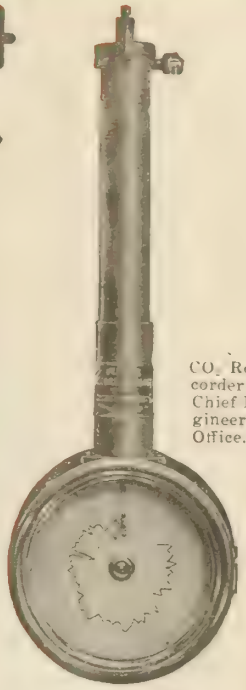
Published by The MacLean Publishing Company, Limited, 143-153 University Ave., Toronto

MONTREAL: Southam Bldg. LONDON, ENG.: 88 Fleet St., E.C. WINNIPEG: 1207 Union Trust Bldg.

Vol. XI—No. 10 Publication Office, Toronto—November, 1918 Published Monthly $1.00 per Year.

Bring Down Your Steam Cost In Spite of High Coal Prices

With coal prices soaring away above the normal and with coal harder to get then ever before, you are facing a critical situation.
Coal must be saved without curbing your steam output. You can do this only by abolishing preventable fuel waste in the boiler room.
Continuous knowledge of the heat wasted up the chimney is the first essential toward establishing better combustion.



CO_2 Recorder for Chief Engineer's Office.

UEHLING CO_2 Recording Equipment

offers a direct and absolutely reliable means for detecting heat waste by indicating and making 24-hour chart records of the percentage of CO in the flue gases.

The operation is positively continuous and not intermittent.

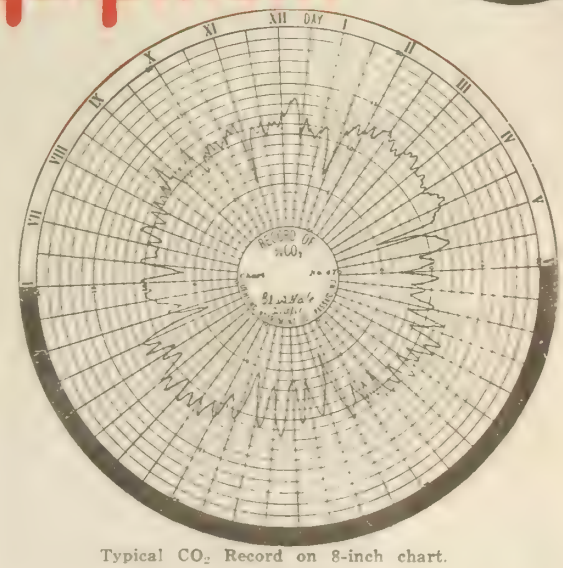
The recording gauge may be mounted in your office or elsewhere at a distance from the machine.

The indicator serves as a guide for the firemen in the boiler room.

The charts also serve to show the time taken for cleaning fires, the number of times and how long the fire doors were left open and how often the men fired.

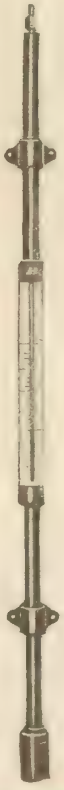
Do you wonder why Uehling CO_2 Equipment has enabled so many engineers to reduce their steam coal?

Uehling CO_2 Meters and Combined CO_2 and Temperature Machines are made up in various styles and combinations to meet any requirement. Our engineers are ready to take up your combustion problem now. W



Typical CO_2 Record on 8-inch chart.

CO_2 Machine.



CO_2 Indicator for mounting in boiler room.

Uehling Instrument Company

Combustion Engineers

2008 Empire Bldg. New York City

Representatives in Montreal, Toronto, Winnipeg, Vancouver

ENGINEER WILLIAM WILLIAMS

of the Power House Staff of the McCormick Mfg. Co., London, Ont.,

Using The "Dean"

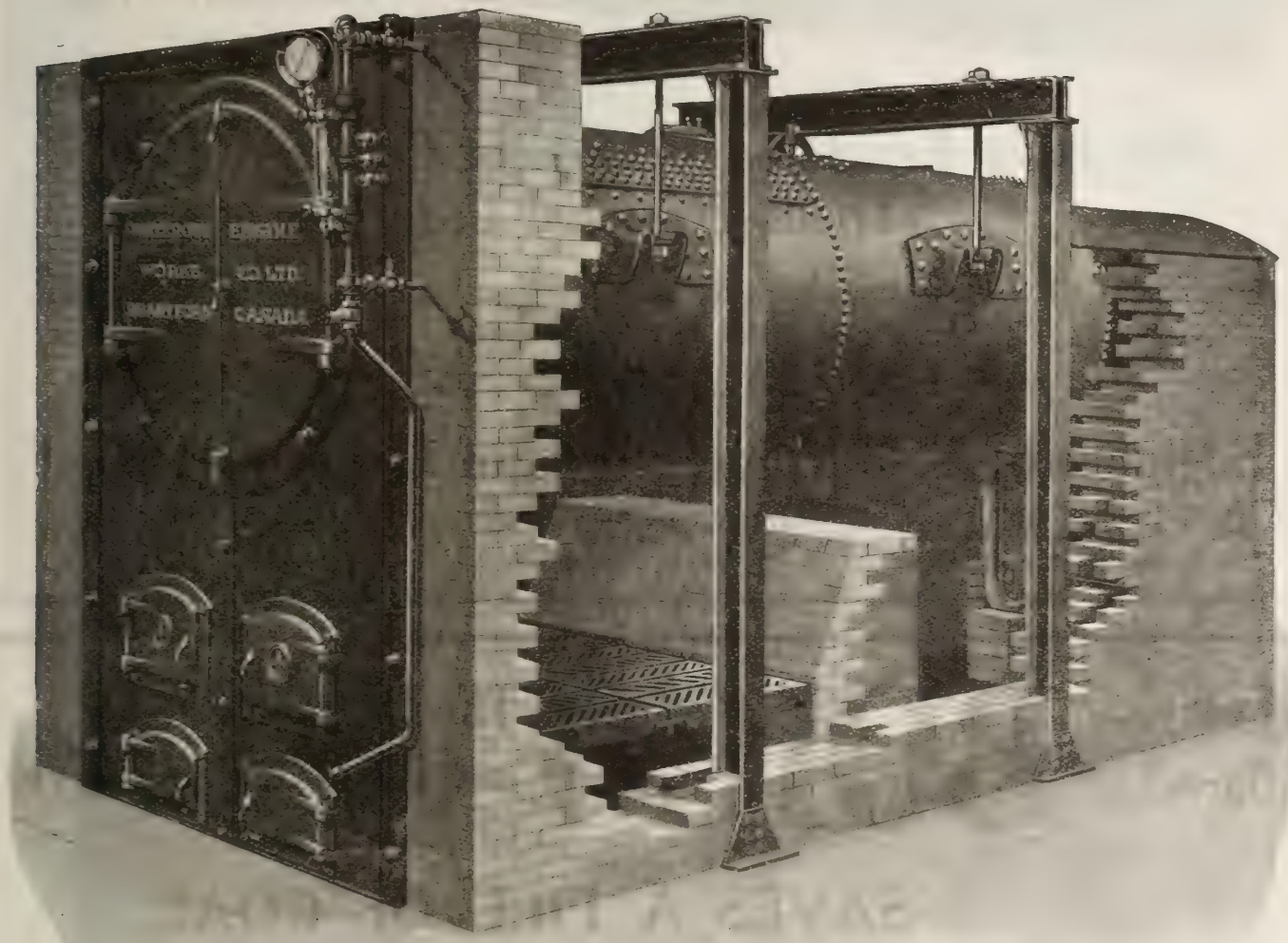
The McCormick Factory is one of the finest of its kind on the continent and the Dean Cleaner has been employed as a factor in the efficiency of this splendid organization.

The Dean Cleaner has proven its ability to take out scale faster and more thoroughly than any other type of tube cleaner, due largely to the absence of all intricate cutting and boring parts, and its sturdy simplicity which make for a long life, a low upkeep cost, and ease of operation.

You can use the "Dean" interchangedly in fire and water-tube boilers and different sizes of tubes.

The William B. Pierce Co.
153 Ellicott Street
Buffalo, N.Y.

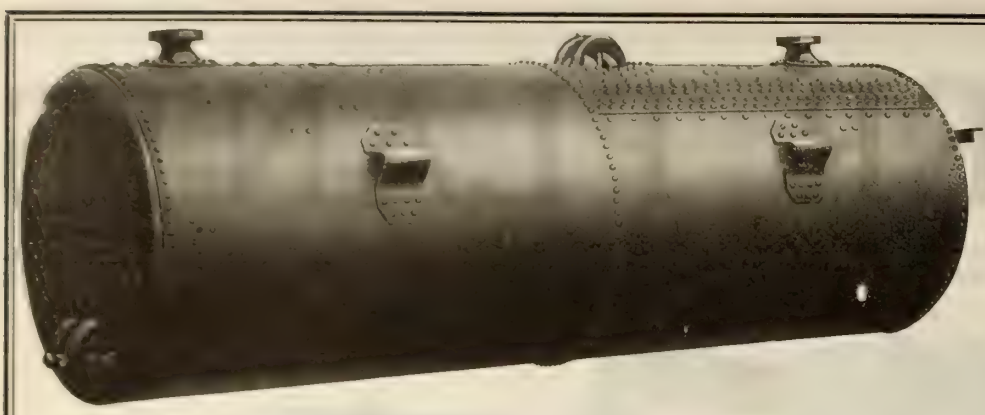
POWER PLANTS



Waterous

BRANTFORD, ONTARIO, CANADA

If any advertisement interests you, tear it out now and place with letters to be answered.



BOILERS

Horizontal Tubular
Locomotive Types
Vertical Tubular

We Have Registered Designs to Conform With Various Provincial Codes

Our BOILERS Are Installed in the Largest Industrial Plants---There Must Be A Reason

Write Us for Boiler Information and Prices.

Engineering & Machine Works of Canada, Limited

FORMERLY
St. Catharines Works of
The Jenckes Machine Co., Ltd.

HEAD OFFICE AND WORKS:
St. Catharines, Ont.

SALES OFFICES:
St. Catharines, Ont.
Hall Machinery Co., Sherbrooke, Que

Every Barrel of BOICO The Quick Remover and Positive Preventive of Boiler Scale

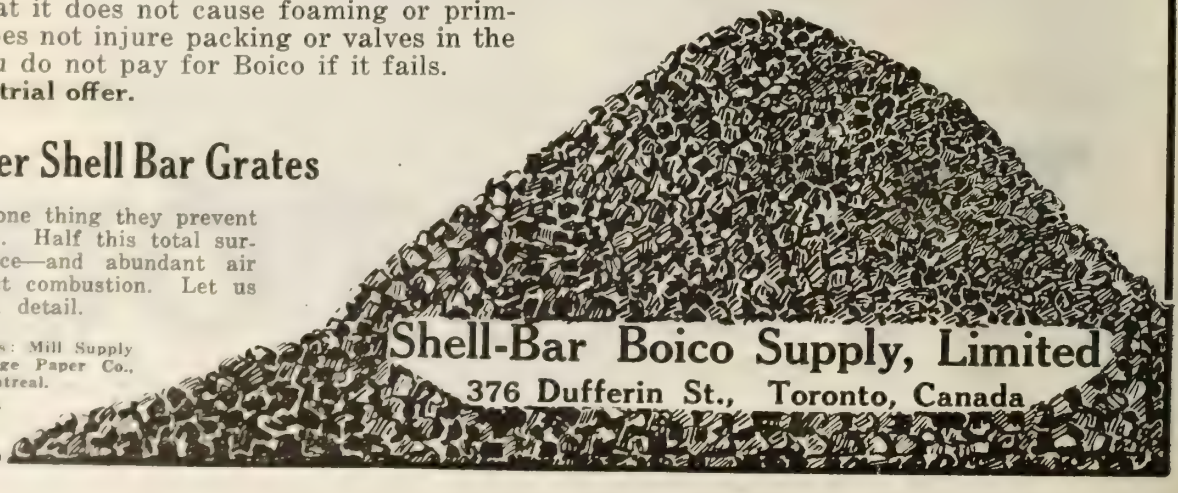
SAVES A PILE OF COAL

It's such a heartless job trying to keep a boiler clean with ordinary compounds that comparatively few are always wholly clean. Consequently a good deal more fuel than need be is turned up on the grates. We claim for Boico that it removes absolutely all scale; that it positively prevents further formation of scale; that it does not carry over in the steam; that it does not cause foaming or priming; that it does not injure packing or valves in the slightest. You do not pay for Boico if it fails.
Write for our trial offer.

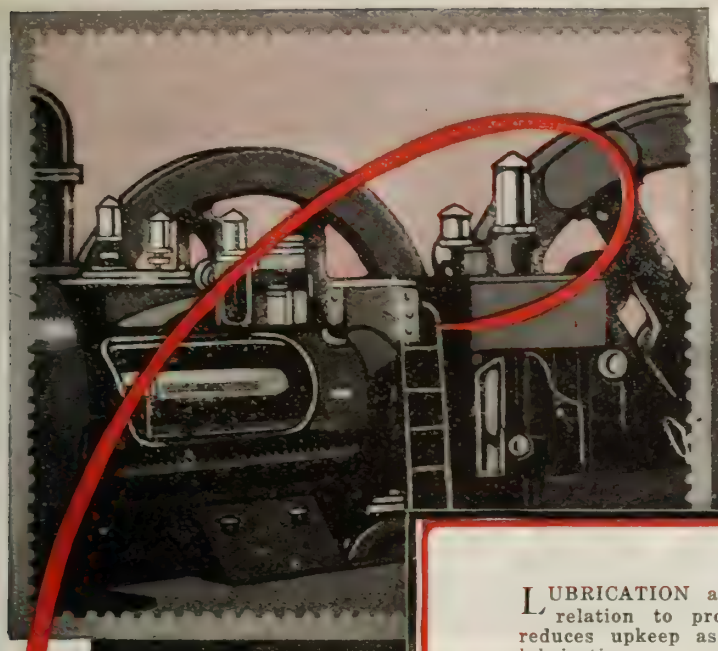
Anti-Clinker Shell Bar Grates

save coal. For one thing they prevent clinker formation. Half this total surface is air space—and abundant air commands perfect combustion. Let us tell you more in detail.

Eastern Sales Agents: Mill Supply Department, Beveridge Paper Co., Ltd., Montreal.
Adolphe Huot & Sons, Quebec.



Shell-Bar Boico Supply, Limited
376 Dufferin St., Toronto, Canada



A DIRECT CONNECTION

LUBRICATION always has a direct and important relation to production costs. Proper lubrication reduces upkeep as well as operation costs. Proper lubrication means a greater output, less repair bills and more years of service from power plants and other machinery.

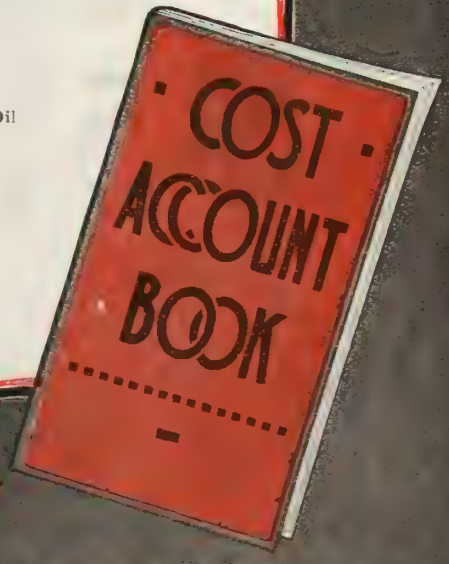
Correct lubrication requires not only high quality lubricants but **carefully selected lubricants.** To properly lubricate your plant you must use the right lubricant for each specific purpose. Do not let poor lubricants or improper lubrication destroy expensive machines before their time. Imperial lubricants are always cheaper in the long run. There is indeed a direct connection between lubrication and your cost account book.

Our Lubrication Engineers will gladly advise you on anything relating to lubrication. Write us at 56 Church St., Toronto. All enquiries will receive prompt attention.

Imperial Lubricants

For Manufacturing, Mining and Milling

Imperial Atlantic Red Engine Oil
Imperial Bayonne Engine Oil
Imperial Standard Gas Engine Oil
Imperial Kearsarge Engine Oil
Imperial Renown Engine and Dynamo Oil
Imperial Solar Red Engine Oil
Imperial Junior Red Engine Oil
Imperial Eldorado Engine Oil.
Imperial Capitol Cylinder Oil
Imperial Beaver Cylinder Oil
Imperial Cylinder Oil
Imperial Shield Cylinder Oil
Imperial Ebony Cylinder Oil
Imperial Acme Cylinder Oil
Imperial Disc Cylinder Oil
Imperial Dominion Cylinder Oil



IMPERIAL OIL LIMITED

Power Heat Light Lubrication

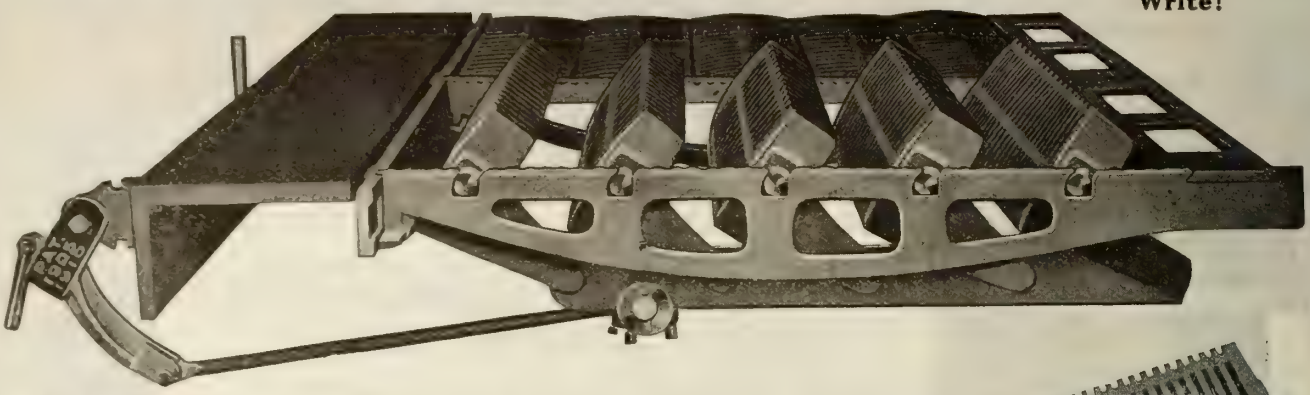
Branches in all cities

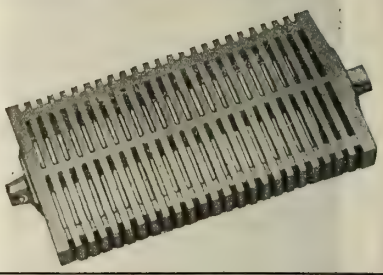
Cyclone Grates

Their 60% air space and 90% under-draught insure positively perfect combustion, whether the fuel used is screenings, soft coal or the highest grade hard coal. Their use means that all the energy locked in fuel will be freed and utilized to make steam.

There's no clinker formation, no good fuel lost in the ash pit, no waste whatever where Cyclone Improved Shaking and Dumping Grates are used. Cyclone Grates can be installed without delay or trouble. And we've a 30-day trial offer that you should know about.

Write!





The Canadian Steam Boiler Equipment Co., Ltd.

Sole Makers for Canada

20 McGee Street Phone G. 3660 Toronto, Ontario

AGENTS:
ST. JOHN, N.B.—F. W. Blizzard, 329 Charlotte St. MONTREAL—Mason Regulator Co., Ltd., St. James St. HAMILTON—Robt. Fitzsimmons, 8 Grove St. WINNIPEG—Vulcan Iron Works.

Annual Sales Away Over

$5,000,000

The above figures go to demonstrate the great popularity of Hoyt Metals.
Power plants in all quarters of the globe (enemy countries excepted) are users of our products.
Order from your dealer—if he cannot supply, have us ship you a 25-pound box on trial.

Hoyt's Frost King BABBITT

a first-class, all-round Babbitt. It will not only take care of high speed but will stand up to heavy work in an extraordinary way.

For saw mills, planing [illegible] traction, rolling mills, pulp machinery, and all classes of stationary en[illegible]

Hoyt's Nickel Genuine BABBITT

Is designed especially for use in gas engines, gasoline engines, and all classes of marine engines, and is especially adapted for automobiles. For heavy duty high speed work is probably as perfect as an alloy can be made.

HOYT METAL CO., TORONTO

NEW YORK, N.Y. LONDON, ENG. ST. LOUIS, MO.

Babbitt

Distribution All Over the World in Two Years

When placed on the market two years ago the **Babbitt Adjustable Sprocket Rim** met with instant acceptance and success. Engineers everywhere realized it was a mighty handy little device.

YOU, too, should realize this. **Then you can** stop carrying a ladder when operating overhead valves. Pamphlet on request.

BABBITT STEAM SPECIALTY CO.
New Bedford, Massachusetts

Manufactured in Canada, under Canadian Patents, exclusively by the Engineering Specialties Company, Limited, 1089 King Street West, Toronto, Ont.

Make Your Fuel Go Further

There is no waste with

Jones Underfeed Automatic Stoker

IN ACTION — Everything that should be burned to generate steam is consumed. An immediate and permanent result that comes from the installation is a SAVING OF FROM 15 to 25%.

Jones Stokers maintain a constant steam pressure, due to the automatic control of air supply and coal feed, take care of large overloads on the boilers and prevent objectionable smoke.

Give us your name and address and we'll gladly send you full particulars.

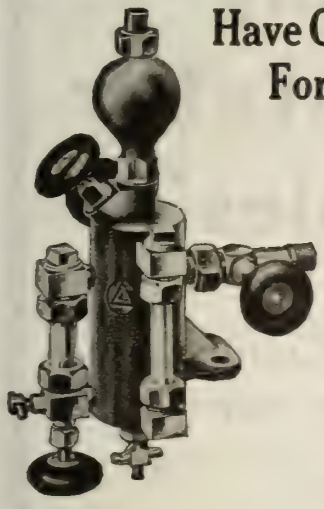
Jones Underfeed Stoker Co., Limited

37-41 Britain St.
TORONTO

Jones Underfeed Stoker Installation in the C.P.R. Passenger Terminal, Quebec.

Detroit Lubricators

Have Given Satisfaction For Forty Years.



Built in a sufficient variety of styles to lubricate properly every type of steam engine, pump, gas engine, air compressor, etc.

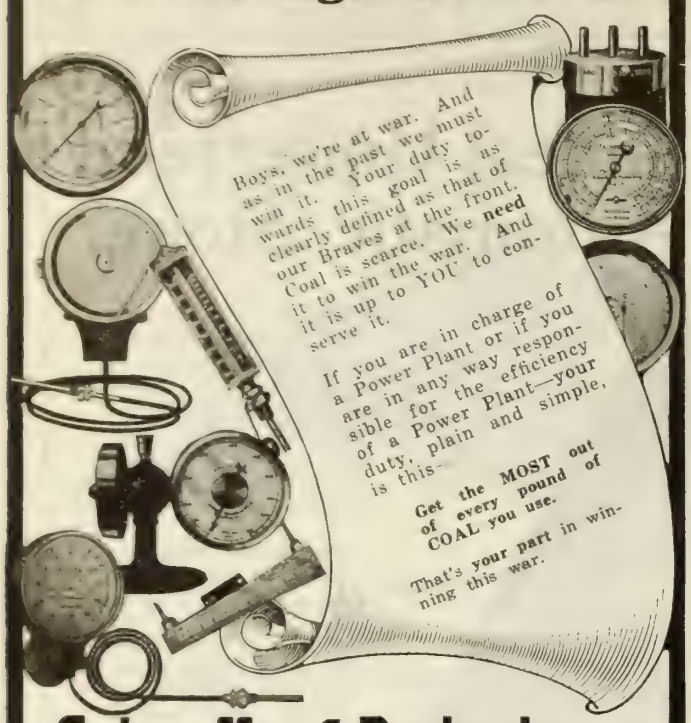
Send to-day for catalog L 1. The information on lubricating devices contained in it will be valuable to you.

THEIR efficiency holds over half the world's trade.

Makers of Stewart Carburetors.

CANADIAN DETROIT LUBRICATOR COMPANY, LTD.
WALKERVILLE, ONT.

A Message to YOU


Boys, we're at war. And as in the past we must win it. Your duty towards this goal is as clearly defined as that of our Braves at the front. Coal is scarce. We need it to win the war. And it is up to YOU to conserve it.
If you are in charge of a Power Plant or if you are in any way responsible for the efficiency of a Power Plant—your duty, plain and simple, is this—
Get the MOST out of every pound of COAL you use.
That's your part in winning this war.

Schaeffer & Budenberg

Makers of Efficiency Promoting Instruments

BROOKLYN, N.Y.

CHICAGO ST. LOUIS PITTSBURGH PHILADELPHIA
SAN FRANCISCO LOS ANGELES

MASON

Reducing Valves

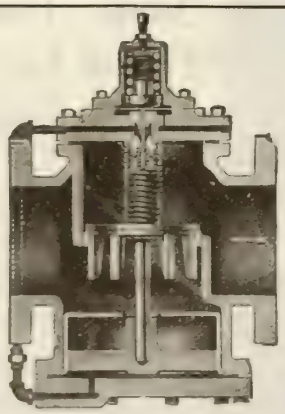
Pump Regulator
Balanced Valves
Damper Regulators

If you order a Mason you will get absolute satisfaction. This we guarantee you. You simply cannot make a mistake.
Dependable regulation under every possible condition.

Our complete catalog tells you WHY. Let us mail you a copy.

Mason Regulator Company
BOSTON, MASS.

TORONTO REPRESENTATIVES:
The Arthur S. Leitch Co.,
506 Kent Bldg., Toronto.



Kieley & Mueller Specialties

Regulating Valves
Back Pressure Valves
Pump Governors
Separators
Traps

FOR EVERY SERVICE
SALES ENGINEERS
THE ARTHUR S. LEITCH CO.
TORONTO

Having Commutator Troubles?

The Jordan Commutator Truing Device will true your commutators without a shut-down.

Jordan Bros., Inc.
82 Beekman St. New York City, N.Y.

Canadian Representative :
CANADA SALES CO., 183 Church Street, Toronto, Canada

A Practical Interest

is assured every customer by our Engineers. We will demonstrate "Mason" Service on your next Power Plant problem.

"Reliable Equipment" is the policy that has made our lines the medium to permanent customers.

USE "MASON" SERVICE

POWER PLANT SPECIALTIES

"Mason" Reducing Valves (Genuine)
"Mason" Pump Governors
"Mason" Pressure Controllers
Bundy Steam Traps for every service
Coppus Turbine-driven Blowers
Sims Hot Water Generators
Sims Storage Heaters
Sims Open Feed Water Heaters
Bundy Oil Separators
Ashton Gauges and Safety Valves
Everlasting Blow-Off Valves
Babbitt Sprocket Rims
Stratton Steam Separators
Reilly Multi-coil Feed Water Heaters
Reilly Evaporators and Distillers
Reilly Multi-screen Feed Water Filters

"MASON" STANDARD REDUCING VALVE
(Iron Body)

Full Information Gladly and Quickly Furnished

THE MASON REGULATOR & ENGINEERING CO., Ltd.

Successors to H. L. PEILER & COMPANY

Montreal, Office and Factory: 135 Dagenais Street

Toronto Representative: The Arthur S. Leitch Co., 506 Kent Building, TORONTO

If any advertisement interests you, tear it out now and place with letters to be answered.

Murphy AUTOMATIC Furnace

Murphy Stokers

A few longtime constant users, and there are others!

Lockport Paper Co.,	Lockport, N.Y.	33 years constant use
Hartje Paper Co.,	Steubenville, Ohio	24 years constant use
Sherwin-Williams Co. 12 contracts 20 Stokers	Montreal, P.Q. Cleveland, Ohio Kensington, Ill.	16 years constant use
Laurentide Co., Ltd.,	Grand Mere, P.Q.	13 years constant use
Ford Motor Co.,	Detroit, Mich.	
" " "	Des Moines, Iowa	18 years constant use
" " "	New York, N.Y.	
Ohio Traction Co., 16 Repeat Orders	Cincinnati, Ohio	28 years constant use 74 Murphy Stokers

For printed matter address

MURPHY IRON WORKS

DETROIT, MICH. BUFFALO, N.Y.

The Webster Vacuum System of Heating

can be likened unto the Matterhorn. It has an individuality all its own. From its pinnacle of fame it commands everything in sight.

The Webster System cannot be anything but a good system because of its simplicity and excellence of operation.

It is a **Vacuum System,** which means, crudely, that steam leaving the boiler is sucked through the radiation, no matter where placed, and made to perform its functions to the last ounce.

But the real beauty of the thing is this: Your heating, or a large part of it, can be taken care of by the use of **Exhaust Steam from your Boiler. Think of it,** steam that you would otherwise waste can be developed into heating units by the use of the **Webster Vacuum System of Heating.**

Sole Agents for Canada

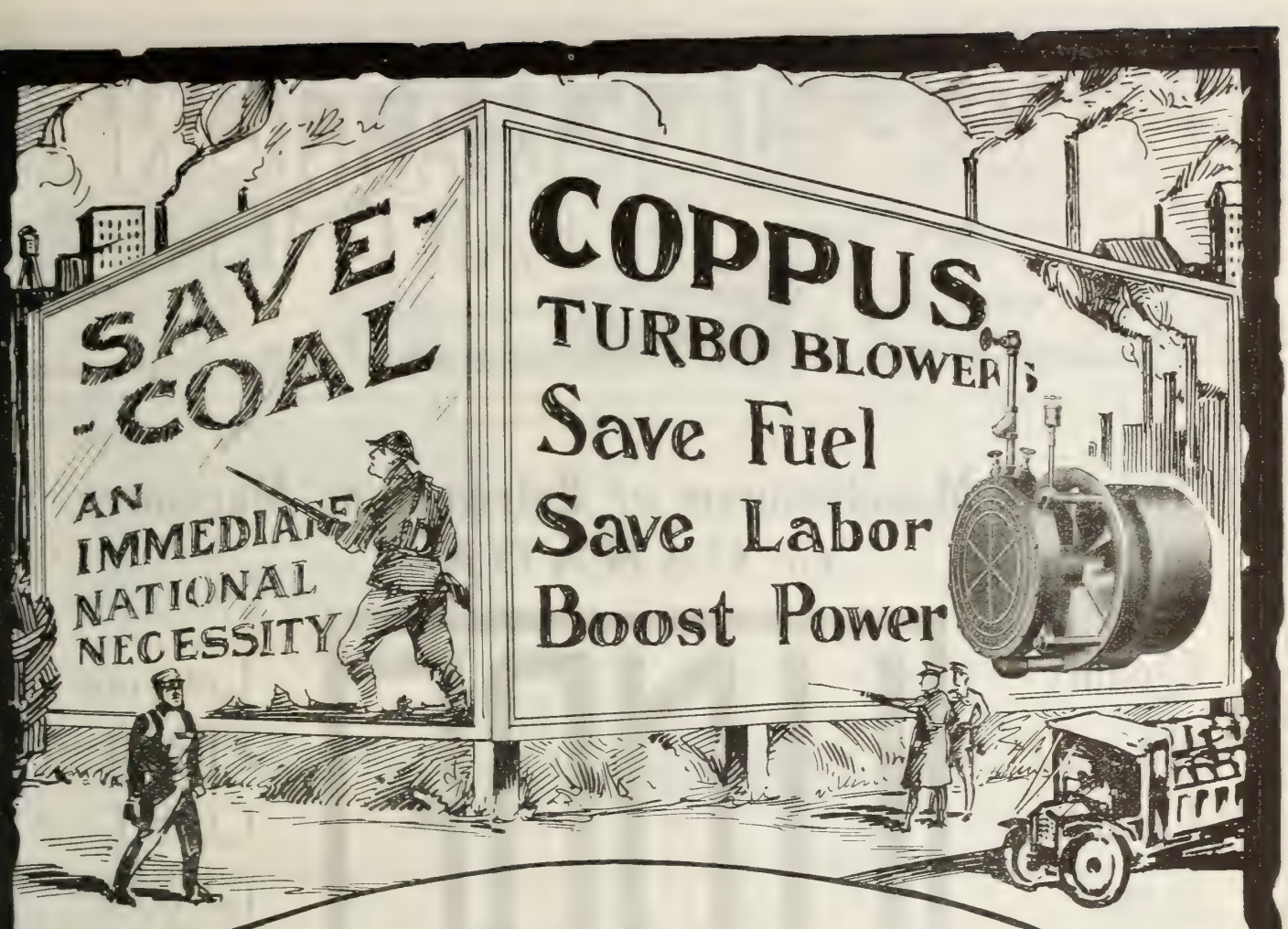
DARLING BROTHERS, LIMITED

Engineers and Founders

120 PRINCE STREET - MONTREAL

VANCOUVER CALGARY WINNIPEG TORONTO HALIFAX

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.



Help Solve A National Problem

Coal is scarce. It is an essential war commodity, and patriotism and humanity call for its conservation. There is a need for national effort in this direction and every industrial plant that uses coal should adopt every economic method available for saving this precious fuel.

Coppus Turbo Blowers, Type "C"

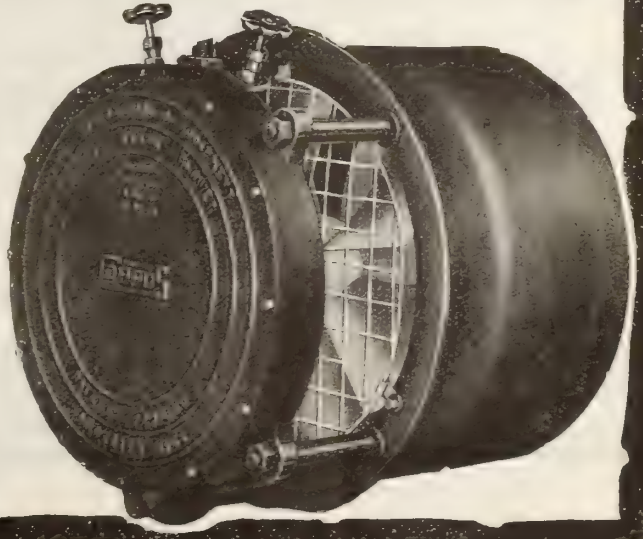
places in the reach of every power house and industrial concern that uses coal an opportunity to effectively combat the fuel problem.

You can increase your present steaming capacity to 200 and even 300% of the normal rating of the boilers without injury to the boilers.

Coppus Turbo Blowers give you more power, better p from less and cheaper coal.

You will have all the steam you want all the time. Hundreds of satisfied customers will attest to this. No drop in steam pressure when a heavy load comes on and you can laugh at the weather man as he varies the draft in your chimney.

Conditions favor the adoption of Coppus Turbo Blowers now as never before. They will not only help **you** but will also help **your country** to solve a national problem. **Write for the full story of "Coppus" efficiency without delay—it will pay you.**



Coppus Engineering and Equipment Co.

341 Park Ave., Worcester, Mass.

The Only Manufacturers *of* Refrigerating Machinery
***In* CANADA**

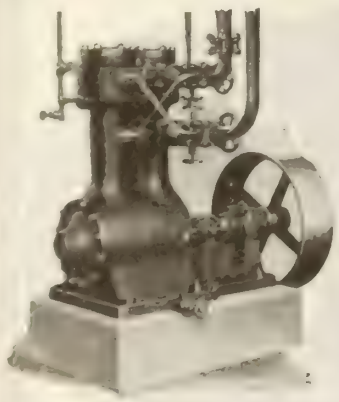
Quality not Quantity is our Standard

LINDE

Let your FIRST COST be your LAST

— ESTABLISHED 1896 —

The LINDE CANADIAN REFRIGERATION CO., Limited
37 St. Peter St., Montreal, P.Q.
TORONTO WINNIPEG VANCOUVER



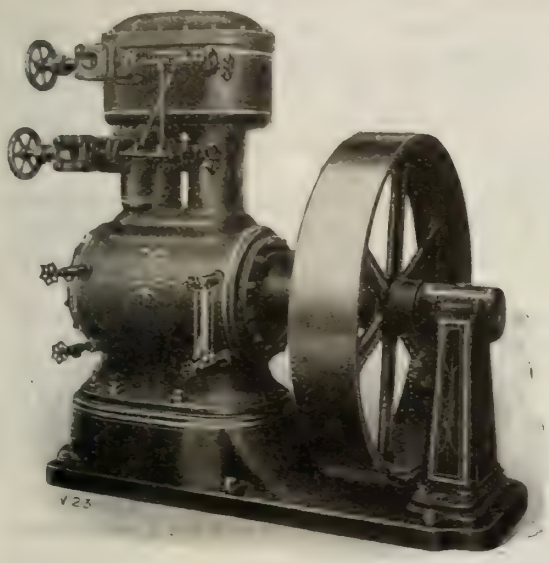
Ice-making and Refrigerating Machinery

Built in any capacity that you desire. HORIZONTAL OR VERTICAL
Our SMALL MACHINES have the same "regularity of Operation," "Reliability" and "Efficiency" as our large ones.
AMMONIA FITTINGS, CONDENSERS, BRINE COOLERS, ETC.

Our Machines are in daily operation in Canada
CORLISS and POPPET VALVE ENGINES

The Vilter Manufacturing Company
242 Beecher St. - - - Milwaukee, Wisconsin

FRICK Machines "Carry On"



It is a fact that FRICK Machines have been "Carrying On" for more than thirty years, meeting all attacks and conditions encountered in every-day operation, especially during the busy season, when overloads and extra duty are of common occurrence.

"We are practically running our cold storage plant just as you installed it eighteen years ago ; we added a twelve ton fish sharp freezer some dozen years ago, and added four rooms for fruit from time to time, and the machinery installed keeps all running in good shape. Our cost for maintenance and repairs during all these years has been very small, and the machinery looks good for another eighteen years."

(Name on request

36 YEARS OF SUCCESSFUL REFRIGERATING ENGINEERING EXPERIENCE.

Ask for a copy of our list of users covering 48 pages of satisfied customers—also your copy of "Ice and Frost."

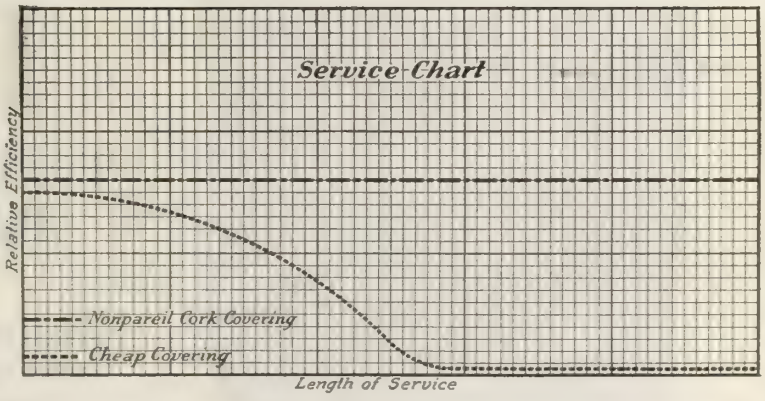
Frick Company
WAYNESBORO, PA. U.S.A.
ICE MACHINERY SUPERIOR SINCE 1882
BRANCHES IN ALL PRINCIPAL CITIES

There is a FRICK Machine for every refrigerating purpose—all types: Vertical — Horizontal — Absorption.

Efficient? Yes. But for How Long?

How long will cold pipe covering last without losing its initial efficiency? This is one of the most essential points to consider when buying cold pipe insulation.

Water vapor is present in the atmosphere at all times. And coverings that are fibrous in structure, even though they may have a waterproof coat, will soon begin to suck in moisture by capillary attraction. Under such conditions they gradually become watersoaked and in a short time their value as insulation is almost nil.



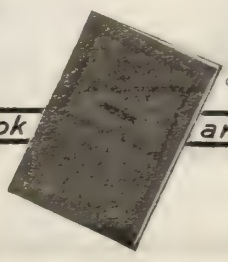
Nonpareil Cork Covering is not only efficient in stopping refrigeration loss to begin with, but it possesses no capillary attraction. Its minute, sealed air-cells are impervious to moisture. Hence the covering keeps dry and retains its original efficiency for many, many years.

Even if the first cost of Nonpareil Covering is a little more, its additional years of efficient service make it by far the cheapest in the long run.

Nonpareil Cork Covering
For All Cold Pipes

Armstrong Cork & Insulation Company
504 McGill Building, Toronto, Ontario, Canada

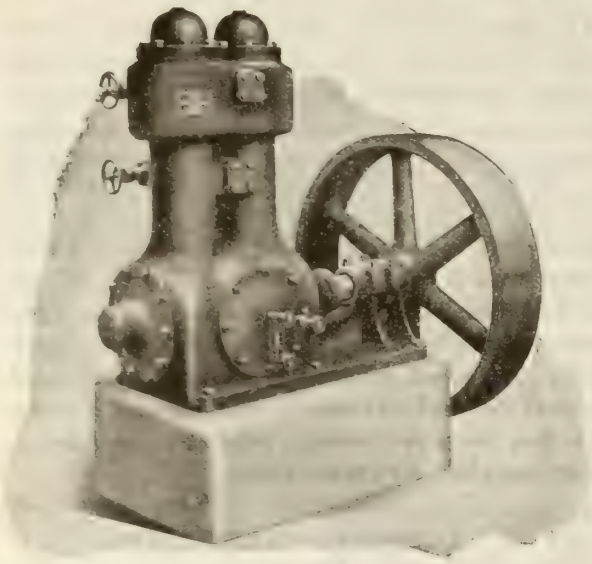
Also manufacturers of Nonpareil Corkboard Insulation for all cold storage rooms.



This 64-page Book and Sample Free

If any advertisement interests you, tear it out now and place with letters to be answered.

Refrigeration—A National Demand



The nation-wide appeals for the conservation of food products is greatly increasing the demands for mechanical refrigeration. Ice-making and Refrigerating Plants all over the country are overhauling and improving their equipment so that they may supply this demand and reap the increased profits.

Quality in refrigerating machinery, under present conditions, is more to be valued than ever before. An interruption of operation will mean a definite loss.

York Ice-making and Refrigerating Machinery is known universally as the Standard. There's a York Machine to meet every practical condition of mechanical refrigeration, and we are always ready to advise with prospective customers concerning their requirements and then to furnish the plant best suited to meet his conditions.

Let Our Engineers Help You. Write us about your problem.

York Manufacturing Company

(Ice-Making and Refrigerating Machinery Exclusively)

YORK, PA.

Canadian Representatives:

Canadian Ice Machine Company

WINNIPEG 85 Lombard St. | TORONTO 82 Chestnut St. | MONTREAL 626 Coristine Bldg. | CALGARY 605 Second St.

DOORS

For Cold Storage and Freezer Purposes Either Standard or Fireproof

JAMISON'S "JONES" and "NOEQUAL" doors are SUPERIOR because:

1st—Only the best materials are used in their construction.
2nd—We use heavier materials. Result: Longer life and increased efficiency.

3rd—Our doors are built with double and triple seals of contact—others have but one.

4th—Our Automatic Self-Tightening Fastener is the only truly AUTOMATIC and SELF-TIGHTENING Fastener on the market.

5th—Our ADJUSTABLE SPRING Hinges mean the door is always properly seated in the frame, making sagging impossible.

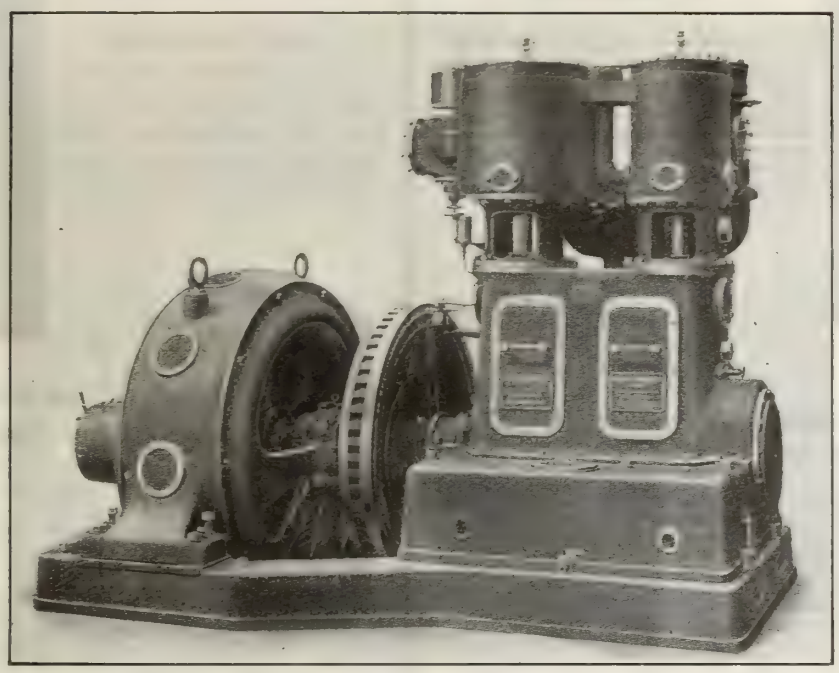
Write for General Catalog No. 7, illustrating and describing both "Jones" and "Noequal" doors, windows, ice doors and chutes, etc.

Jamison Cold Storage Door Company

Formerly Jones Cold Door Co.

HAGERSTOWN, MD., U.S.A.

BELLISS & MORCOM, LTD.
Engines and Air Compressors



Belliss & Morcom Motor-Driven Air Compressor.

Belliss Steam Engines, Steam Turbines, Diesel Engines,
Air Compressors, Condensing Plants

Heenan Refuse Destructors, Air Coolers, Water Coolers,
Oil Coolers, Dynamometers

Paterson Water Softening Plants and Filters

Centrifugal Pumps

We can make good delivery for War Service.

LAURIE & LAMB

Engineers

211 Board of Trade Bldg. - - **MONTREAL**

Books for the Engineer's Library

Hawkins' New Catechism of Electricity

It contains 550 pages with 300 illustrations of electrical appliances; it is bound in heavy red leather, with full gold edges and is a most attractive handbook for electricians and engineers. One-third of the book is devoted to the explanation and illustrations of the dynamo, with particular directions relating to its care and management—$2.10 post paid.

Engineers' Examinations

By N. Hawkins, M.E.

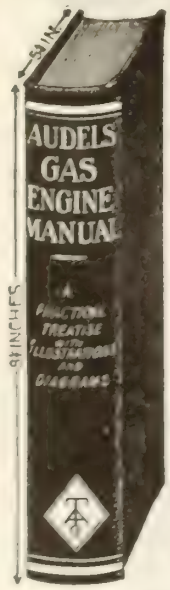
It presents in a condensed form the most approved practice in the care and management of steam boilers, engines, pumps, electrical and refrigerating machines with examples of how to work the problems relating to the safety valve, strength of boilers and horse power of the steam engine and steam boiler.—$2.10 post paid.

Steam Turbines

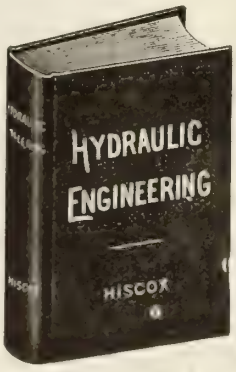
By Leland.

A reference work on the development, advantages and disadvantages of the steam turbine; the design, selection, operation and maintenance of steam turbine plants and turbo-generators. 136 pages. Illustrated.—$1.00.

Audel's Gas Engine Manual



A practical treatise relating to the theory and management of gas, gasoline and oil engines, including chapters on producer gas plants, marine motors and automobile engines.—$2.00.



Hydraulic Engineering

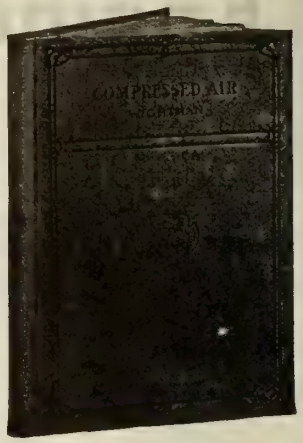
By G. D. Hiscox.

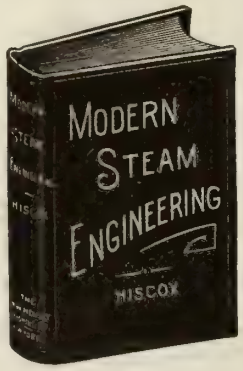
This comprehensive book of Hydraulics written by an experienced engineer, is a practical treatise on the properties, power and resources of water for all purposes, including the measurement of streams, the flow of water in pipes or conduits; the horse-power of falling water; turbine and impact water wheels; wave motors, etc. All who are interested in Water Works Development should have a copy. 320 pages, 305 illustrations. Price $4.15 post paid.

Compressed Air

By L. I. Wightman, E.E.

A reference work on the production, transmission and application of compressed air; the selection, operation and maintenance of compressed air machinery; and the design of air power plants. Illustrated.—$1.10.





Modern Steam Engineering in Theory and Practice

By Hiscox.

This book has been specially prepared for the use of the modern steam engineer, the technical students, and all who desire the latest and most reliable information on steam and steam boilers, the machinery of power, the steam turbine, electric power and lighting plants, etc. 450 pages. 400 detailed engravings.—$3.15 post paid.

Boiler Construction

By Kleinhans.

The only book showing how locomotive boilers are built in modern shops. Shows all types of boilers used; gives details of construction; practical facts, such as line of riveting punches and dies, work done per day, allowance for bending and flanging sheets and other data that means dollars to any railroad man. 421 pages, 324 illustrations, six folding plates.—$3.00.

Compressed Air, Its Production, Uses and Application. *By G. D. Hiscox, M.E.*

Comprising the physical properties of air from a vacuum to its liquid state, its thermodynamics, compression, transmission and uses as a motive power in the operation of stationary and portable machinery, in mining, air tools, air lifts, pumping of water, acids and oils and the numerous applicances in which compressed air is a most convenient and economical transmitter of power.—Price $5.15 post paid.

Boiler Accessories

By Walter S. Leland. S.B.

Assistant Professor of Naval Architecture, Mass. Institute of Technology, American Society Naval Architects and Marine Engineers. 144 pp., 80 illus. Cloth binding. A treatise giving complete descriptions of the various accessories of the boiler room and engine room essential to economical operation, such as evaporators, pumps, feed-water heaters, injectors, mechanical stokers, etc., with practical instruction in their use.—Price $1.10 post paid.

Technical Book Department

MacLean Publishing Company — 143 University Ave., Toronto

The Publisher's Page

TORONTO NOVEMBER, 1918

What Do You Think About It?

IT is officially announced that Canada is to receive orders for millions of dollars' worth of material and supplies for reconstructing devastated Europe!

Mr. Lloyd Harris, Chairman of the Canadian Munitions Board in Washington, and Mr. Frank P. Jones, Chairman of the War Trade Board, Ottawa, are proceeding to England at once. Lloyd Harris has been instrumental in securing orders for millions of dollars' worth of munitions from Uncle Sam, and he can be counted on to get Canada's share of European reconstruction business. Mr. Jones is a team-mate worthy of his associate, and the pair, together with others who will be associated with them, can be relied upon to solve, in a large measure, some of the anticipated problems of the period of readjustment which was expected to follow the close of the war.

Then, too, the Railways are to have their innings, and their purchases of rolling stock and track equipment will keep our steel mills busy for some months.

The shipbuilding programme of the Government is to be carried out and possibly enlarged, and the industries which have suffered through lack of raw material and supplies will be able to catch up.

The world is forming into a vast bread line, turning with appealing eyes and outstretched hands to America. Our production of foodstuffs must be greatly increased, and there should be no unemployment so long as there is an acre of tillable land that is not producing.

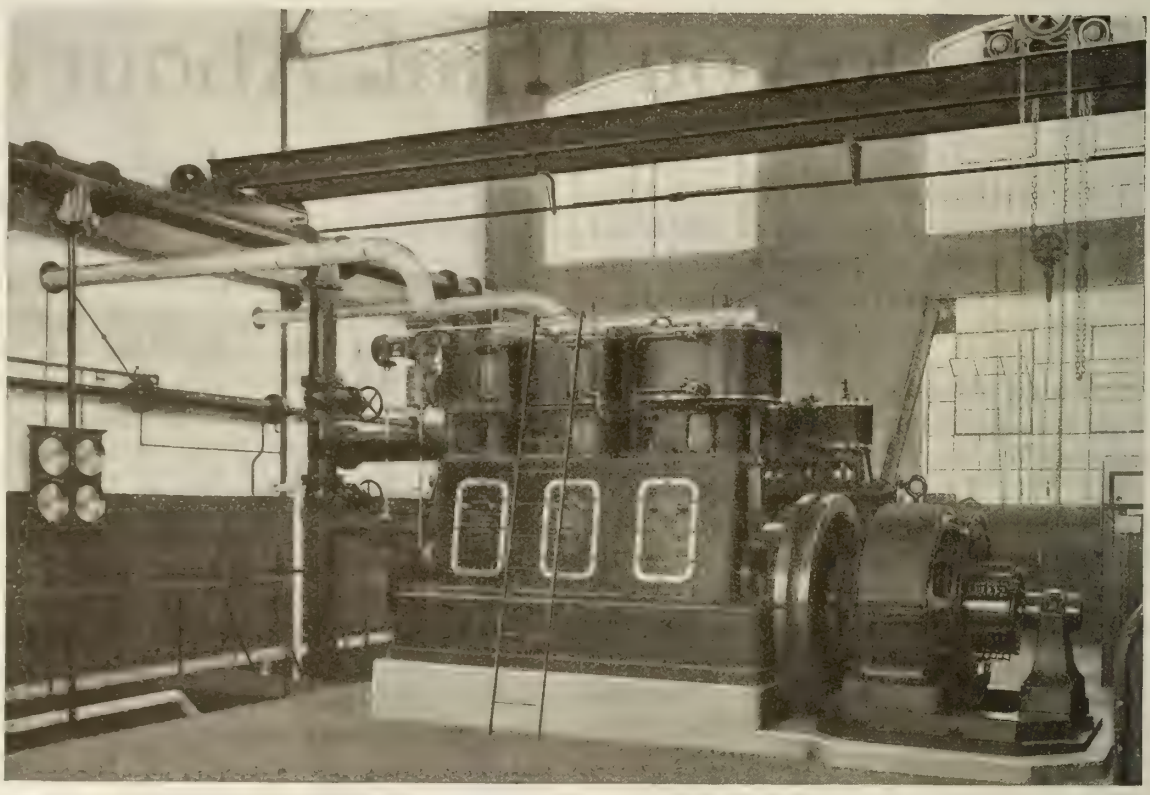
There were those who said that business would go to the dogs when the war broke out, and see what happened! There will be gloom spreaders rampant again, and if we would listen we would become gloomy too.

This is a time for balance, for good judgment and optimism, for clear thinking, initiative and action. It is a time for thanksgiving and not for gloom. For unselfishness, for charity of thought and not for greed and parsimonious profit protecting. It is a time for kicking old policies and old doctrines into the street if they stand in the way of doing the things which better judgment says should be done.

Two shadows never made a ray of light and pessimists didn't win the war. Let us take fresh courage and face the future with faith, hope and confidence. We're living in a better world!

POWER EQUIPMENT

Built to Meet Your Own Requirements



A corner in the Engine Room of our New Power Plant recently erected at our Main South Works. Equipped with G. & McC. Co. Three-Cylinder Compound and Two-Cylinder Compound Vertical Forced Lubrication Steam Engines.

G. & McC. CO. ENGINES and BOILERS

will provide your plant with

A Continuous and Economical Service

WE BUILD

Horizontal and Vertical Steam Engines; Steam Turbines; Return Tubular and Water Tube Boilers; Heaters; Tanks; Pumps and Condensers; Transmission Machinery; Safes, Vaults and Vault Doors.

The advice of our Engineering Experts, our Catalogues, Specifications, Photographs, etc., will be cheerfully supplied to interested parties.

The GOLDIE & McCULLOCH CO., Limited

Head Office and Works: GALT, Ontario, Canada

TORONTO OFFICE:	WESTERN BRANCH:	QUEBEC AGENTS:	BRITISH COLUMBIA AGENTS:
Suite 1101-2.	248 McDermott Ave.,	Ross & Greig, 412 St. James St.	Robt. Hamilton & Co.,
Traders Bank Bldg.	Winnipeg, Man.	Montreal, Que.	Vancouver, B.C.

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

POWER HOUSE

The Historical Development of Steam Turbine I.

The Beginning of a Series Treating of the History of the Turbine From An Engineering Standpoint—Early Progress—Charles A. Parsons—American Development

ROUGHLY speaking, the whole of the development of the steam turbine has occurred within thirty years. This is a very brief period as compared with the development of the reciprocating engine, which occurred over a period of more than ninety years. Many are inclined to attribute this to the high technical skill and scientifical attainment of the present age, but a more true reason than this is the fact that metallurgical and manufacturing arts were available for the turbine manufacturer which were not available for the early builders of steam engines.

Early Progress

A cursory review of the British Patent Office records in the early years, say 1800 to 1850, show them to be rich in turbine inventions, and nearly every modern turbine principle and some others will be found exemplified. It is assumed that these ideas were abandoned because of the then apparently greater promise of the reciprocating engine and the undeveloped stage of machine shop practice which rendered production of efficiently shaped blades practically impossible.

The steam turbine is generally regarded as of European origin, the reduction to useful practice having been carried out by Messrs. Parsons and DeLaval, and it is not generally known that steam turbines were commercially built in Syracuse, New York, as early as 1833. Several of these were sold and employed for driving saw mills, and were of the kind which might be described as of the "Hero" type, steam being admitted through the shaft and issuing tangentially from two radial arms. One user of these, Mr. N. Felt, of Cicero, New York, reported in 1835 that the turbine driving his saw mill used two-thirds the fuel of the reciprocator it replaced.

It is reported that in 1836 one of these was placed upon a locomotive near Newark, New Jersey. The turbine had an arm tip speed of 14.25 miles a minute. Its life was ended in a ditch. It is, however, interesting to record that Parsons built a precisely similar machine about 1890, comprising a single "Hero" element. Its capacity approximated 20 horsepower, and with 100 pounds pressure and 26 inches vacuum, had a steam consumption of 40 pounds per horsepower hour. His attempts to improve performance by compounding were unsuccessful because of the friction of the arms in the more dense fluid.

Charles A. Parsons

No historical review of the development of steam turbines would be complete without tribute to the work of Sir Charles A. Parsons, who, in spite of the many difficulties to be overcome, had the courage of his convictions and expended a large personal fortune in this work. He commenced work in 1884 by determining whether bodies could be operated at eighteen or twenty thousand revolutions per minute, and then proceed to the building of a small turbine. Sir Charles at the outset thoroughly realized that the sphere of the steam turbine was in large sizes rather than small, but he had associated himself with a firm of engineers whose principal business was the equipping of ships with donkey boilers, winches, windlasses, etc., so it was natural that his activities were confined to the building of lighting sets for shipboard use. These sets were of small capacity, running at from fourteen thousand to eighteen thousand revolutions per minute, driving direct-current generators. The generators, while highly unsatisfactory from the standpoint of a modern direct-current machine, were remarkably ingenious in their design. It was not until he dissolved partnership with the above mentioned firm and established his own engineering works that he was enabled to build steam turbines and apply them to what he believed to be their proper sphere, viz., central station work. He applied them to the earliest central stations, viz., Newcastle, Cambridge, and Scarboro, in England, in 1889, a 75-kilowatt machine being furnished to the former city. Of course, early progress was retarded by the small demand for high-speed machinery. Practically their only application was for driving dynamos which were then built only in small sizes.

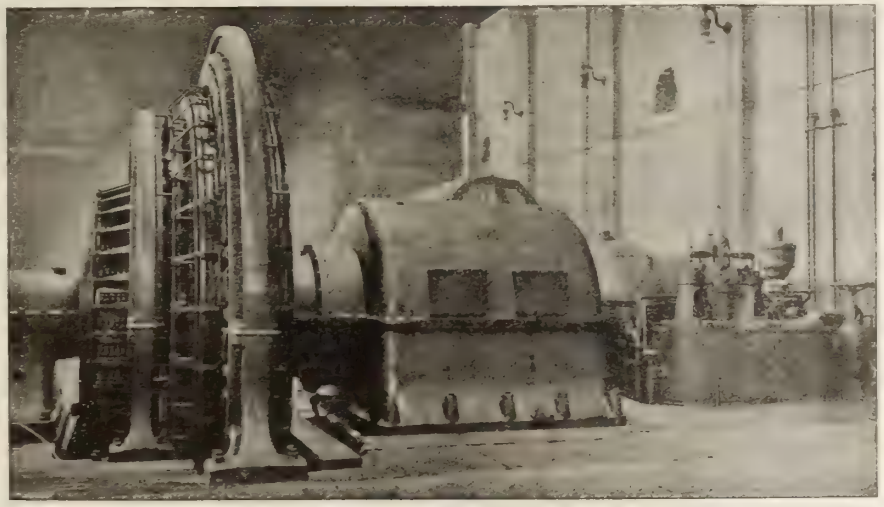


FIG. 1.—GEARED TURBINE DRIVING LARGE D. C. GENERATOR

During the period from 1884 to 1889 about 300 turbines were built ranging up to 75 kilowatts. In 1894 a number of 350 to 500-kilowatt non-condensing turbines were built for driving 50-cycle generators at 3,000 r.p.m. These were furnished to various electric lighting companies in London and displaced both Willans and Westinghouse single-acting engines, as the company operating them had received an injunction on account of the vibration being a nuisance to the

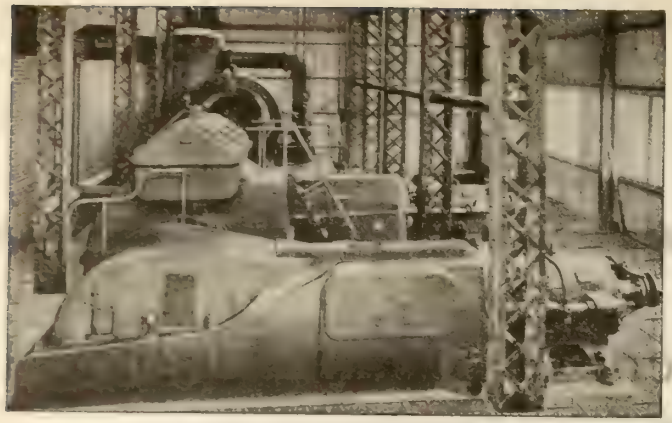


FIG. 2.—ANOTHER GEARED TURBINE APPLICATION

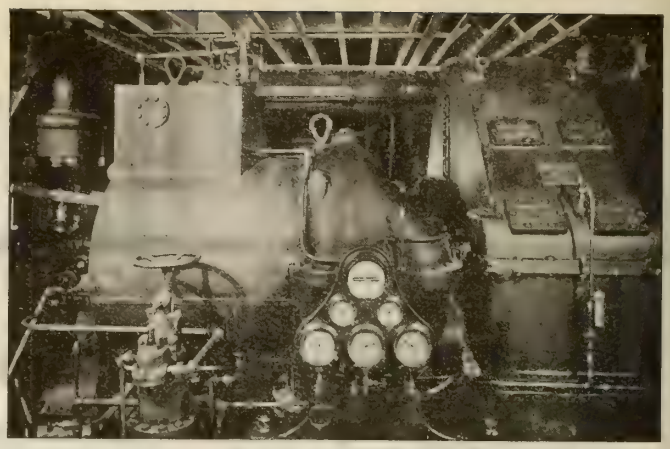


FIG. 3.—GEARED TURBINE

community, which was withdrawn with the installaton of these turbnes.

Sir Charles Parsons has been unrelaxing in his energy in the development of steam turbines, his efforts culminating finally in the construction of enormous turbines for direct connection to the propellers of express steamers, the engineering difficulties to be overcome in their construction being of a far higher order than that required for the most successful high-speed turbine for land service.

American Development

In 1896, the steam turbine as a practical machine was almost unknown in the United States. A foreign built DeLaval turbine of 300-kilowatt capacity had been furnished to the Edison Company of New York. A few Dow turbines of small capacity had been built, and while exceedingly ingenious in their character, they did not have much commercial application except for use in speeding up the flywheels of Howell torpedoes for the United States Navy.

At this time Mr. George Westinghouse, realizing with his characteristic foresight the possibilities of the turbine, secured for the Westinghouse Machine Company the rights to manufacture them under a license from Sir Charles A. Parsons. In 1896 a 120-kilowatt turbine was built in Pittsburgh of condensing design and drove a direct-curren generator at 5,000 r.p.m. This turbine had a water rate of 25.6 pounds per kilowatt-hour operating with 160 pounds steam pressure and 27.1 inches vacuum. The turbine was regarded as entirely satisfactory, but it need hardly be said that the generator did not come up to standards of direct-current apparatus, even of that day. In the succeeding years this company was substantially alone in the turbine field; gas engines and large Corliss engines occupied most of the activities of the company, so that until 1899 turbine development, except for some experimental machines, was practically at a standstill.

During the year 1899, the powerhouse of the Westinghouse Air Brake Company, Wilmerding, Pa., was equipped with three 400-kilowatt turbines, which was the first serious turbine installation carried out in this country. The performance of these machines with 150 pounds steam pressure, 100 degrees F. superheat, and 28 inches of vacuum was as follows:

Brake Horsepower. Load in	Brake Horsepower Hour. Pounds Steam Per
264	14.48
445	12.87
593	12.05
759	12.06

A quite historic turbine installation was made in 1900 at the plant of the Hartford Electric Light Company, Hartford, Conn., which was of 2,000-kilowatt capacity, running at 1200 r.p.m. This turbine was at least twice as large as any turbine that had ever been built, and caused much comment at that time. The whole of the expansion was carried out in a single cylinder. European turbine builders, commenting on this, regarded it as a courageous thing to attempt to build such a large turbine structure in one single cylinder, and here came about a crossing of ideas, which is not infrequent in engineering process; viz., two groups of engineers each abandoning their own line of progress and adopting that of the other.

Tandem Compound Turbine

At this same time, viz., 1900, Sir Charles Parsons constructed the historic Elberfeld machine wherein the expansion of steam was carried out in two separate turbine cylinders coupled to each other tandem fashion. This machine, operating with 144 pounds absolute steam pressure, 26 degrees F. superheat, and 28.2 inches of vacuum, gave a steam consumption of 19.0 pounds per kilowatt-hour at 1250-kilowatt load.

Sir Charles Parsons and also Brown Boveri of Basle, who had by that time become a licensee of Parsons, encouraged by the success of the American Hartford machine, proceeded to build large

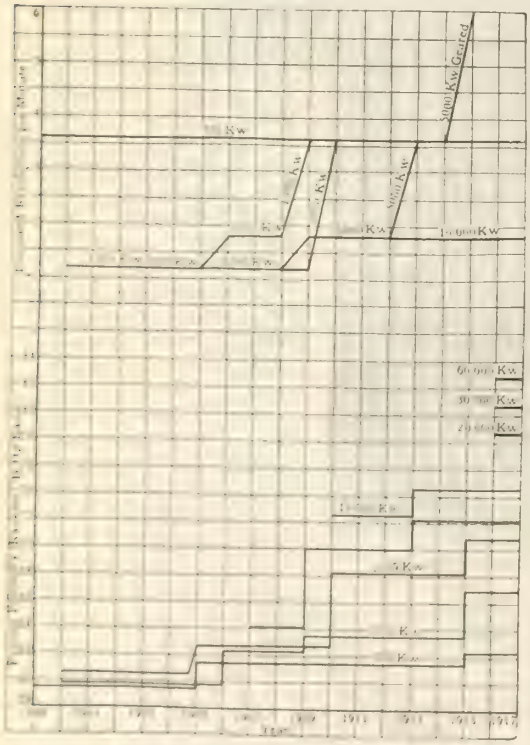


FIG. 4.—PROGRESS IN 25-CYCLE TURBINE DESIGN

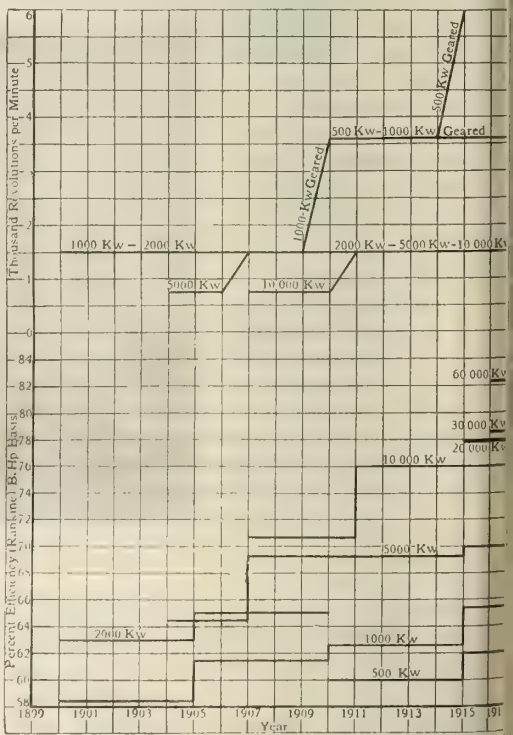


FIG. 5.—PROGRESS IN 60-CYCLE TURBINE DESIGN.

size turbines in single cylinder, while we in America, being impressed by the reliability to be obtained from dividing the steam cycle of the turbine into two separate elements, proceedd to build several machines of from 1,000 to 2,000 kilowatt-capacity in two cylinders; these being constructed in 1903. Plainly two cylinder machines of such small capacities were expensive, but it is interesting to point out a reversion to this type, by the Westinghouse Company, in the last two years. The Hartford machine above referred to caused sufficient interest that the General Electric Company saw their way to enter the turbine field and shortly thereafter commenced the construction of 5 000-kilowatt units for the Commonwealth Edison Company of Chicago.

Referring again to the two-cylinder tandem turbines built in 1903; one advantage of the design was expected to accrue from the use of a reheating receiver between the two cylinders. Tests, however, showed clearly that the gain due to this did not warrant the expense when high pressure steam was used for reheating. But the prophecy is ventured that there will be a reversion to intermediate reheating by means of separately fired superheaters for large machines in the near future.

Growth in Capacity

Th rapid strides made in central station practice in this country have brought about developments of turbines for land purposes in sizes that have gone beyond any Eupropean practice, and very remarkable steam engine performances have been obtained by the principal manufacturers. There is an impression that this development has, in this country, within the era say from 1900, grown from a very poor and uneconomical machine. This, however, is not true of the Westinghouse Company for it is seen from the steam consumption of the earliest machines quoted and in what follows that they do not compare very unfavorably with what can be done to-day with similar speds and capacities. Unquestionably improvements have been made in producing less expensive and more reliable detail design. Improvements in economy, however, have been due to increased speeds for a given capacity rather than to any material change of thought or principle as regards turbine systems. Very material advances have been made in the development of the high-speed alternating current generators which have permitted turbines to be designed more appropriately for the volumes of steam involved. To-day, 5,000-kilowatt 60-cycle machines have been built for operation at 3600 r.p.m., while in the year 1900 electrical engineers looked askance at such speeds even for 500-kilowatt units and regarded 1800 r.p.m. as the more desirable speed for this capacity and frequency. Improvements in condensing apparatus have also contributed to the development of the turbine, bringing ordinary available vacua from 26 inches to 29 inches, this improvement having been brough about by the demands of the turbine builder, which were largely responded to by manufacturers of the more modern systems of condensers apparatus.

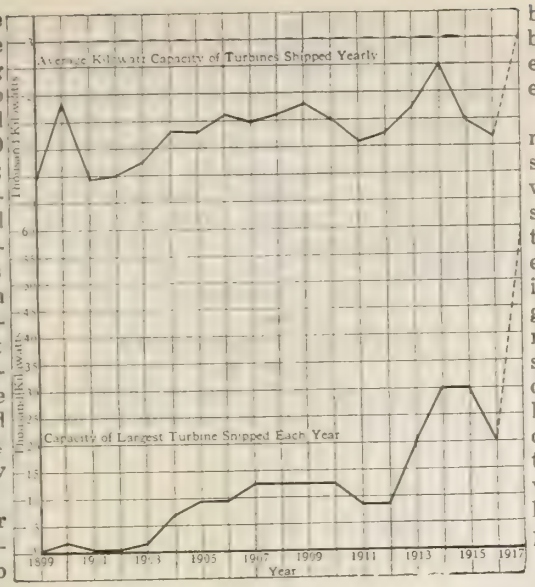


FIG. 6—GROWTH IN SIZE OF INDIVIDUAL UNITS

To-day it may be said that the maximum capacities of generators at given speeds are as great as the capacities for which the turbine can be conveniently designed. In other words, the turbine ceases to be a machine of too high speed for general application. It may be designed for its best speed and direct connected to the generator in the case of alternating-current machinery for all but the smaller sizes below 500 kilowatts. It may be still operated at its most economical speed and by the intervention of toothed gearing be connected to direct-current generators or to other apparatus for any other purpose whatsoever, including direct mill drive, large reciprocating pumps and the propulsion of ships.

Reduction Gears

The principal field for the steam turbine in the past has been driving a-c generators; and as there are, broadly speaking, but two frequences in conventional use in this country, 25 and 60 cycles, the speeds available were limited. Because of the difficulties of electrical transmission there has not been much demand for direct-current generators of large size. Further, because of the difficulty of designing direct-current generators for high speeds, the number of direct-current turbine installations is comparatively small. In the installations of direct-connected turbines and direct-current generators which were made, the speeds selected were too high for successful operation of the generators and too low for the economical operation of the turbines. Within the last eight years, however, reduction gears have been developed which remove this objection; so that to-day first-class designs of direct-current generators may be driven by turbines as successfully as can alternating-current units. A number of such geared outfits have been installed, giving entire satisfaction, the speeds being as follows:

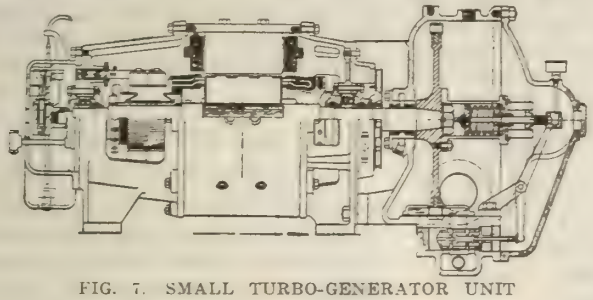


FIG. 7. SMALL TURBO-GENERATOR UNIT

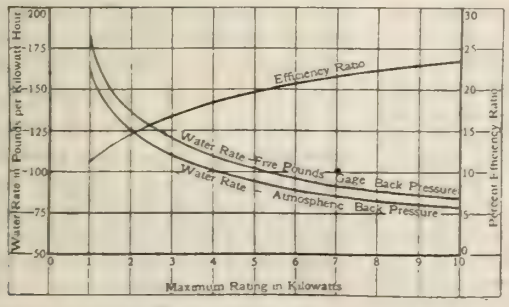

Efficiency Ratio
Water Rate—Five Pounds Gage Back Pressure
Water Rate—Atmospheric Back Pressure
Water Rate in Pounds per Kilowatt Hour
Percent Efficiency Ratio
Maximum Rating in Kilowatts

FIG. 9.—PERFORMANCE OF SMALL TURBINE

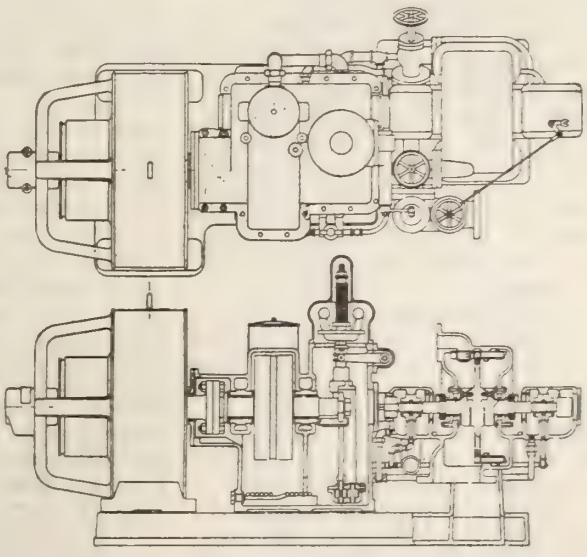


FIG. 8.—SMALL GEARED UNIT

Capacity Kw.	Turbine Speed R.P.M.	Generator Speed R.P.M.
150	6,000	900
300	6,000	900
500	5,000	720
1,000	3,600	514
1,500	3,600	360
3,750	1,800	180

The generator speeds given above are standard for motor-generator sets. Examples of important geared installations for purposes ordinarily considered outside the field of the steam turbine, is given in Figs. 1 to 3.

The improvements which have been made in turbine performance since 1899 are shown by Figs. 4 and 5, for 25 and 60-cycles respectively. These curves show how speeds have been changed with the progress of time, each change of speed having been more productive of improved results and improvements in what are essentially turbine principles. The comparisons have been made on the basis of the efficiency ratio rather than steam consumption, because to make a comparison with the latter the results would have to be reduced to a common operating condition, which would be improper. Should a high operating condition be selected it would not be fair to some of the older machines, which were hardly adapted to operate with high superheats and vacua, and the later machines would be at a disadvantage if their results were reduced to a low operating condition. The effect of the condenser on turbine development has been previously referred to. The improvement of condenser performance is directly attributable to the demands of the turbine. Early turbines had their low pressure elements designed to be suitable for vacua not much over 26 inches. All turbines nowadays are designed to expand steam at their point of best steam consumption to 29 inches vacuum.

Fig. 6 is of passing interest, showing the increase in the capacity of single units as built from year to year. The average capacity of turbines is also shown; it has not, however, been continuously an upgoing scale on account of the growth of business in single wheel impulse turbines of small capacity. In 1909 was commenced the development of small, single disc, non-condensing turbines of the re-entry type, intended primarily for the operation of condenser auxiliaries. Their general performance was so encouraging that in the course of time a line of excellent small machines suitable for electric generator drives, and also adaptable for driving any other kind of machinery have been developed. The smaller ones, up to 15 kilowatts, are direct-connected; above that they are geared. The general schemes of design are shown respectively in Figs. 7 and 8, and their performance in Figs. 9 and 10. The r.p.m. shown on the curves represent the speeds of the turbine shaft; the gear ratio being arranged to suit the driven machine.

To be continued

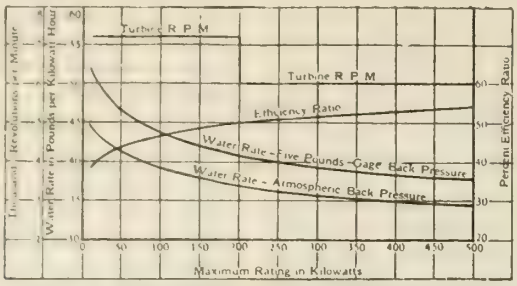

Turbine R.P.M.
Turbine R.P.M.
Efficiency Ratio
Water Rate - Five Pounds Gage Back Pressure
Water Rate - Atmospheric Back Pressure
Thousand Revolutions per Minute
Water Rate in Pounds per Kilowatt Hour
Per Cent Efficiency Ratio
Maximum Rating in Kilowatts

FIG. 10—PERFORMANCE OF A GEARED UNIT

UNUSUAL LUBRICANTS

By M. M.

The problem of lubrication is by no means simple and its complexity has been pointed out on many occasions. Lubrication is conditioned by many circumstances.

A spindle from the machine and likewise the bearing in which it is carried have surfaces which consist of circumferential grooves. These are minute, but until the surface more nearly approaches a perfect cylinder, a new bearing requires unusual care until run in, otherwise until the hills have been abraided to the level of the valleys. It is by no means well known that longitudinal drawfiling with a dead smooth file has, before to-day, restored running conditions in a bearing which would not behave. For large spindles such treatment is beneficial before erection and is seriously recommended. Since it will restore a bearing which persistently runs warm to a sense of due behaviour, it is worth more general adoption.

There are instances where a big job must be kept running at all costs with a hot bearing, and playing a hose on the same may dissipate the heat, but does not remove the conditions; leading as it does to very rapid wear.

There are a few simple prescriptions all of them tried and found successful, which have restored a hot bearing to good running conditions, when shutting down was impossible. Heavy doses of castor oil and minute alterations or injections of distilled water, to induce saponification, is one remedy. Graphite and lubricating oil is another. The worst cases are those in which a steel spindle runs in gun-metal, and there is no remedy to compare with flour of sulphur mired with lubricating oil; it acts like a charm in most instances, and is strongly advised.

Cast iron sliding on cast iron gives in time a surface skin whose co-officient of friction is very small, and such skin is not easily broken. When this surface is abraided, the conditions are rather startling, for actual red hot sparks commence to fly in a very short time, and lubricating oil simply burns to a carbon deposit, and has no effect whatever. Putty white lead, mixed with lubricating oil, has been successfully used to cure even these conditions. The most unusual lubricant which came under personal notice and experience was used in the thrust bearing of a steamer, and had been utilized there for many years. As is well known, the type of bearing has a large enclosed volume which can serve as a bath. This was filled to axis of shaft with a solution of soft soap in distilled water, about 1 cwt. of soft soap sufficing for six month's use. The entire contents were occasionally changed, and a daily feed of about ½ pint of strong solution added. The bearing never gave trouble unless a new greaser started to oil it, when its temperature increased in direct ratio to the amount of oil.

When a bearing gets hot, the metals are in intimate contact, and the normal film is broken down. The remedies noticed restore conditions by the interposition of a more durable film between the surfaces. They give an artificial skin to the bruised surfaces, and allow gradual restoration of its condition.

Unlike the nigger doctor, who gave rosin and alum for a broken limb—the last to draw the bones together, and the first to stick them—the remedies, although perhaps not scientific, are successful. A word of caution is perhaps advisable—don't follow Mark Twain in his cure for a cold, and mix the remedies—give one a chance before trying another.

Finally, the remedies here noticed are known to, and practised by, marine engineers, and they have before to-day, kept the job running when a shut down on a lee shore would have meant disaster. This last for the sceptic who may be inclined to doubt their efficacy.

GAS RIVET HEATERS

At the Bethlehem Shipbuilding Corporation's Alameda Works, U.S.A., gas is henceforth to be used exclusively for rivet heating, plate-bending, and general fabricating heating purposes. This is a radical departure from the shipbuilding methods that have been in use for years, whereby it was thought that only coke could be used—even oil was considered an innovation. Good work by a riveting crew depends to a great extent on properly heated rivets. With a continuous and uniform gas forge the heater man can give his undivided attention to regulating the forge so that there will be no burned or overheated rivets, irrespective of the speed at which the crew works. This tends towards regularity, with properly upset and tight, full-headed rivets as a result. The cooling contraction is likewise more uniform, and caulking is reduced to a minimum.—"Chemical and Metallurgical Engineering."

Power Plant Management; Hand Firing

Methods of Hand-Firing—Standard Practice—Proper Combustion Conditions—Thickness of Fire—Minimization of Smoke

By ROBERT JUNE

A MINER will produce, on the average, 10 tons of coal per day, 22 days per month. This is at the rate of 220 tons monthly, or 2,640 tons yearly.

Our present annual consumption of hituminous coal for industrial purposes is fully 250,000,000 tons. Of this amount, we are wasting to-day, in a preventable manner, anywhere from 10 to 25 per cent. Conditions are improving. Let us give ourselves the benefit of the doubt by conceding a 10 per cent. waste. That is 25,000,000 tons.

Twenty-five million! The figures slip glibly enough from our tongues, for are we not all infected with cypherosis, and used to dealing in big sums? But if we would realize the magnitude of the loss we must resolve it into concrete terms which can be visualized. 25,000,000 tons is 500,000 carloads—enough to make a train 3,840 miles from engine to caboose, long enough to reach from New York to our battle front in France, where its energy belongs.

This train represents the continuous labor for a year, of 85,000 men. We would have four new divisions of over 20,000 men to send against the Kaiser if we would eliminate the waste. Were we to utilize the 25,000,000 tons instead of wasting it, we would have the heat and power required to produce a combined fleet of 50,000 motor trucks, 50,000 tanks, 50,000 airplanes, 2,500 submarine chasers, and 250 merchant vessels.

Of the various sources of coal waste in the power plant, improper firing is among the most important. Also, given a fair measure of intelligence, good intention and determination to improve operation on the part of the boiler-room crew, improper firing may be easily bettered.

There are two general methods of hand-firing; first, the spreading method, second, the coking method.

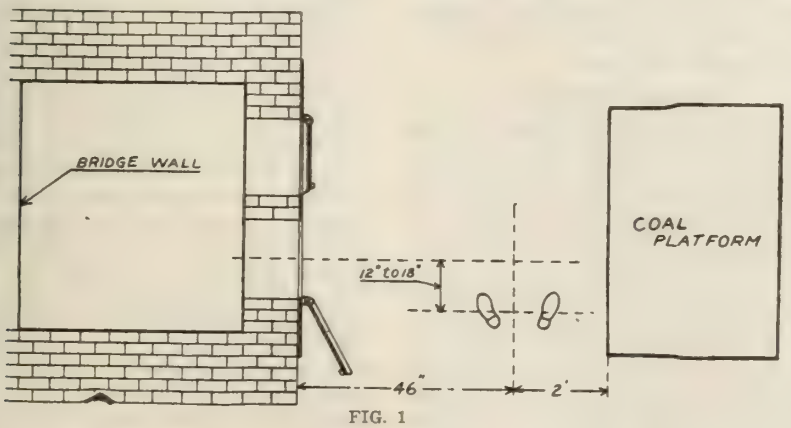


FIG. 1

In the spreading method a small amount of coal is fired at one time, and spread evenly over the fuel bed, front to rear. In order that the entire fire may not be blanketed with green coal, the surface of the bed is divided into sections which are fired alternately. Thus on a furnace with three firing doors the rear half of the grate is fired through doors 1 and 3, and the forward half through door 2 at the same time. At the next firing the arrangement is reversed, and the forward half of the grate fired through doors 1 and 3, and the rear through door 2.

In the coking method, fresh coal is fired at considerable depths at the front of the grates, and when nearly or wholly coked is pushed to the back of the furnace. The object is to maintain a bed of incandescent carbon at the rear of the grate, in passing over which the volatile from the green coal at the front will be burned. This method is particularly adapted to furnaces wherein gases pass horizontally over the fire.

Before each firing the coked fuel is pushed back, leaving about one-third of the grate bare and all of the green fuel on the bare grate. The fire door is cracked slightly to admit air for the volatile gases.

Of the two methods, it may be said that modern practice leans more and more to the spreading method. This is because of its evident tendency to produce higher efficiency, higher CO_2, lower flue gas temperature, and more uniform steam generation—results attributable to greater constancy in furnace temperatures.

On the other hand the coking method produces less clinker since the levelling of the fire at the firing period shakes more ash through the grates. The longer firing period produces a general lowering in CO_2, and there is a tendency to admit excess air through the thin spots. The coking method cannot be used successfully with a fluctuating load, as holes which cannot be seen develop in the rear of the fuel bed.

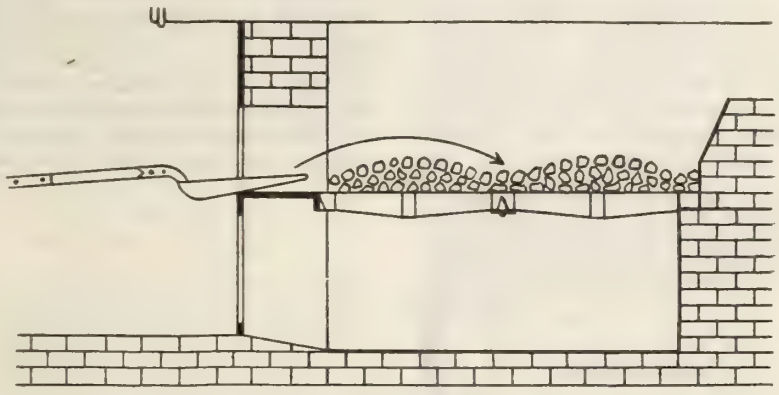


FIG. 2

Standard Practice for Hand-Firing

The position of the fireman and the location of the coal pile have a great deal more to do with securing good results in hand-firing than is generally realized.

The fireman must take a proper position so that he can see the thin spots and can throw the coal onto them with the least effort. He should stand 4½ to 5 feet in front of the furnace, and 12 to 18 inches to the left of the center of the door, see Fig. I. He should then be about two feet from the coal, which is 6 or 7 feet from the furnace front and should preferably be on a car, or an elevation, knee-high from the floor.

The scoop should travel in a nearly straight line. At the end of the throw the scoop should suddenly be stopped by laying it on the bottom edge of the door frame. The coal then flies off and is scattered over the proper spot. By thus stopping the scoop the fireman saves effort and locates the coal better. If he pushes the scoop way into the furnace he has to jerk it back to get the coal off. See Fig. II.

Hand-firing is hard work, and requires considerable judgment and skill. There should be sufficient firing space for handling the shovels and tools.

If the coal is closer than 6 or 7 feet the fireman is crowded and will stand

away to one side of the door to avoid the intense heat. He cannot see the fire and throws the coal in by guess. His scoop travels in the arc of a circle, scattering coal on the floor and dumping it in a heap directly inside of the door, see Fig. III. This results in an uneven fire, low efficiency, and requires raking of the coal on to the back of the fire.

Provide a smooth firing floor, or a smooth bottom to the coal car, so that the shovel does not hit bumps or rivets. Such obstructions delay the firing operation, keeping the door open longer than necessary and admitting an excess of air.

Benefits of Rapid Combustion

Coal should be burned rapidly and at high temperatures in order to secure the best available economy. Fire small quantities of coal at short intervals so that thin places do not burn through and admit large excess of air. The quantity depends upon the grate size and the drafts. With a draft of one inch in the uptake, 2 to 2½ pounds per square foot of grate is a good average. Thus, on a grate 6 by 8 feet, 100 to 125 pounds of coal, or about 6 to 9 shovelfuls, would be the quantity for one firing. The intervals should be about five minutes. For a higher draft the periods could be three minutes; with a weaker draft they could be lengthened to eight minutes, but under ordinary circumstances should never be more than ten minutes. This method makes the coal supply more nearly proportional to the air supply, which in most hand-fired plants is nearly constant.

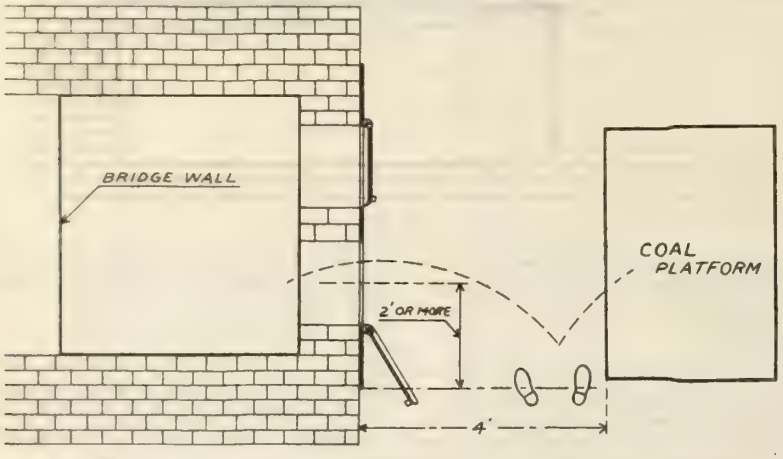


FIG. 8

The following are reasons for light and frequent firing: When fresh coal is fired the volatile matter is immediately distilled. The process is nearly completed in 2 to 5 minutes, therefore immediately after firing large quantities of air should be admitted over the fire. After 2 to 5 minutes it should be cut down. Such regulation is practically impossible. As the air supply is practically constant, immediately after firing it becomes insufficient, and incomplete combustion results. After most of the volatile matter has been driven off the air is in excess. The two losses are much less when small amounts are fired at frequent intervals. Automatic air control devices can be purchased, but even with them frequent and light firing is best Frequent firing alleviates the tendency to form a crust on the top of the fuel bed.

Cover Up the Thin Spots

A skillful fireman can, at a glance, estimate the amount of coal required at a given spot. Almost unconsciously he picks the right amount and selects the right mixture of fine and coarse coal. If the coal is burned way down he selects coarse coal to avoid its sifting through the grate. This also permits of the building up of the level on the spot more quickly, as the coal does not tend to fuse so much as slack. Thin and thick spots will occur, even with most careful firing. In places where the air flows freely the coal burns faster, forming a thin spot. The cause of the variation in air flow may be the difference in the size of the coal, the accumulation of clinker or the fusing of coal into a hard crust. Before firing fresh coal the fireman should note the thin places. They have bright, hot flames, while high spots have smoky flames, or none at all. Cover the holes, if burned through, with incandescent coal before firing. Place the coal on the thin spots in thin layers. If deep hollows are filled at once fresh coal may fuse and choke off the air, forming a new high spot. If high spots are missed for one or two firings they will burn down to normal. If the high spot is due to clinker, the clinker must be removed.

Thickness of Fire

With one inch draft available at the breeching, firing run of mine coal, a 4 to 8 inch fuel bed is best; the coarser the coal the thicker the bed. A thick bed offers more resistance than a thin one, therefore with the same available draft there is less air passed through a thick fuel bed, which means a lower rate of combustion and lower capacity. If difficulty is experienced in maintaining steam pressure with a thick fuel bed, it may be possible to overcome the difficulty by carrying a thinner bed. The objection to a thin fuel bed is that too much air flows through without uniting with carbon, but a thin fuel bed does not pass oxygen through unburned unless there are holes in it. Evidence shows that from a fuel bed 3 to 4 inches thick the gases rising from the surface average less than 2 per cent. oxygen, and about 25 per cent. combustible gas. As a result considerable air must be admitted through the fire-doors and other openings to burn the combustible gases. A thick fuel bed does not necessarily decrease the free oxygen in the flue gas but may actually increase it. Thickening the fuel bed increases the resistance to the passage of air. As the fuel bed is thickened less air passes through it, and less combustible gas rises from its surface.

The higher draft, however, brings in more air over the fuel bed, resulting in a greater amount of free oxygen in the flue gases.

The Smoke Problem

Hand-fired furnaces, as a rule, are most obstinate smoke producers. Although they can be operated efficiently without the production of objectionable smoke the result depends more upon the fireman than upon the design of the furnace. The chief difficulty with hand-fired furnaces lies in the intermittent nature of the firing. When a fresh charge of coal is fed into the furnace an enormous volume of volatile matter is evolved. For complete combustion a corresponding amount of air must be supplied and intimately mixed with the volatile gases before contact is made with the comparatively cool heating surface. In the average hand-fired furnace the combustion chamber is so small and the heating surface is so close to the grate that the partly burned gases strike the heating surface before oxidization is complete and combustion is hindered or even completely arrested. The most economical and smokeless hand-fired plants are those that approach the continuous feed of the mechanical stoker.

Minimizing Smoke in Cleaning Fires

Two methods of cleaning fires in hand-fired furnaces are in general vogue. In the side method, one side of the fire is cleaned at a time. In the front to rear method the burning coal is pushed with the hoe against the bridge wall, the clinker from the front half of the furnace is loosened and pulled out and the burning coal is spread over the bare grates, the process then being reversed for the rear half of the furnace. For smokeless operation the side method is preferable and should be carried out as follows:

Build up the fire on one side and let the other side burn down. Just before cleaning, "wing" over the live coal from the burned-out side and pull out the clinker and ash, cleaning the grates thoroughly. Cover the clean grates with green coal and push over live coal from the other side. When the cleaned side has become thoroughly ignited and the volatile matter has passed off, throw in coal to fill the spots not covered and pull the clinker and ash out of the other side. Cover the grates with green coal as before, winging over live coals from the opposite side. Keep the panels wide open and allow the fresh coal to ignite thoroughly. Never allow the fire to burn

low before cleaning, if carrying a heavy load as there is a possibility of losing the steam pressure.

The following rules represent the best standard practice in eliminating smoke in banking fires: Throw 15 or 20 scoops of coal on each side. Open the panel doors slightly, close the ashpit doors and partially close the damper. To break up the bank, level the fire with the panel doors open and start firing by the usual method, making sure the damper is wide open.

Keep the fire bright by the spreading method, using the panel doors and steam jets, and regulate the steam pressure with the ashpit doors. This insures a temperature in the furnace high enough to maintain the brickwork at the igniting points of the coal and promotes combustion of the volatile matter. At the same time it keeps down the distillation of the volatile matter to a low rate, and by having the damper open and the panels cracked, the circulation of the gases is not retarded. Do not try to regulate the steam pressure by the damper or smoke will be produced.

The method just described is contrary to the general rules for firing, but its philosophy is explained in the following manner: If a shovelful of coal is thrown on a bright fire by the spreading method, every particle of that coal is immediately subjected to the intense heat of the fire and the volatile matter is rapidly driven off. If this is followed by more coal, the result is a volume of volatile matter which is beyond the capacity of the furnace to handle without dense smoke.

If, on the other hand, the fuel is fired in a lump from the shovel without spreading there is a considerable quantity of the coal which does not immediately become subjected to the high temperature. The coal on the outside of the pile gives up its volatile and the coal within is not affected until the volatile matter has been distilled from the outside lumps. Furthermore, the volatile matter from the inner portions of the pile must pass outward through the incandescent outer layer of fuel, much in the same way as in the underfed stoker. In this way the production of smoke can be retarded, and the more coal thrown on the fire at once, the less smoke. Two shovelfuls of coal fired by the spreading method on a clean, bright fire, will make more smoke than ten shovelfuls fired by the lump method. In practice it will be necessary to determine just how much coal should be fired at once, but six or seven shovelfuls on a side with the draft operated according to the method ordinarily used will be found to be about right.

When a battery of boilers is to be fired the fires should be fed by the spreading method, as before, passing from one boiler to another until they are all charged and then repeating on the other side of the furnace. It should be determined by experiment, however, just how many furnaces can be fired consecutively without producing dense smoke, and after this has once been made known, the fireman should adhere strictly to the rules laid down in this regard.

CASTOR OIL RANKS TOP OF LIST AS THE BEST KNOWN LUBRICANT

PERHAPS your earliest recollection of castor oil was of having a fond parent hold your stubby nose while the stuff stuck to the roof of your mouth, your windpipe, and all your tasting and sampling organism. But apart from that you never paid much attention to it. Just now it is pulling down fancy prices The price of castor beans advanced in a few months from about $1.25 a bushel to $3.50, which was the price the government guaranteed those who would produce the necessary beans. This price has been found too low, and so the government has offered the large grower or contractor $4.50 a bushel for all the castor beans he can deliver. It is certain that the demand will continue to grow as more airplanes are built, and that the moderate and the chronic drinker of castor oil will continue to pay war or government vendor's prices for his tipple until peace has been declared.

The Perfect Lubricant

The lubricating value of castor oil was not left for this war to disclose, but it was not until the war was well under way that experts came to appreciate just what a wonderful lubricant it is. It is agreed that for many purposes it is the very best in the world, and this is especially true with regard to airplanes. The propellers of these craft are turned at a far greater number of revolutions a minute than the engine of an automobile, and at every impulse stroke there is developed within the cylinder of the engine inflamed gas of very high temperature. This intense heat will attack and consume most mineral oil lubricants, thus seriously impairing the engine. If the high temperature of combustion burns up the lubricating oil or thins it out so that it no longer furnishes the required anti-frictional film between contiguous metal surfaces, the pistons become too hot, expand, jam, and the machine is stalled. The consequences of a stalled engine in an airplane flying over the enemy lines, or perhaps engaged in battle need not be emphasized.

Indifferent to Temperature

Tests has shown that castor oil will not be burned up or thinned out by any heat that an airplane engine will develop. It will maintain its body at all times and flow freely through the distributing system whatever the temperature. Many other lubricants are affected by the cold, and it often happens that while the ground temperature may be 80 degrees or more, the air will be below freezing point at an altitude reached in a few minutes by an airman. Castor oil is a perfect lubricant in these circumstances, and wide differences in temperature appear to make little or no impression upon it. These facts were proved by exhaustive tests made in the United States to discover the perfect airplane lubricant, and naturally enough when it was found that castor oil was the best and that anything else was at best a makeshift, likely to fail in some important particular in some circumstances, the War Department set out to buy all the castor oil in the country.

Does Best in Hot Climates

When the available supply was secured, it devolved upon the Agricultural Department to induce growers to raise more castor oil beans, and the result has been satisfactory, although there continues to be a shortage. The beans may be grown in practically all parts of Canada and the United States, but they thrive best in semi-tropical conditions. In Florida, Texas and Oklahoma they have been extensively planted, yielding there from thirty to forty bushels an acre, while in the Middle West the yield is about one-half as great. But the United States, judging from the land devoted to the cultivation of the bean this year and likely to be cultivated next year, will hardly supply one-fifth of the demand of the American Department of War, let alone supplying any of the allies, and as in the past the chief reliance will have to be placed upon the imported article. In the tropics the bean flourishes like a weed. Where cultivated it begins to produce in from five to six months. and from that time on is a ceaselessly yielding perennial, and the seeds can be gathered month in and month out the whole year round. The war demand has resulted in hundreds of thousands of additional acres being planted with castor beans in India. Siam, China, and Central and South America.

Has Many Uses

The castor oil bean has many other uses beside that of a lubricant, medicinal or mechanical. In India it is very largely used for illuminating purposes. The oil burns very slowly and gives a light of notable brilliancy. In the United States, according to the "New York Sun," it is indispensable in the manufacture of imitation leather and rubber. Some kinds of soap could not be produced without castor oil, and from it there is also manufactured what is known as sulphonated oil or Turkey red oil, which is used as a softener or filler for cotton goods. It also enters into the makeup of the tracer bullet. In view of the foregoing facts there appears to be more than a germ of truth in the battle cry, "Castor oil will win the war!"

STARTLING WASTE OF OIL

Startling waste is shown by experts of the Bureau of Mines, Department of the Interior, who have been co-operating with the Fuel Administration in a general survey of the use of fuel oil for power purposes in the United States. They find that last year 160.000,000 barrels of fuel oil were used and that 40.000.000 barrels, or one-fourth of the entire amount, was wasted and might have been saved by proper firing.

The Calculation of Alternating Current Circuits

Simple Rules For Conditions Usually Met With in Practice— Their Application to Actual Problems and Tables of Constants For Simplification of Work

By GORDON KRIBS, Assistant Engineer Hydro-Electric Power Commission of Ontario

THE calculation of the size of wire necessary, under given conditions, for an A. C. circuit is usually considered by the average superintendent as rather too complicated to attempt, and the usual practice seems to be to guess at the size of wire necessary, calculate it on the basis of a direct current circuit and add something for good luck, or use the size of wire which has the required current-carrying capacity.

The writer is not aware that any very simple method of calculating alternating current circuits has been published and so the accompanying tables have been devised in the hope that they may fill a long-felt want and provide those interested with a simple means of calculating alternating current circuits accurately with minimum expenditure of time and labor.

The following explanation applies to the attached tables which have been calculated for both 25 and 60 cycles:—

Three power-factors have been assumed as representative of the various types of load, viz.:—

95% for lighting loads.
80% for a combined lighting and power load.
65% for a strictly power load.

Single-Phase Circuits

In order to calculate the size of wire necessary for a single-phase circuit, **multiply the load in kilowatts by the distance to be transmitted in feet and divide by the regulation or per cent. voltage drop desired.** This will give the constant K for this particular circuit

$$K = \frac{\text{Distance in feet} \times \text{K.W.}}{\%\ \text{Regulation}} \qquad (1)$$

Now look up, in the table calculated, for conditions corresponding to those of the circuit in question, the number most closely corresponding to this constant, and, opposite this number, find the size of wire necessary in order to obtain the desired drop under the given conditions.

Example.—It is required to transmit 25 K.W. at 600 volts, 60 cycles, 80% P.F., a distance of 1,000 feet, with an allowable line-drop of 5%. What is the proper size wire to use?

$$\text{Constant} = \frac{1000 \times 25}{5} = 5{,}000$$

Now in proper table, under 80% P.F., find the number most closely corresponding to 5,000. This is found to be 5,254. Opposite this number will be found No. 4 copper or No. 2 aluminum, as the proper size wire to use.

Conversely, by re-arranging formula (1), we have

$$\%\ \text{Regulation} = \frac{\text{Distance feet} \times \text{K.W.}}{K} \qquad (2)$$

Or, in other words, to find the regulation under given set of conditions for a given size wire, multiply the load in K.W. by the distance in feet and divide by the constant found in the tables for that size wire under the given conditions.

For three-wire circuits, use the voltage between the two outside wires, finding the proper size for these wires. For the neutral, it is considered good practice to use a wire one-half the cross-sectional area of the two outside wires.

Two-Phase Circuits

Since two-phase circuits are merely a combination of two single-phase circuits, it is necessary to divide the quantity of power to be transmitted by 2, and calculate as above. This is equivalent to using formula (3) for three-phase circuits, given below.

Three-Phase Circuits

To apply the tables to the calculation of three-phase circuits, we proceed exactly as in the case of a single-phase circuit, but, owing to the fact that the drop in a three-phase circuit is the same as that in a single-phase circuit, transmitting half the power, our formula becomes:—

$$\text{Constant} = \frac{\text{Distance in feet} \times \text{K.W.}}{2 \times \text{Regulation}} \qquad (3)$$

or conversely:—

$$\%\ \text{Regulation} = \frac{\text{Distance feet} \times \text{K.W.}}{2 \times K} \qquad (4)$$

Example—It is required to transmit 50 K.W. at 80% P.F., a distance of 10 miles, by means of a three-phase, 60 cycle, 4,000-volt line, with a regulation or voltage drop of 10%. What size wire is necessary?

$$\text{Constant} = \frac{5280 \times 10 \times 50}{2 \times 10} = 132{,}000$$

which corresponds to a wire between No. 6 and No. 7 copper.

For mechanical and other reasons, No. 6 would no doubt be chosen and therefore the regulation using No. 6 wire under the above set of conditions would be

$$\%\ \text{Regulation} = \frac{5280 \times 10 \times 50}{2 \times 156{,}366} = 8.4\%$$

Mains With Branch Circuits

1. **Fed from one end**—Besides the very simple problems, above outlined, it is possible to calculate complicated networks accurately by this method.

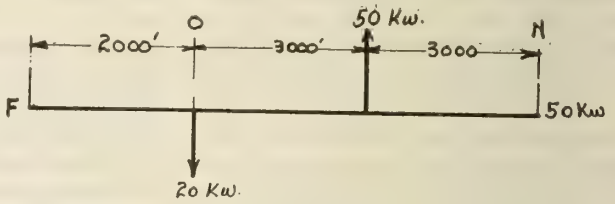


FIG. 1

Example.—Suppose we have a circuit as shown in Fig. 1. Let F be the power source and let the loads be tapped off at intervals as shown in Fig. 1. It is required to find the size of wire that will transmit three-phase power at 2,400 volts, 60 cycles, 65% P.F. and give a 5% drop at N. This problem is solved by adding together the sum of the moments of the various loads about F and dividing by twice regulation desired to get the wire constant, as follows:—

Moment of 20 K.W. about F = 2,000 × 20 = 40,000
Moment of 50 K.W. about F = 5,000 × 50 = 250,000
Moment of 50 K.W. about F = 7,000 × 50 = 350,000

Sum of moments about F = 640,000
Divided by 2 × Regulation = 64,000

We find in the proper table that the size of wire having a wire constant nearest to 64,000 is No. 4, which is the proper size to use.

It is always well to check the carrying capacity of the wire decided upon, as otherwise the safe carrying capacity for a given wire may be exceeded in cases where a large amount of power is to be transmitted a short distance at a comparatively high voltage.

In the above case, the total amount of power to be transmitted is 120 K.W., which, at 2,400 volts, corresponds to a current in each wire of 45 amperes. The safe carrying capacity

of No. 4 copper is 92 amperes; therefore, it is safe to use No. 4 for this installation.

It may be required to find the regulation at some other point in the circuit, as at O. Up to this point the conductor is transmitting 120 K.W. a distance of 2,000 ft. The constant K for No. 4 copper at 2,400 V., 65% P.F. and 60 cycles is 68,305; therefore the

$$\text{Percentage drop} = \frac{120 \times 2000}{68{,}305} = 3.5\%$$

2. **Fed from both ends.**—Sometimes we have a stretch of line fed from both ends at the same voltage. Consider such a case as shown in Fig. 2.

Let F_1 and F_2 be the two feeding points and let loads be tapped off at various intervals as shown in Fig. 2. It is evident that there will be a fall in potential from each feeding point outwards and there will be some point in the circuit at which the potential has a minimum value. Let us assume M as being the point of minimum potential. Now, the load which branches off at M will be fed partly from F_1 and partly from F_2. Let X_1 and X_2 denote the two quantities of power supplied to the point M from F_1 and F_2 respectively and let Im denote the total load which branches off at M.

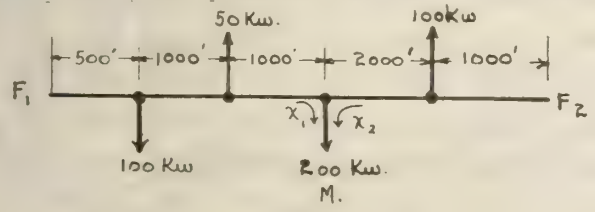


FIG. 2.

Then $X_1 + X_2 = I.m$ (a)

AMPERES PER K.W., PER PHASE, AT STATED VOLTAGE AND POWER FACTOR

Voltage	Single Phase			Three Phase		
	65% P.F.	80% P.F.	95% P.F.	65% P.F.	80% P.F.	95% P.F.
120	12.8	10.-	8.7	7.4	6.0	5.1
240	6.4	5.2	4.4	3.2	3.0	2.5
480	3.2	2.6	2.2	1.6	1.5	1.25
600	2.6	2.0	1.8	1.5	1.2	1.05
2400	.64	.52	.43	.4	.3	.26
4000	.38	.32	.25	.22	.18	.15

A second equation is given by—

Drop in potential from F to M = drop in potential from F_2 to M (b)

If you wish to find the percentage regulation at the point M, we must first find the values of X_1 and X_2. This can be done by using the system of moments. Starting from the two feeding points, write down in two parallel columns the moments of the various loads about the two feeding points, proceeding along each column at such a rate as to keep the sum of the moments as nearly as possible the same in each column. The point of lowest potential is thus reached and the quantities X_1 and X_2 are determined by means of the equations (a) and (b). In the circuit shown in Fig. 2, consider that power is being transmitted at 2,400 volts, three-phase, 60 cycles and 80% P.F., the loads tapped off, as shown. Find the size of wire necessary, in order that the regulation at M may be 2%. In order to find the value of X_1 and X_2,

TABLE FOR CALCULATING A..C. CIRCUITS

Size Wire		Carrying Cap. Amps.	110 - 120 Volts: Constant K for 60 cycles			110 - 120 Volts: Constant K for 25 cycles			220 - 240 Volts: Constant K for 60 cycles			220 - 240 Volts: Constant K for 25 cycles		
Copper	Al. Equiv.		65% P.F.	80% P.F.	95% P.F.	65% P.F.	80% P.F.	95% P.F.	65% P.F.	80% P.F.	95% P.F.	65% P.F.	80% P.F.	95% P.F.
500 M	790 M	590	492	605	719	1069	1316	1563	1973	2423	2877	4278	5266	6253
300 M	475 M	400	448	551	655	876	1078	1280	1793	2207	2621	3505	4313	5123
400 M	630 M	500	470	579	687	983	1210	1437	1882	2317	2751	3933	4840	5748
4/0	335 M	312	402	495	588	717	882	1048	1610	1981	2352	2867	3930	4190
3/0	265 M	262	376	463	550	619	762	905	1505	1853	2200	2478	3050	3622
2/0	4/0	220	347	427	507	524	645	766	1387	1707	2026	2096	2580	3063
0	3/0	185	313	386	458	436	536	637	1255	1544	1838	1743	2145	2548
1	2/0	156	277	341	405	360	443	526	1110	1365	1722	1441	1773	2106
2	0	131	241	297	352	290	358	425	965	1187	1410	1163	1432	1700
3	1	110	204	251	298	233	287	341	816	1005	1193	932	1148	1362
4	2	92	171	210	250	187	230	274	683	840	998	747	922	1094
5	3	77	140	172	205	150	185	220	563	692	821	600	739	878
6	4	65	115	141	168	120	147	175	458	565	670	478	589	700
7	5	58	92	113	135	95	117	139	368	454	538	380	467	555
8	6	46	74	91	108	75	92	110	2.95	362	430	300	370	438

TABLES FOR CALCULATING A. C. CIRCUITS

Size Wire		Carrying Cap.	440 - 480 Volts						550 - 600 Volts					
			Constant K for 60 cycles			Constant K for 25 cycles			Constant K for 60 cycles			Constant K for 25 cycles		
Copper	Al. Equiv	Amps.	65% P.F.	80% P.F.	95% P.F.	65% P.F.	80% P.F.	95% P.F.	65% P.F.	80% P.F.	95% P.F.	65% P.F.	80% P.F.	95% P.F.
500 M	790 M	590	7876	9693	11510	17115	21065	25014	12306	15146	17985	26742	32914	39085
400 M	630 M	500	7175	9268	11010	15732	19363	22994	11767	14482	17198	24582	30255	35928
300 M	475 M	400	6440	8830	10487	14020	17255	20490	11211	13800	16386	21906	26961	32018
4/0	335 M	312	6036	7925	9435	11470	14116	16758	10061	12383	14705	17982	22058	26192
3/0	265 M	262	5550	7428	8802	9912	12198	14480	9410	11580	13753	15486	19060	22634
2/0	4/0	220	5018	6830	8110	8583	10518	12248	8670	10670	12672	13100	16122	19145
	3/0	185	4438	6176	7335	6972	8582	10187	7841	9650	11460	10895	13410	15923
1	2/0	156	3860	5462	6486	5764	7094	8421	6935	8535	10158	9006	11085	13163
2	0	131	3265	4750	5640	4654	5728	6780	6030	7420	8812	7255	8950	10628
3	1	110	3265	4018	4772	3730	4590	5450	5101	6280	7455	5828	7172	8518
4	2	92	2732	3362	3994	2995	3686	4376	4270	5254	6240	4680	5760	6840
5	3	77	2248	2766	3285	2402	2950	3512	3512	4322	5132	3753	4620	5485
6	4	65	1835	2258	2682	1915	2356	2798	2866	3528	4190	2992	3682	4372
7	5	58	1474	1813	2154	1517	1868	2218	2302	2833	3365	2372	2920	3466
8	6	46	1178	1450	1722	1200	1478	1754	1840	2265	2690	1872	2310	2742

TABLES FOR CALCULATING A. C. CIRCUITS

Size Wire		Carrying Cap.	2200 - 2400 Volts						3800 - 4000 Volts					
			Constant K for 60 cycles			Constant K for 25 cycles			Constant K for 60 cycles			Constant K for 25 cycles		
Copper	Al. Equiv.	Amps.	65% P.F.	80% P.F.	95% P.F.	65% P.F.	80% P.F.	95% P.F.	65% P.F.	80% P.F.	95% P.F.	65% P.F.	80% P.F.	95% P.F.
500 M.	790 M	590	196895	242330	287770	427885	526625	625350	545300	671254	797122	1185241	1458751	1732219
400 M	630 M	500	188270	231715	275165	393320	484085	574850	521507	641850	762207	1089496	1340915	1592334
300 M	475 M	400	179385	220785	262180	350505	431385	512275	496896	611574	726238	970898	1194936	1419000
4/0	335 M	312	160980	198125	235275	286745	352920	419090	445914	548806	651711	794283	977588	1160880
3/0	265 M	262	150560	185300	220045	247785	304965	362145	417051	513281	609524	686364	844753	1003141
2/0	4/0	220	138725	170740	202750	209585	257955	306320	384268	472950	561617	580550	714535	848506
0	3/0	185	125465	154420	183370	174325	214555	254780	347538	427743	507934	482880	594317	705740
1	2/0	156	110955	136565	162170	144105	177360	210615	307345	378285	449210	399170	491287	583403
2	0	131	96465	118730	140990	116350	143200	170055	267200	328882	390542	322289	396664	471052
3	1	110	81620	100450	119565	93245	114765	136285	226087	278246	331195	256288	317900	377509
4	2	92	68305	84070	99835	74880	92160	109440	189200	232873	276542	207417	255283	303148
5	3	77	56320	69160	82125	60050	73905	87765	156000	191573	227486	166338	204716	243109
6	4	65	45866	56450	67035	47865	58910	69955	127048	156366	185686	132586	163180	193775
7	5	58	36840	45341	53845	37943	46700	55455	102046	125595	149150	105102	129360	153610
8	6	46	29452	36248	43045	30015	36942	43869	81582	100406	119234	83141	102330	121517

write down the moments about F_1 and F_2, as follows:—

M of 100 K.W. about F_1 = 50,000
M of 50 K.W. about F_1 = 75,000

Sum about F_1 = 125,000
M of 100 K.W. about F_2 = 100,000

Sum about F_2 100,000

Now, $X_1 + X_2 = 200$ K.W.

$125{,}000 + X_1 \times 2{,}500 = 100{,}000 + X_2 \times 3{,}000$

or

$25X_1 - 30X_2 = -250$

$X_1 + X_2 = 200$

Here we have two simultaneous equations

and $25X_1 - 30X_2 = -250$

$25X_1 - 25X_2 = 5{,}000$

Subtracting, we get

$-55X_2 = -5{,}250$

$X_1 = 106.5$ K.W.
$X_2 = 93.5$ K.W.

In order to find the size of wire, take moments about F_1.

Moment of 100 K.W. about $F_1 = 500 \times 100 = 50{,}000$
Moment of 50 K.W. about $F_1 = 1{,}500 \times 50 = 75{,}000$
Moment of 106.5 K.W. about $F_1 = 2{,}500 \times 106.5 = 266{,}250$

Sum of moments about F 391,250

$$\therefore \text{Constant K} \quad \frac{391{,}250}{2 \times 2} = 97{,}815$$

which corresponds with a No. 3 copper wire, and it is therefore probable that No. 2 copper would be used. Either wire has ample current carrying capacity.

If No. 2 copper were used, the regulation at M would be as follows:—

$$\% \text{ regulation} = \frac{\text{Sum of moments}}{2 \times \text{constant for No. 2 Cu}} = \frac{391{,}250}{2 \times 118{,}730} = 1.6\%$$

Electricity and Hydraulics

PRINCIPLES AND OPERATION OF MODERN ELECTRICAL EQUIPMENT IX.

By A. M. Pere

IN the previous lesson some of the characteristics of the generator and motor field windings were given, and some indication as to how any particular type of machine would function when used as a dynamo or motor. In the generator the speed is

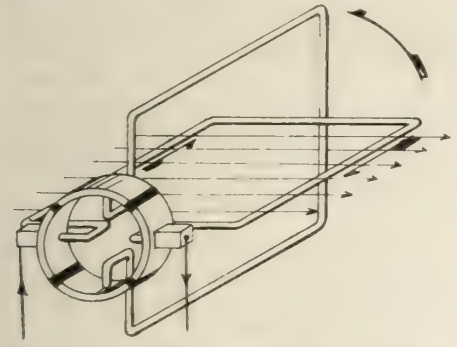


FIG. 1—ARMATURE CONSISTING OF TWO COILS. ACTING AS A MOTOR. THE ARMATURE TENDS TO REVOLVE IN THE DIRECTION INDICATED BY THE ARROW UNDER THE CONDITIONS ASSUMED FOR CURRENT AND FLUX DIRECTION.

governed by the driving agency whatever it may be, and the voltage is dependent upon the speed, other conditions remaining the same. In the motor the voltage is usually somewhat constant, and the speed depends not only upon this voltage but upon the counter-electro-motive force generated in the armature, and increases as the field flux and excitation are decreased.

In the armature of the motor or generator there is always a magnetic drag present on the conductors of the armature. In the generator as was seen in a former section of the course the armature conductors are forced to revolve in a direction opposed to this magnetic drag and energy is used up in consequence. In the motor the armature is free to revolve with the magnetic drag of the field flux on the conductors, and gives out power through this action of the magnetic flux on conductors carrying current.

This force exerted upon a conductor in a magnetic field is always present whether the current is being generated or used to produce work, and as before stated the direction of rotation in the generator is opposed to it while in the motor it is in the same sense.

The counter-electro-motive force of an electric motor, abbreviated c.e.m.f., is of considerable importance in the study of direct current motors, as the operation of the machine and its speed are dependent upon the fact that such a current is generated.

Fig. 1 shows a motor armature very much simplified, with the current flowing in the direction indicated, and the magnetic flux in the direction indicated, the armature will revolve as shown. Now suppose that the same armature be driven in the same direction as before. It will now act as a generator, but the current generated will flow in a direction opposite to that in which it was sent when the armature was used as a motor, see Fig. 2. Both these actions take place in the motor for, as the conductors are moved through the magnetic field under the influence of the current supplied, they must necessarily cut the magnetic flux and in doing so must generate potential. This potential must be opposed to that causing the current to flow through the armature from the outside source, as will be seen from the right and left hand rules here reproduced, see Figs. 3 and 4.

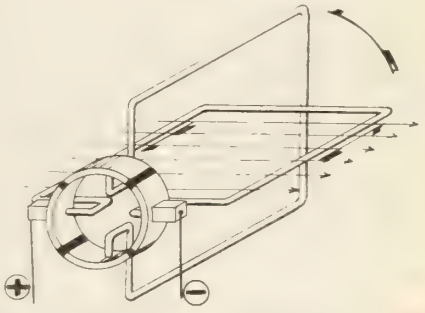


FIG. 2—ARMATURE CONSISTING OF TWO COILS. SHOWING THE DIRECTION OF CURRENT FLOW WHICH TENDS TO BE SET UP OWING TO DYNAMO ACTION, THE ROTATION BEING IN THE SAME DIRECTION AS FIG. 1

Therefore there will be two electro-motive forces at work in the armature conductors, one impressed upon the armature from the outside source causing it to rotate as a motor; the other an e.m.f. generated in the armature conductors themselves by the cutting of the lines of force, and opposed to the exterior source of potential.

$$\frac{\text{Applied voltage} - \text{Counter e.m.f.}}{\text{Armature Resistance}} = \text{Armature current}$$

Since these two e.m.f.'s are opposed the effective e.m.f. which causes the current to flow will be their difference, and the current flowing may be represented as follows:

The counter e.m.f. of a motor must always be lower than the applied voltage, for if it were equal to current would flow at all, and the armature motion depends upon the fact that we have current flowing in a magnetic field. The moment the armature of a motor begins to slow down in consequence of the load being increased, an interesting action takes place which is

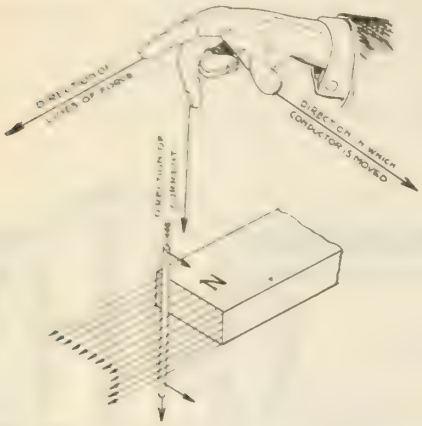


FIG. 3—FLUX CURRENT RELATIONS IN THE DYNAMO AND RIGHT HAND RULE FOR REMEMBERING SAME.

well worth while following through somewhat carefully.

The e.m.f. produced in a generator is proportional to the rate at which the armature conductors cut the magnetic flux produced by the fields. That is to say that if the flux were increased to twice the amount, the e.m.f. would be twice as great and if the speed were twice as great the e.m.f. would likewise double. If the speed were decreased while the field strength were kept constant, the e.m.f. of the generator would be decreased because the total number of lines of force cut in one-second would be less than before. It follows that the instant the armature of a motor slows down, the counter e.m.f. will be decreased so that if it were possible to have the counter e.m.f. equal to the applied voltage, the motor slowing down would cause a decrease in the counter e.m.f. until such a value were reached that sufficient current would flow to keep it revolving.

If the motor is running idle, the c.e.m.f. closely approaches the applied voltage, and only enough current flows to take care of machine losses, such as friction, etc., but the moment load is thrown on the speed drops and the c.e.m.f. in consequence is lowered until enough current flows to establish stable speed conditions.

Provided the supply voltage remains constant we would find a certain definite speed for each load, and the greater the load the lower the speed. The amount of change in speed for change in load differs greatly with various types of motors. The shunt motor suffers the least change, the series motor the most and the compound wound machine is somewhere midway between the two depending upon its field windings. The difference between the applied voltage, and the counter e.m.f. is never very great. This may be shown by means of an example. If a 10 h.p. 220 volt motor whose armature resistance is 0.2 ohm is carrying full load, it will be delivering 10 by 746 watts of electrical energy in the form of power, or 7,460 watts, 746 watts being the electrical equivalent of one horse-power. The current consumed, neglecting machine losses, would be 7,460 ÷ 220, which equals 34 amperes, nearly. Since we have a current of 34 amperes flowing through a resistance of 0.2 ohm there will be a voltage drop of 3.4 by 0.2 = 6.8 volts, and the counter e.m.f. must make up the difference between this and the terminal voltage of 220, or the c.e.m.f. is 220 — 6 8 = 213.2 volts.

Suppose the c.e.m.f. were only 100 volts, the voltage then causing current flow would be 220—100=120 volts, which would cause a current of 120÷ 0.2=600 amperes.

Characteristics of The Shunt Motor

When the shunt motor is operated on constant voltage and constant resistance in the field circuit, its speed will usually decrease with an increase in load or armature current. The torque of a shunt motor increases with an increase in armature current, and would vary directly as the armature current if the field strength of the machine remained constant.

The speed of the series motor decreases rapidly with increasing load, and at no load the motor runs away. This is explained by means of the series connection of the fields. As the current due to the load falls off with decreasing load, the field strength is proportionately weakened and in consequence the counter e.m.f. is lowered.

Speed Regulation

With the shunt, or compound motor, the shunt field offers a very convenient

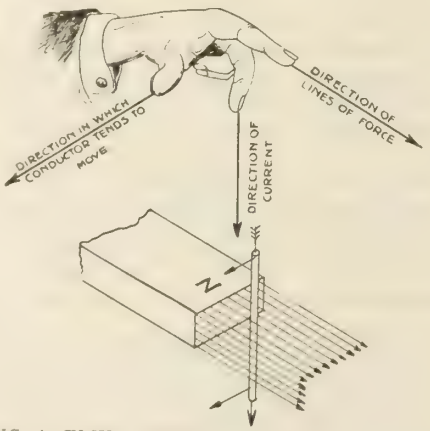


FIG. 4—FLUX CURRENT RELATIONS IN THE MOTOR AND LEFT HAND RULE FOR REMEMBERING SAME.

method of varying the speed of the machine through the adjustment of the field strength by means of a rheostat. When the field current is reduced by means of the rheostat, the counter e.m.f. falls off, and in consequence a larger current flows through the armature. This in turn increases the speed to a point where the counter e.m.f. reaches a value at which the speed is steady. When the field is strengthened, as when the rheostat is cut out, the counter e.m.f. grows larger, cuts down the armature current in consequence and lowers the speed.

Fuel Oil and Its Uses, recently published by Tate-Jones & Co., Inc., Pittsburg, contains information of value to the power plant engineer and those who use fuel oil in furnace work or other industrial processes. A glossary of oil terms is included and the composition and differences of the various oils is explained. Crude oils fall under two classifications, the oils with a paraffin base and those with an asphaltum base. The relation between the specific gravity and the Beaumé reading of oils is clearly set forth and formulae given to change from one to the other. The use of tar as a fuel is treated of at some length and methods for its proper use given. A table gives comparative values of different fuels for equal heat units and a companion table gives the calorific values of various oils according to their specific gravity. Installations for the burning of oil are described, the storage of crude oil, its heating when necessary, oil feeding, piping layouts and burners being some of the points touched upon.

In a pamphlet entitled "Centrifugal Boiler Feed Pumps," the De Laval Steam Turbine Co., Trenton, N.J., describes the De Laval combined steam turbine and centrifugal boiler feed pump. Centrifugal pumps have been used for feeding high-pressure steam boilers for a number of years, but the machine here described differs from those previously used in that the steam turbine rotor and the pump propellers are mounted upon one shaft, with only two bearings and are enclosed within one housing. The combined turbine pump casing is split horizontally, and by lifting the cover all internal and working parts are exposed. The steam and water connections are in the lower part of the casing and are thus not disturbed when the pump is opened. The turbine is of the velocity-stage type, and the pump contains either two or three impellers, according to the boiler pressure.

One of the most remarkable features is the extremely small size and weight of this type of pump. A pump for 3,000 boiler horse-power occupies a floor space of only two by three feet, as against about eight times that space for an ordinary duplex pump. Turbine-driven centrifugal pumps in one housing are made in capacities from 2,000 to 10,000 boiler horse-power. For larger units up to 60,000 horse-power the pump and turbine are built separately, but mounted upon a common base plate. The pamphlet also describes electric motor-driven units.

Turbo-Alternator Rotors: Features of Mechanical Design--II.

A Review of the Conditions Underlying the Mechanical Design of the High-Speed Alternator Rotor—Suggested Specifications For Guidance in Purchasing Equipment

By S. F. BARCLAY, Ph.D., B.Sc.

HEAT TREATMENT

THE rate at which steel cools has a profound effect on its structure and physical properties. The effect of rapidly cooling steel is much debated by metallurgists, and there is no general agreement as to the precise effect.

It has been established that steel has the characteristic of allotropy and its properties vary according to the allotropic form in which it exists. As with most substances, allotropy in steel is a function of temperature with normal

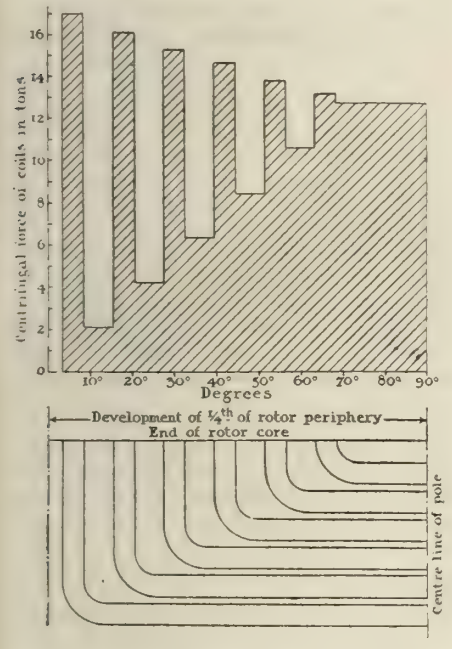


FIG. 11—SHOWING VARIATION IN THE CENTRIFUGAL FORCE OF THE ROTOR COILS IN THE CIRCUMFERENTIAL DIRECTION OF A 5,000 KW., 3,000 REV. PER MIN. ALTERNATOR WITH 31 IN. DIA. ROTOR (CALCULATED AT 20 PER CENT. ABOVE NORMAL SPEED).

cooling as is shown by the recalescence points in the time-temperature curve.

The change, however, from one allotropic form to another requires time, and rapid cooling as is brought about by quenching in oil or water considerably influences the degree of the change. Under a tensile test the performance of steel is apparently little affected by the crystal size, but the resistance to shock and the capacity to withstand reversals of stress are directly influenced. The greater the temperature to which steel is heated the longer it is maintained at high temperature, and the more slowly it is cooled the greater is the crystal size and the less dependable is the steel. A medium carbon steel of the kind suggested for the rotor has its yield point increased about 30 per cent. by oil hardening. It is seen, therefore, that the correct oil treatment of steel very considerably improves its tensile strength, and also puts the steel generally into better condition and makes it more reliable. For these reasons it is very desirable that all alternator rotor forgings should be oil treated The approximate treatment of the steel in question would be to immerse in oil at about 800° C. and temper at about 550° C., the treatment varying according to the carbon content. The heat treatment should be carried out after the forging has been rough turned. Some distortion of the forging is unavoidable in the oven, and the rough-turned dimensions should be somewhat greater than the finished sizes. In an average case the allowance on the diameter should not be less than 0.25 inch.

Rotor End-Bells

As already indicated, the most highly stressed part of the rotor is in the end-bells retaining the rotor end-windings, and the design of the bells, therefore, requires the most careful attention. In the case of a 5,000-k.w. alternator at 3,000 r.p.m. with a 31-in. diameter rotor, at the overspeed of 20 per cent. above normal the centrifugal force exerted by the windings at each end of the core is about 820 tons. If to this is added the centrifugal force of the bell itself, the total centrifugal force at each end is about 2,000 tons. For such enormous forces it is obvious that the material employed must be very high grade.

In the earlier days of the turbo-alternator, steel binding wire was frequently used. The material itself is satisfactory, since it is reliable and has very great strength—an ultimate strength of over 100 tons per square inch being usual, with the yield point not much lower. Two great disadvantages of using binding wire are the difficulty of maintaining a good balance and the necessity for completely re-winding the band if the rotor windings have to be examined. For these and other reasons wire banding is not used on modern turbo-alternators.

In considering the choice of material for the end-bells the designer naturally has preference for non-magnetic material. With the end-bell registering on the rotor core, if it is magnetic it offers a direct leakage path of considerable area from pole to pole, and has an appreciable effect in reducing the useful rotor flux. The leakage has a constant value with a given diameter and excitation, and the percentage value is therefore less the longer the rotor. In the case of an average 5,000-kw. 3,000 r.p.m. alternator at full load the leakage is of the order of 10 per cent. of the excitation energy. Before steel bells were tried it was thought that there might be heating in them due to leakage flux from the stator, but experience shows that such is not the case, the reason being that any such flux rotates synchronously with the bell. It was thought also that for solid bells of any material such as a large mass of metal close to the end of the stator core might cause undue heating due to eddy currents induced by the action of the flux swinging from tooth to tooth. Such, however, is found not to be the case, or if there is

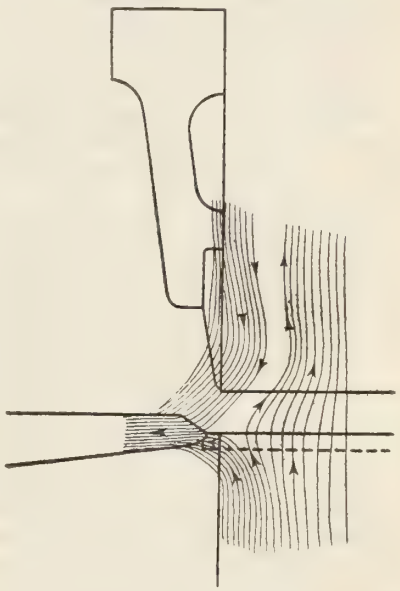


FIG. 12—STATOR LEAKAGE INTO STEEL END-BELL ON SHORT-CIRCUIT.

any such action it is not important in degree.

The magnetic end-bells appear to have one rather remarkable effect in causing great heating in some cases at the ends of the stator core when running on short-circuit. In one case that came to the author's notice of a 5,000-kw. 1,500 r.p.m. alternator with steel end-bells, when running on short-circuit the stator end-plates and the laminations in the immediate neighborhood became very hot; embedded thermocouples placed about 2 inches from the end of the core showed a rise of 150 degrees F. Thermometers placed against the back of the core also showed a high temperature rise in the immediate vicinity of the end-plates and a low temperature elsewhere. On full load the end-plates were quite cool, and the temperatures shown by the thermometers and thermo-couples were quite normal. In two cases of 5,000-kw. alternators at 3,000 r.p.m. there was similar heating at the ends of the stator

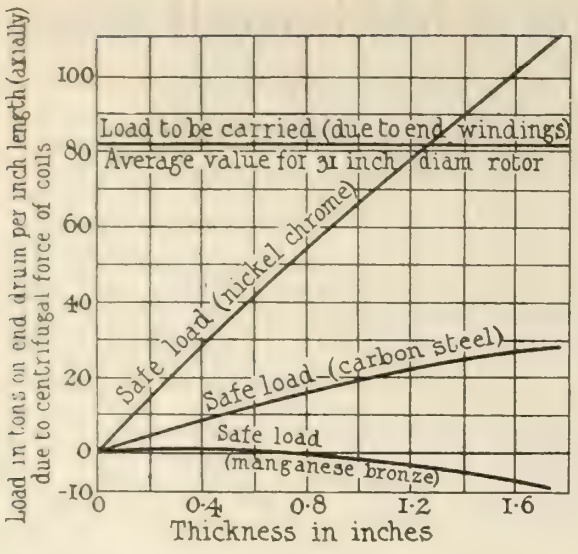


FIG. 13—5,000 KW., 3,000 R.P.M. ALTERNATOR. (CALCULATIONS MADE AT 20 PER CENT. ABOVE NORMAL SPEED).

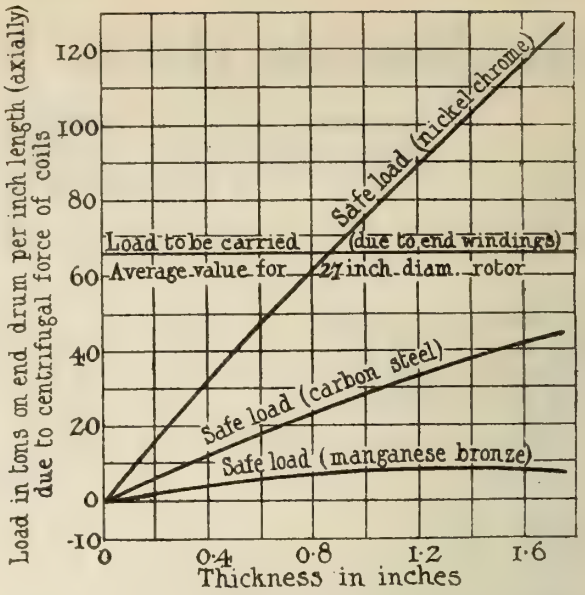


FIG. 14—3,000 KW., 3,000 R.P.M. ALTERNATOR. (CALCULATIONS MADE AT 20 PER CENT. ABOVE NORMAL SPEED).

core in a still more marked degree. Embedded thermo-couples placed ½ inch from the end of the core showed a rise of 250 degrees F. after an hour's run on short-circuit. The temperature rise of the cast-iron end-plates was about 120 degrees F., showing that the greatest heating was in the laminations themselves.

The author suggests that this phenomenon is probably due to the steel end-bells. When a short-circuit test is made with an alternator the excitation is increased until the current reaches its full-load value. The stator current lags almost 90°, and the reaction is in phase with the rotor flux and in opposition to it. Most of the rotor excitation is required to overcome the stator reaction. The leakage into the end-bells weakens the rotor magnetism at the ends of the core, and quite conceivably the stator reaction may overcome it and there may be an appreciable flow of reverse flux between the ends of the stator and the end-bells. The reaction between these fluxes flowing in different directions at the ends of the stator core may quite well cause some of the reverse flux to flow obliquely through the plates and so cause heavy eddy-current loss. Probably also there is a small leakage of flux into the stator end-plates. The effect is indicated roughly in Fig. 12. Since the effect, whatever the explanation may be, does not occur under any running condition, it is of little importance. It may, however, quite upset the method some makers have of forecasting the temperature rise on load from light-load tests—with which one factor is the temperature rise on short-circuit. Moreover, it may cause the designer to attribute to eddy-current loss in the copper a loss that is due to something else altogether.

Of the non-ferrous metals available for making end-bells the best is a high-grade manganese-bronze. Good material of this kind has an ultimate strength of about 44 tons per square inch, a yield point of 22 tons per square inch, and an elongation of 20 per cent. The real elastic limit of the material as shown by its behaviour under reversals of stress is lower with regard to the yield point than with a good steel. For this reason the author is of opinion that the maximum stress should not exceed 45 per cent. of the yield point. In Figs. 13, 14, 15, 16 and 17 are shown the average load per axial linear inch that the end-bell has to carry due to the centrifugal force of the end coils for rotors for 3,000 r.p.m. of 31-in., 27-in., 25-in., 22-in. and 20-in. diameter respectively, calculated at the overspeed of 20 per cent. above normal. The bottom curve in each case shows for various

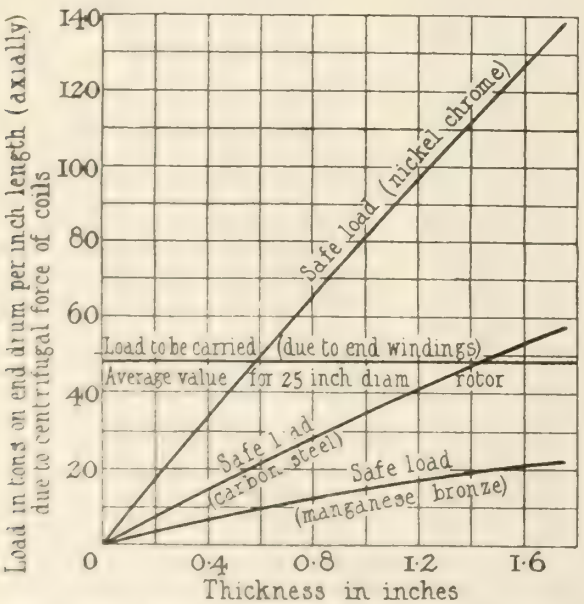


FIG. 15—2,000 KW., 3,000 R.P.M. ALTERNATOR. (CALCULATIONS MADE AT 20 PER CENT. ABOVE NORMAL SPEED).

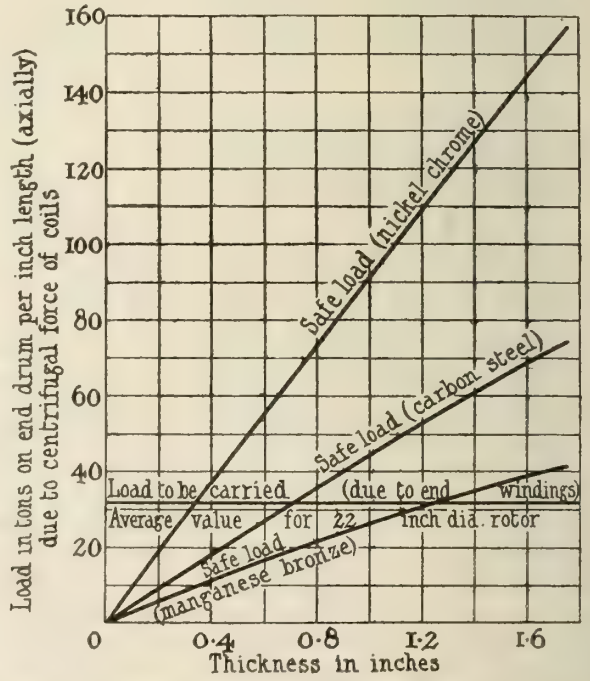


FIG. 16—1,500 KW., 3,000 R.P.M. ALTERNATOR. (CALCULATIONS MADE AT 20 PER CENT. ABOVE NORMAL SPEED).

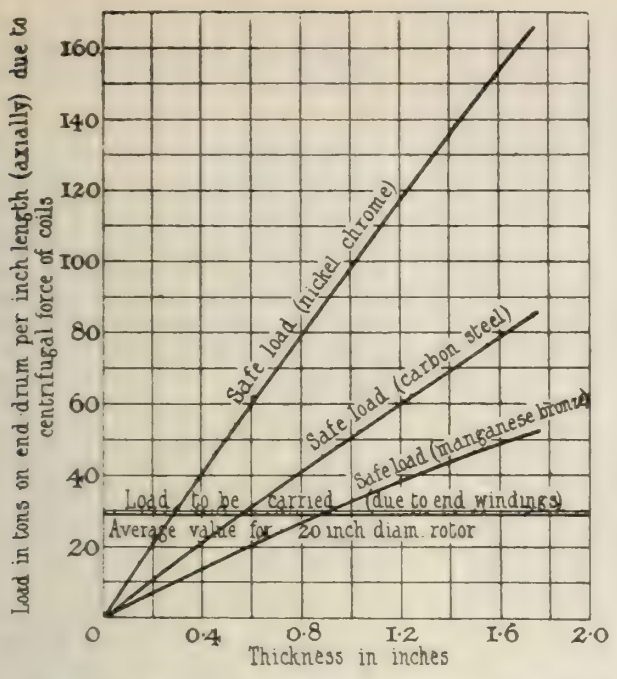


FIG. 17—750 KW., 3,000 R.P.M. ALTERNATOR. (CALCULATIONS MADE AT 20 PER CENT. ABOVE NORMAL SPEED).

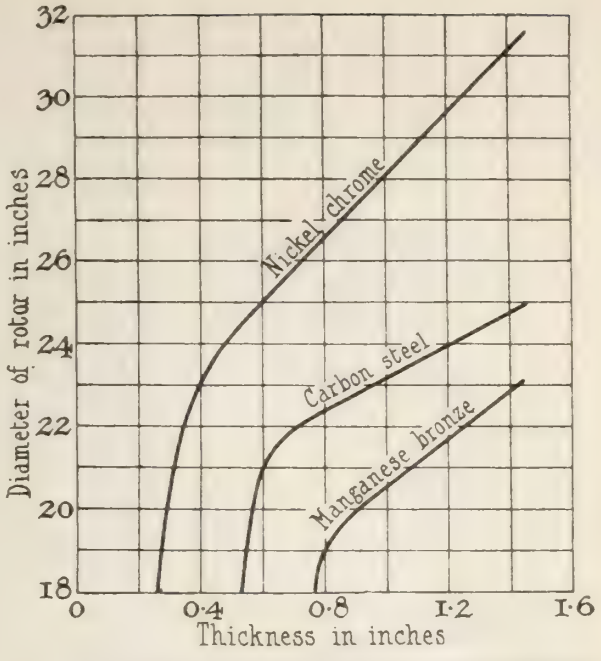


FIG. 18—MINIMUM THICKNESS OF END DRUM REQUIRED FOR DIFFERENT DIAMETERS OF 3,000 R.P.M. ROTORS. (CALCULATED AT 20 PER CENT. OVER SPEED).

thicknesses the load that the manganese-bronze can carry in addition to itself with a stress equal to about 45 per cent. of the yield point—i.e., 10 tons per square inch. With a 31-in. diameter rotor it will be seen that the manganese-bronze can only just carry itself when its thickness is varied from 0 up to about 0.7 inch. If the thickness is further increased the stress is increased and exceeds the safe value for the material. With the 27-in. diameter rotor the manganese-bronze has a maximum load-carrying value when the thickness is about 1.5 inch, but it can then carry only about 8.5 tons per linear inch out of about 66 tons that have to be carried. With the 25-in. diameter rotor with a bell thickness of 1.7 inch the bronze can carry only about 22 tons per inch against 48 tons to be carried. For the 22-in. diameter rotor the bronze bell is satisfactory if it is given a thickness of 1.25 inch, and for a rotor of 20-in. diameter it is satisfactory when 0.9 inch thick. These diagrams thus show clearly the extent to which the material may be used—i.e., that it is satisfactory for 3,000 r.p.m. rotors up to about 22-in. diameter.

Figs. 15, 16 and 17 show that oil-treated carbon steel can be used satisfactorily for the end-bells of rotors up to about 25-in. diameter at 3,000 r.p.m., but not for any larger diameters. The curves for the carbon and for the nickel-chrome steel are based on working at 50 per cent. of the yield point of the material, the carbon steel having a yield point of 22 tons per square inch and the nickel-chrome steel 40 tons per square inch. Even for the smaller diameters, however, there are advantages in favor of using nickel-chrome steel. For instance, for the 25-in. diameter rotor (Fig. 15) it will be seen that a thickness of 1.43 inch is necessary for carbon steel, whereas with the nickel-chrome steel 0.6 inch would be sufficient. The magnetic

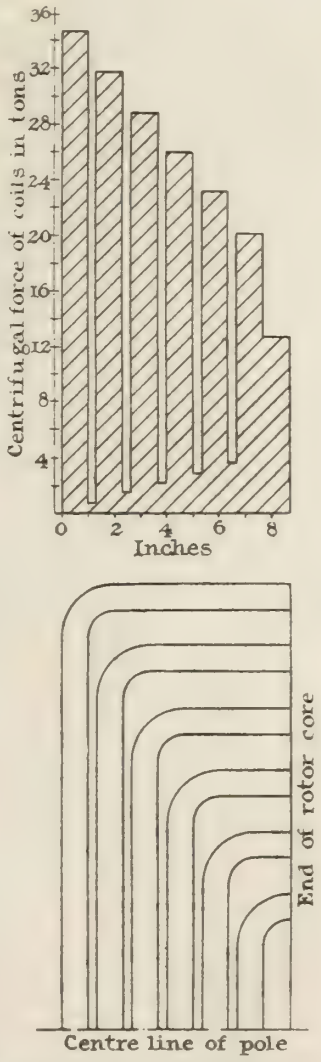


FIG. 19—SHOWING THE VARIATION IN CENTRIFUGAL FORCE OF THE ROTOR COILS IN THE AXIAL DIRECTION OF A 5,000 K.W., 3,000 R.P.M. ALTERNATOR, WITH A 31-IN. DIAM. ROTOR. (CALCULATED AT 20 PER CENT. ABOVE NORMAL SPEED.

leakage with the nickel-chrome steel would be much less and the flow of the ventilating air into the air gap would be less restricted. For rotors more than 25 inches in diameter nickel-chrome steel should always be used. Nickel-chrome steel containing about 3.5 per cent. nickel, 0.5 per cent. chromium, and 0.25 per cent. carbon has an ultimate strength of about 50 tons per square inch, a yield point of 40 tons, and an elongation of 18 per cent. on a 2-in. test-piece, and a reduction of area of 50 per cent.

Of the non-magnetic steels 25 per cent. nickel is the only kind of which the use has been suggested for end-bells. This material, having the approximate composition of 25 per cent. nickel, 4 per cent. chromium, and 0.36 per cent. carbon, has the ultimate strength of about 42 tons per square inch and an elongation of 40 per cent. on 4 inches. The observed yield point is about 25 tons per square inch, but the real elastic limit is very low. With a careful test the extensometer shows a slight permanent set with a loading as low as 15 tons per square inch, and of course the real elastic limit must be at a still lower stress. The steel is not difficult to machine and can be drawn satisfactorily into wire. It is difficult to forge, however, there being a marked tendency for the red-hot billet to crack under the hammer. It is annealed by quenching in water at about 1,450° F. The steel is not magnetic, for the reason that at ordinary temperatures it exists in the same allotropic form as does iron heated above its highest recalescence point—i.e., about 900° C. If the non-magnetic steel is immersed in liquid air it is changed into the same allotropic form as is iron cooled below about 760° C., and it becomes magnetic. 25 per cent. nickel steel is quite unsuitable for high duty, and manganese-bronze, with its higher yield point and more reliable qualities, should always be used in preference.

Hadfield's manganese steel is quite unsuitable for end-bells, having a very low yield point and having the remarkable quality that, although really soft, deformation makes it extraordinarily hard and it cannot be machined. Another non-magnetic steel also unsuitable is that due to Carpenter, Hadfield,

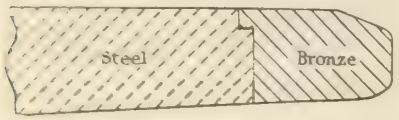


FIG. 20 COMPOSITE END BELL FOR HIGH SPEED ROTOR.

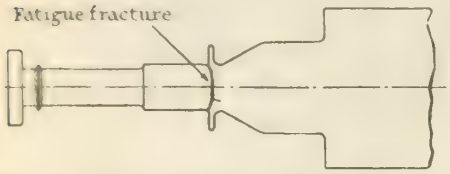


FIG. 21—SOLID FORGED ROTOR WITH DEFECTIVE SHAFT DESIGN.

and Longmuir, containing 19.91 per cent. nickel, 0.41 per cent. carbon, and 0.96 per cent. manganese.

Magnetization appears to be due to the arrangement of the atoms in the molecule, or of the molecules themselves, and is not a property peculiar to the atoms of those elements that are magnetic. There is the effective proof furnished by Heusler* that an alloy containing only non-magnetic elements may be magnetic. He produced such an alloy composed of 60 per cent. copper, 26 per cent. manganese, and 14 per cent. aluminum, all of which elements are non-magnetic. On the other hand, alloys containing a large percentage of iron may be non-magnetic—such as 25 per cent. nickel having about 70 per cent. of iron, and Hadfield's Austenitic manganese steel containing about 88 per cent. of iron. Heusler's magnetic alloy undergoes allotropic change when quenched at 400° C. and becomes magnetic.* Hadfield's manganese steel undergoes allotropic change when it is deformed and becomes magnetic.** The non-magnetic steel of Carpenter, Hadfield and Longmuir behaves similarly.†

Whereas with carbon steel oil treatment is desirable, with nickel-chrome it is indispensable. As with the rotor, the end-bell forgings should be rough-turned and then be heat treated.

As an alternative to the magnetic and non-magnetic end-bells, there may be considered the question of a composite end-bell. The centrifugal force of the coils varies in the axial direction, being least at the core end and a maximum at the other end. In Fig. 19 is given a curve showing this variation in the case of a 26-in. diameter rotor for 3,000 r.p.m. with six concentric rotor coils. It will be seen that the load on the end-bell is appreciably lower near the stator than the average value. For a 25-in. diameter rotor, for which a manganese-bronze bell could not be used, it would be permissible to employ a composite bell of steel with a relatively narrow band of manganese-bronze next to the core. Such a bell is shown in Fig. 20. The saving in magnetization loss with such a construction as compared with the all-steel bell may be of the order of 50 per cent. The author's view is that the all-steel nickel-chrome end-bell represents the preferable construction, and that the composite bell should be employed only in exceptional circumstances. With the composite bell it is important to remember that the elasticity of manganese-bronze is about 20,000,000 lb. (inch units) against 29,500,000 lb. for steel; that is to say, for a given stress the manganese-bronze stretches (elastically) 47½ per cent. more than steel. It is important for this reason that the manganese-bronze ring should be registered on the steel ring, and not under it, so that it is free to open. If the bronze were registered under the steel, the projecting lip would prevent the bronze opening sufficiently (elastically) to carry its share of the load, and the lip might be overstressed. The correct construction is shown in Fig. 20. The author has heard of failures due to this obvious precaution not being taken.

The usual design of end-bell is a cylinder registering on the rotor core at one end and on a disc shrunk on to the shaft at the other. In the case of a 5,000 kw. 3,000 r.p.m. alternator the cylinder opens about 0.03 inch in diameter. It is not possible to give the cylinder sufficient initial tension by press fit to prevent it opening in this way. The tendency of the coil loading (see Fig. 11) is to make the cylinder become elliptical, but since there is nothing to centre it definitely it may move bodily out of centre by the amount it opens radially. The vibration with some alternators that cannot be corrected completely is probably due to this cause in some cases. The author is very strongly in favor of making the cylinder and the end disc down to the shaft in a single piece as shown in Fig. 23; the bell is thus definitely centred and eccentricity is prevented. An additional advantage of this design is that it is not necessary to register the bell on the rotor core and an appreciable gap can be provided between the core and the bell, so reducing the magnetic leakage. The short length of coil between the core and the bell is supported by extending the slot wedge and by registering the end of the wedge under the bell. Another advantage that may be obtained with this construction is to make the seating on the shaft larger in diameter than the slip-rings, so that the end-bells may be removed for examination or repair of the windings without interfering with the slip-rings or the connections to them. The construction also has the advantage of very considerably strengthening the cylinder at the end where it is most heavily loaded. In Fig. 18 is shown the average thickness of end-bell required for rotors of various diameters for manganese-bronze, carbon steel, and nickel-chrome steel.

Ventilation

The various systems of ventilation that have been tried at various times have now settled down roughly to two distinct types—axial and radial. The advantages of the axial systems are that the omission of the radial ducts shortens the machine and that the rotor may be separately and positively ventilated. The disadvantage of this system is that there is an appreciable difference of temperature between the two ends of the machine. The temperature difference may be reduced somewhat by arranging the flow of air through the rotor and stator in opposite directions. With the radial system the temperature rise can be eptk almost uniform from end to end, but there are the disadvantages that the most useful material is removed from the rotor in forming the radial ducts and that the rotor ventilation is not positive. The flow of air through the rotor is induced only by the natural fanning effect of the radial ducts, and the flow is opposed by the pressure in the gap set up by the fans. With large machines the air velocity through the stator has to be made high for the necessary volume of air to flow, and pressure equal to 6 inches or 7 inches of water has to be set up by the fans. At the ends of the rotor such a pressure quite overcomes the rotor fanning effect, and the discharge from the rotor ducts must be prevented if not actually reversed. It is probably only towards the centre of the core, where the air-gap pressure is reduced,

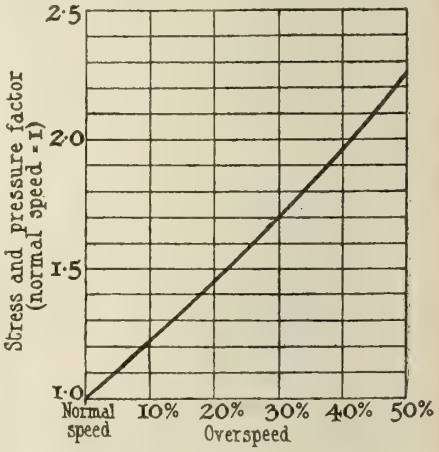


FIG. 22

that there is any appreciable flow of air from the rotor.

The author considers the ideal system to be to have radial ventilation for the stator with independent axial ventilation for the rotor as shown in Fig. 23. The air for the rotor and stator is kept quite separate and the volume and temperature rise of it can be separately measured. By varying the rotor fan the volume of air flowing through the rotor can be regulated to give the exact volume required. The omission of the rotor axial ducts gives the designer liberty to work to the tooth density he prefers rather

* "Über die ferromagnetischen en Eigenschaften von Legierungen Unmagnetischer Metalle," Marburg, 1901.

*Proceedings of the Royal Society, vol. 77A, p. 256; see also vol. 76A, p. 271.

†Journal of the Iron and Steel Institute, vol. 69, p. 132.

‡Eleventh Report of the Alloys Research Committee, Institution of Mechanical Engineers, 1905, p. 949.

than that to which he may be forced. There must be some difference of temperature between the two ends of the rotor, but the volume of air can be made sufficient to keep the hotter end within the desired limit. By suitably disposing the stator ducts the temperature throughout can be kept substantially uniform. In addition, when necessary, axial ducts may be arranged in the stator and the discharge from these into the various radial ducts may be separately varied to further equalize the temperature rise. The omission of the radial ducts reduces somewhat the noise of the alternator and also the windage loss.

Fans.—It is quite usual to see with an otherwise well-designed rotor, fans that are anything but robust in construction. Sheet steel about 1-16 inch thick for the blades and about ⅛ inch thick or less for the runners is frequently employed, and apparently that the fans will be satisfactory is taken for granted and is not verified by calculation. Several cases have come to the author's notice of such fans collapsing and striking the stator end-windings with complete breakdown of the alternator. For silent running the more blades the better, but on the other hand the more blades the greater is the load on the runners. It is unnecessary to postulate that safety must come first, and the permissible number of blades must be determined by the maximum thickness that it is desirable to employ for the runners. By running alternators with and without the fans the author has determined the effect they have on the noise. The difference, though appreciable, is not great. The blades should be given such a thickness that collapse is impossible. For the smaller sizes oil-hardened boiler plate is satisfactory for the blades and runners, but for the larger sizes oil-treated nickel-chrome steel plates should be used.

The loss due to the fans in large high-speed machines is of the order of 20 per cent. of the total windage. It is important that the efficiency should be kept as high as possible, since the loss not only affects the alternator efficiency but also adds to the heating. The entering angle of the blades should be the same as the direction of the flow of air into the fan, so that there is no shock. The leaving angle affects the pressure and the direction of the air more than the efficiency. It is usual to make the blade quite straight, but the pressure is increased if the blade is curved in the direction of rotation. The blades and runners should be given a good smooth finish and be coated with a thin hard varnish. With such fans, on account of the big peripheral speed as compared with the air velocity through the fan, the direction of the air leaving the fan is almost tangential. The air, therefore, does not flow axially from the fan to the gap, but is carried round with a high velocity. This action causes some churning and loss, but on the other hand the stator end connections are well cooled. Probably the resistance to entering the air gap is reduced by the motion, since the air in the gap is being carried round violently by the rotor, but if there are stator axial ducts the flow into them may be less easy.

The author has tried the effect of providing a row of standing blades over the fans to make the air flow purely radially into the end chamber. The air pressure was increased about 15 per cent.; the volume of air flowing through the machine was increased correspondingly, and it was therefore decided that there was no gain or detriment in preventing the circular movement of the air in the end chambers.

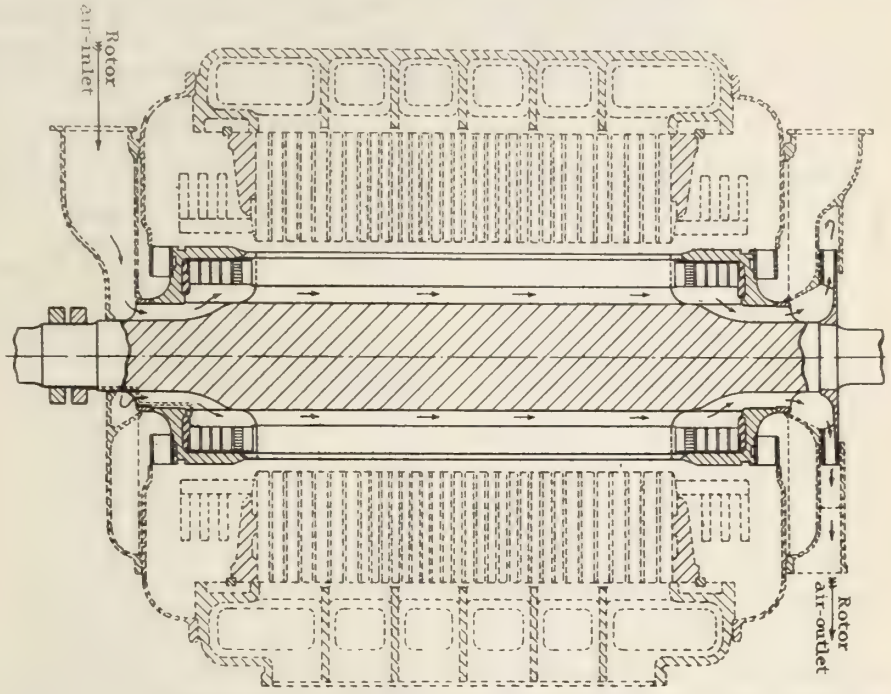


FIG 23—TURBO ALTERNATOR WITH AUXILIARY VENTILATED ROTOR AND RADIALLY VENTED STATOR.

Noise.—With very high peripheral speeds more noise must be expected than with the lower speeds of a few years ago. A good deal of the noise from an alternator is transmitted through the air leaving it, and the station can be made much quieter if the discharge air is led away through a duct. With a new station there is little difficulty in accommodating the discharge duct in the foundation, and for large high-speed sets it is very desirable to adopt this arrangement.

Balance

Freedom from vibration is an essential mechanical requirement apart from being desirable for more obvious reasons. With marked vibration, wear of rubbing parts may take place at an extraordinary rate and the soundest construction be weakened in the course of time. A press fit that would be perfectly solid in normal circumstances may become free in the presence of vibration, and relative movement of the parts may take place. Movement of the end windings is more probable, and the insulation under great pressure is very likely to suffer wear. Every component part should be so designed that change of balance is safeguarded against. It is desirable that the degree of balancing should not be left to the judgment of the erecting engineer, but should be put on a positive basis by using a vibration indicator. The grooves for the balance weights should be provided in the disc supporting the bell cylinder; the practice of attaching balance weights to the outer fan runners is most unsound. Much time is saved in balancing, and the final result is often better if the rotor is balanced statically before running. Although the correct division of the balance weights between the two ends of the rotor cannot be determined statically, the total weight required is determined and adjustment of it only is required when making the running balance. The sensitiveness of the knife edges is much increased by resting the shaft on ball or roller races.

Overspeed Test

The stresses and pressures for a given rotor increase with the square of the speed. The increase of stress and pressure factors at overspeeds are shown in Fig. 22 based on unity at the normal speed. For proving mechanical soundness the overspeed test fails because it is fatigue failure that is most to be feared, and an increase of speed does not prove capacity to withstand fatigue. The overspeed does directly test the soundness of the rotor teeth and of the end-bells, but even its value in this way is limited because in the event of there being a flaw, due to the ductile quality of the steel, it is more probable that failure will result after prolonged running than at the moment. A great disadvantage is that the overspeed imposes an undue stress on the insulation that is harmful. The turbine emergency governor should be set to operate at 10 per cent. overspeed, and since some allowance to make sure of the governor operating is necessary it is desirable that the set should be capable of standing an overspeed of 20 per cent. At this overspeed the pressure and the centrifugal force are 44 per

Notes on Lignite, Its Characteristics and Utilization

A Summary of Present Information on the Composition and Utilization of Lignite is Being Prepared by the U.S. Bureau of Mines—The Following is an Extensive Abstract of the Paper and Should be Read in Conjunction With the Bureau of Mines Bulletin No. 89, and the Report of the Carbonizing and Briquetting of Lignite Published by the Government of Saskatchewan

By S. M. DARLING

CLASSIFICATION OF COALS

THIS classification rests partly on the percentages of volatile matter, oxygen and moisture contained in the coals. There is, speaking generally, a progressive loss of these elements in passing from lignite to anthracite, but chemical criteria alone are not a sufficient basis for such classification. The dividing line is really determined by physical characteristics that directly affect the market value of the coals.

Although subbituminous coals generally have more moisture than bituminous coals, there are so many exceptions to this rule that it has little value as a means of distinction. But there is a very marked difference in behaviour on weathering. The subbituminous coals, on exposure, give up their moisture more readily; as a result they shrink, crack irregularly, and in a measure disintegrate, whereas the bituminous coals shrink very little and show practically no disintegration on drying.

Again, between subbituminous coal and lignite there is no clearly defined chemical difference, but the physical difference is marked. The subbituminous coal is black and shiny, has little trace of woody structure, carries less moisture, and has a greater heating value than lignite, and is capable of producing a coke of fairly good quality. Lignite, on the other hand, is brown, dull, markedly woody in texture, has no coking quality whatever, carries a greater percentage of moisture which it gives up readily, and its disintegration on exposure is so rapid as largely to prevent its shipment any distance, except during the excessive cold northern winters, when it is of course frozen.

The coal resources of the United States totals 3,553,637,100,000 minable tons. Of this total 1,051,290,000,000 tons, or nearly one-third, is lignite. Of this lignite 964,424,000,000 tons are in North and South Dakota and northeastern Montana; in Texas approximately 23,000,000,000 tons; in Alaska, 7,404,300,000 tons; and relatively smaller quantities in several of the other western and southern states (U. S. Geological Survey, Professional Paper 100).

The lignite tonnage given above includes only group 3; it does not include group 2, subbituminous coal, which in earlier days was called "black lignite" and classed in the lowest rank among coals—lignite.

Characteristics of Lignite

It is an important economic consideration that these lignites are found in those parts of the country that have no other solid fuel. They compare substantially as follows:

Average Proximate Analyses of Lignite

	Arkansas	Texas	North Dakota
Moisture	29.73	28.63	27.13
Volatile hydrocarbons	37.87	32.53	29.11
Fixed carbon	23.95	30.43	36.16
Ash	9.45	8.41	7.60

The Alaska lignite closely resembles that of Texas and North Dakota.

The sulphur content of the lignite in these fields rarely exceeds one per cent. The average heating value is about 7,500 British thermal units per pound.

The feature that distinguishes the Arkansas lignite from the others is the high percentage of volatile matter, which yields large quantities of oils and tars.

The large percentage of moisture in lignite has not been absorbed from extraneous sources, but is the portion, partly chemically combined, remaining from the great amount of water present in the peat from which the lignite was derived. This water is poor stuff to pay freight on or put into a furnace; further, its partial evaporation in warm weather causes rapid disintegration or "slacking," reducing the practical shipping radius during warm weather almost to zero. Lignite fires quickly from spontaneous combustion, making safe storage in even small quantities exceedingly difficult. It does not "coke" in the sense that bituminous coal cokes, but rather crumbles when being carbonized, or when thrown on to the fire, and this gives rise to difficulties in firing and substantial loss, as unburned fuel, through the grate bars.

Fuel Needs of Lignite Areas

For these reasons lignite is not a desirable fuel as mined, and millions of tons of bituminous and anthracite coals are shipped annually into the lignite-bearing regions—literally "carrying coals to Newcastle,"—resulting in high prices for both industrial and domestic fuel, imposing a great handicap on the industrial development of these regions, tying up much transportation equipment now urgently needed for other service, and causing other economic lost motion.

Wastes in Present Methods of Burning Coal

The practice of burning high volatile coals on ordinary furnace grates is wasteful.

Our leading engineers and chemists have for many years decried the waste of burning raw bituminous coal. They have time and again shown that it is far more economical to break the coal up by means of carbonization into its constituent elements of solid carbon, gas, ammonia, oils and tars, thus releasing these several valuable products for use in their respective fields.

The fixed carbon is easy to burn because it stays on the grate. The tars and the more complex gases distilled and rising from the fuel bed are quickly decomposed into soot and simple gases, and the soot in large measure passes out of the stack as black smoke, adding the element of nuisance to that of waste. Heat in the form of coal gas brings eight to sixteen times the price of an equivalent amount of heat in the form of coal. Benzol, toluol, and other oils are obtained as a result of this process of carbonization, and the value of heat in this form of motor fuel is twenty to thirty times as great as that of heat in the form of coal. (U. S. Bureau of Mines Bulletin 135.)

Further, the cheapest method of obtaining nitrogen products for explosives or fertilizers is to procure them from the ammoniacal liquor and gas resulting from the carbonization of coal or its gasification in by-product gas producers.

It is undeniable that in the future the principal use of high volatile coals will be in the by-product gas plants because of the higher commercial value of the products of carbonization. It is even suggested that "the time may come when our views of the relative values of the different coals will change and we shall consider anthracite as of minor importance as compared with the high volatile bituminous coals." (U. S. Bureau of Mines Bulletin 135.)

In Bulletin 102, part 4, of the Smithsonian Institution, there appears the following suggestion:

"It is not beyond the bounds of reason to foresee a condition whereby a householder, in the place of his ton of anthracite which he now welcomes for $11, will receive a ton of smokeless coal without slate, a month's supply of cooking gas, 40 miles of motor fuel, enough fertilizer to start a small garden, and tar sufficient to allay the dust in front of his house—all for far less money than he now pays for inferior coal."

This picture is not a fanciful one; our high volatile coals and lignites contain precisely these possibilities within themselves.

The German government, in order to

assure high economy in the utilization of fuel, has practically forbidden the burning of raw coal, compelling the manufacture of coke, gas, tar and other products.

Because of the inherent shortcomings as fuel in the raw lignite itself, one can safely say that it will never be used to any great extent in its raw state. The one fact of its containing 30 per cent. of water would of itself prevent use elsewhere than in the immediate vicinity of the mine. This treatment, or carbonization, of the lignite, therefore, which is absolutely essential to its more general use, is strictly in accordance with modern scientific research. We are simply, from necessity, starting to do with lignite now what will eventually be done with all of our high volatile coals.

Efficient Utilization of Lignite

Some progress has been made in the way of better utilization of lignite. Instructive experiments have been made by the United States Bureau of Mines, the State of North Dakota, and the Province of Saskatchewan, Canada, which bring the matter measurably nearer to a satisfactory solution.

Instead of trying to burn the raw lignite in the primitive and wasteful ways now employed, it should be modified to produce several products, each peculiarly adapted to a particular commercial need, namely:

1. Dried lignite, for use on automatic stokers and in fuel-gas producers. Because of its more or less soft and comminuted condition the dried lignite can not be handled advantageously by hand, but it can be used very satisfactorily by mechanical means.

2. Powdered fuel, from the dried, pulverized lignite, for use in cement kilns, railroad locomotives, and other large furnaces. Because of its high volatile content this pulverized lignite makes an exceptionally good powdered fuel.

3. Dried lignite briquets, for large, hand-fired industrial furnaces and heating plants. Where it is necessary to handle the dried lignite with a fireman's shovel it should be briquetted. Tests of these dried lignite briquets in commercial boiler furnaces have proved them to be equal to good Middle West bituminous coal.

4. Carbonized lignite, for use in suction power-gas producers. Tests of this product in carload lots have proved it to be an exceptional and unexcelled fuel for this purpose. Its chemical composition, as shown by analysis, is about the same as that of Pennsylvania anthracite. In carbonizing the lignite the objectionable tar found in all coals containing a substantial quantity of volatile matter is removed, and the gas goes to the cylinder of the gas engine clean and tar free. For the production of power in this way carbonized lignite is fully equal to anthracite coal, charcoal, or bituminous coke, the standard fuels for such purpose.

This carbonized lignite can also be burned satisfactorily on the automatic stokers and grates used to consume the smaller sizes of anthracite.

5. Carbonized lignite briquets for domestic service in house heating stoves and furnaces, fireplaces, and cooking ranges. This fuel, ton for ton, compares favorably with anthracite coal, and is an ideal domestic fuel in such rigorous climates as those of North Dakota and Alaska. In climates where the thermometer not infrequently goes to 40 below zero this demand is immediate and very large.

6. Sulphate of ammonia and producer gas. The raw lignite, just as it is mined, when used in by-product gas producers of the Mond type, makes sulphate of ammonia, producer gas, and some tars of undetermined value; there is no solid residue except ash. Lignite carries on the average about 1.40 per cent. of nitrogen. If this nitrogen were wholly recovered as sulphate of ammonia the yield would be about 147 pounds per ton of lignite. This theoretical yield of course could not be obtained in commercial practice; the actual yield of sulphate of ammonia per ton of lignite gasified would be 70 to 80 pounds. Ammonium sulphate is now selling for 6 to 7 cents per pound. Before the war it sold for 3 to 3½ cents per pound; but, as the price of this commodity is determined in world markets, it will probably drop back to near the pre-war price when industrial conditions become normal again. The gas yield per ton of lignite would be 60,000 to 70,000 cubic feet of about 140 b.t.u. per cubic foot. This gas could be used as a furnace fuel or in a gas engine to produce power. If the latter, it would yield 700 to 800 horse power hours per ton of lignite gasified.

The fact that the lignite does not coke in the sense that bituminous coal cokes, but rather crumbles on being carbonized, makes possible a continuous and comparatively inexpensive distilling process, thus obviating the laborious and expensive charging and drawing of retorts as practised in coal gas plants. It also parts with its volatile content more readily than does bituminous coal. The entire process is mechanical. The fuel need not be handled by manual labor from the time the lignite is loaded into the mine car until the briquets are en route to the consumer. The costly element of labor is reduced practically to that required for directing mechanical operations.

By-Products From Lignite

In carbonizing the lignite valuable by-products in the form of gas, ammonia, and oils and tar are obtained.

The Gas

The gas yield is upward of 10,000 cubic feet per ton of lignite. The gas has a heating value of 400 to 450 British thermal units per cubic foot.

A little more than one-half of the gas is necessary to carry on the carbonizing process; the balance can be used as a city gas for cooking, or for lighting if burned in a mantle, for furnace fuel, or for generating power by means of a gas engine. Or, if desired, the entire 10,000 cubic feet can be devoted to these purposes and the carbonizing carried on with lignite producer gas from a fuel gas producer.

If the gas should be used as a town gas and a higher thermal value than 400 B.t.u. per cubic foot were required, the whole 10,000 cubic feet can be enriched to the desired point. The director of the oil division of the Fuel Administration has proposed that the heating values of carbureted water gas sold for domestic use shall not be over 528 B.t.u. per cubic foot. Or, in a carbonizing oven of the Saskatchewan type the poorer portion of the gas could be collected separately and only the richer portion, about 7,000 cubic feet, sent into the city mains without enriching. The inferior gas would not be wasted, but could be used as bench fuel, supplemented by producer gas. If it were desirable to do the carbonizing exclusively with the oven gas, the richer portion available for distribution in city mains would be reduced to between 3,000 and 4,000 cubic feet per ton of lignite.

The fact that the sulphur content of lignite is small is a good feature. There is an almost entire absence of the corrosive acid resulting from the combination of sulphur with water when the lignite is burned. Should the lignite gas be used as a "town gas" for heating, cooking and illuminating purposes, there will be almost no sulphuretted hydrogen to be removed by means of hydrated oxide of iron purifiers.

Consider the matter of power. Of the yield of 10,000 cubic feet per ton of lignite carbonized, 6,000 cubic feet are required to carry on the process, leaving a surplus, costing nothing, of 4,000 cubic feet, of 400 British thermal units per cubic foot, or a total of 1,600,000 British thermal units. A good gas engine uses about 10,000 B.t.u. per horsepower hour. This gives 160 horsepower hours from the surplus gas from each ton of lignite carbonized. This power is comparable in cost with that derived from natural gas. It is fully as cheap as most hydroelectric power.

This cheap power, of course, is limited by the quantity of lignite carbonized, but the first need of the people in northern climates is domestic fuel, hence the demand for these carbonized lignite briquets is very large. As the population and the demand for power increase, the demand for this carbonized fuel will increase apace. If the demand for power in any lignite field should outrun this supply of surplus gas the amount of power can be readily and cheaply augmented by the use of carbonized lignite in power gas producers.

The by-products should at least pay the cost of carbonizing and briquetting, thus affording a first rank fuel in place of one of lowest rank, at no additional cost.

It is not necessary to dwell upon the benefits that would ensue to these lignite sections by thus placing them in possession of a fuel equal to anthracite and a supply of cheap electrical power.

And these remarks apply to one-third of the coal resources of the nation.

The Ammonia

The ammonia is contained in the gas and gas water. It may be recovered as ammonium sulphate, a valuable fertilizer, as anhydrous ammonia, for refrigeration and other commercial purposes, or it may

be treated as the source of other nitrogen products, some of which are of vital importance in the manufacture of explosives. As stated above, this and the Mond process are the cheapest sources of these products, but the amount which can be so recovered is limited to the tonnage of coal carbonized or gasified. The manufacturing practices in this connection have long been standardized.

The Oils and Tars

Just what is the most profitable disposition to make of the oil and tar products in this country remains to be determined. This is an industry by itself.

The simple distillation products of this oil can be put to many uses—fuel oil for furnaces and internal combustion engines, creosoting oils for the preservation of timber, waterproofing and preserving oils for leather and cotton and other fabrics, tar paper, roofing pitch, etc.

The pitch makes an excellent binder for the briquets, and will go far toward reducing the cost of this item, if more valuable uses are not found for it. The anthracene and creosote oils will, without doubt, find a ready market as wood and leather preservatives.

From the several fractions, upon exhaustive distillation and treatment, are derived hundreds of synthetic products in the way of paraffin, acids, antiseptics, photographic chemicals, aniline dyes, perfumes, drugs, preservatives, etc.

From the light oils come benzol, toluol, aniline dyes, photo-chemicals, certain drugs, and many other chemical products. From the carbolic and creosote fractions are derived carbolic acid, creosote, picric acid, photo-dyes and chemicals, coloring materials, and numbers of perfumes. The anthracene oils give, among other things, alizarin, a valuable acid used in the production of dyes, and carbolineum, used as a wood preservative. This latter product is analogous and equal in value to the carbolineum derived from European lignite, which before the war was imported in large quantities and retailed at 65 cents per gallon in barrel lots.

At first, of course, the simple distillation products will be procured and marketed as such, but as opportunity affords, each of these primary by-products will be taken up and synthetic chemical products manufactured. The exact course of this development is a matter to be determined in conjunction with a careful study of the market.

Almost all of these manufactured tar products have heretofore come from Germany. In 1913 the United States imported coal tar products of the value of $11,000,000 at initiating points, and these, when they reached the consumer, probably cost double that amount. Millions of gallons of creosoting oils for preserving timbers have been imported annually. That supply is now cut off and the market value of these commodities on this continent greatly enhanced. It is not unreasonable to expect that in the future a large part of this demand for tar products will be supplied from these immense stores of lignite.

Certain Arkansas and Texas lignites are known to be substantially undeveloped cannel coals, containing a large percentage of volatile matter. It is probable that the day will come when we will distill these lignites to recover products similar to the oils now being recovered from the oil shales of Scotland and elsewhere.

Possible Conservation of Petroleum and Natural Gas

The bringing on to the market of the lignite would release large quantities of Texas petroleum and natural gas for other uses, and the conservation of our petroleum resources is a more important matter than the average man appreciates.

Of our original supply of petroleum, 42 barrels per capita have been used, and only 70 barrels per capita remain for the future. About half of the petroleum currently produced is used as fuel for steam raising. The possibilities in the use of petroleum and its products in connection with the navy, airplanes, the merchant marine, automobiles, motor trucks, tractors, etc., are so great and vital that before long it will be looked upon as an inconceivable folly that oil should ever have been used for steam raising, the most glaring economic perversion that this country has ever been guilty of. (Bulletin 102, part 6, U. S. National Museum).

"The whole mechanical equipment of modern civilization is dependent upon lubricants made from petroleum. Its exhaustion spells commercial chaos or commercial subjugation by the nation or nations that control the future source of supply from which petroleum will be derived." (M. L. Requa).

Efforts are being made in France to introduce the distillation of lignite for tars. The Societe de Distillation des Combustibles, Paris, is constructing an improved Ziegler type of furnace similar to that used for the distillation of peat, a type yielding about 7 per cent. of tar.

"In one place in Germany, where the system was adopted, 70 to 80 per cent. of marketable products was obtained from lignite tar, namely 15 to 20 per cent. paraffin wax; 5 to 20 per cent. kerosene; 5 to 15 per cent. of creosotes and organic acids; the remainder being light products, petrol, etc., or heavy products such as gas-oils and lubricating oils.

"Concurrently with the great interest taken in the development of the shale-oil industry in America, it is worth while to consider the possibility of utilizing the large deposits of low-grade lignites for another set of greatly needed chemicals, including the fixed nitrogen which can be converted into ammonium sulphate. Among the available products are benzol and toluol, and the gas can be employed in many places for industrial purposes." (Mining and Scientific Press, May 11, 1918.)

If we are to prevail against our enemies in time of war and maintain our commercial prestige during peace we must not be less diligent than either friends or foes in the matter of developing and conserving our natural resources.

In respect to the world's future demand for fuel oils, the "London Financier," the leading financial paper of London, says in a recent issue:

"Of all the commercial propositions of the world, probably none has greater potentialities than the oil industry. Although throughout the centuries a staple product of the earth, oil, until comparatively recent years, was never utilized to any extent as a motive power owing to the poverty of invention in respect to engines adequate for its proper exploitation in that respect.

"The war, however, has brought about many wonderful changes, necessity having truly proved the mother of invention, and, among other things, oil engine invention has received a vast stimulus, with the result that perfection in the manufacture of the necessary machinery is now being rapidly approached, and, at the same time, scope for the usefulness of liquid fuel enormously extended.

"It is indeed quite reasonable to prophesy that the next generation will witness the practical disappearance of coal as the motive power for railways and ships, so that 'King Oil' may become a greater potentate on both land and sea than the veteran monarch of motion, 'King Coal.'"

A market for the fuel oils derived from carbonization of lignite is assured.

Advantages in Carbonizing Lignite

A number of substantial economies from the mine operators' and coal dealers' standpoint become available through this method of carbonization of the lignite.

The prime advantage is that the lignite is changed from an unstable commodity into several stable and valuable products, the demand for every one of which is large and increasing.

In the use of raw lignite, under present practice thousands of tons of screenings are annually wasted. The coal is forked over in the mine room and screened again at the surface when being loaded into railroad cars. If the problem is handled as outlined above this waste would be eliminated, every pound of clean lignite broken from the seam could be put to some profitable use.

The raw lignite cannot be stored economically; the treated product can, and this results in another large saving, in that it would enable the mines to operate under stable conditions the year around, instead of only during the winter months, as at present.

Some study should also be directed to designing appropriate apparatus for the consumption of these classes of fuels instead of using devices already on the market intended to consume fuels of quite a different character.

Unquestionably the experiments so far conducted open very large economic and commercial possibilities, and it is believed that a little wider and more thorough investigation will point the way for the establishment of carbonizing and briquetting plants throughout the lignite-bearing sections of the country, thus bringing effectively into the industrial world one of our largest natural resources. The results will be not only

the production of a first-class solid fuel, so much needed, but the saving of many by-products valuable in war as well as peace, and the easing of overburdened transportation conditions throughout the country.

In conserving the coal supply and in increasing the electrical power supply of the country, lignite resources must be developed as well as water powers.

With regard to the extent to which we may expect hydro-electric power to take the place of power from coal, the following statement by Steinmetz is interesting and authoritative:

"Assuming an efficiency of 60 per cent. from the stream to the distribution centres, there remain 230 million kilowatts (24-hour service) as the maximum possible hydro-electric power which could be produced if, during all seasons, every river, stream, brook, or little creek throughout its entire length from the spring to the ocean, together with all the waters of the freshets, could be and were used.

"This maximum possible hydraulic energy of 230 million kilowatts is little more than the total energy which we now produce from coal, and is about equal to the present total energy consumption of the country including all forms of energy.

"This is rather startling. It means that the hope that when coal once begins to fail we may use the water powers of the country as a source of energy is, and must remain, a dream; for if to-day all the potential water power of the country were developed, and every drop used, it would not supply our present energy demand.

"Thus hydraulic power may and should supplement coal as a source of power, but can never replace it.

"This probably is the strongest argument for efforts to increase the efficiency of our means of using coal." "General Electric Review," July, 1918.)

There is a very large demand for electrical power in central Texas close to the Texas lignite beds. Water is rarely present in sufficient quantities for condensing purposes in connection with steam turbine power plants. It looks as if the future supply of power for central Texas must come from lignite, used in the raw state in by-product producer gas plants, as carbonized lignite on automatic stokers under boilers or in power gas producers, or as surplus gas from the carbonizing process used in a gas engine.

There are several uses for the lignite retort gas, as a town gas, as a furnace fuel, and in a gas engine. There are also several uses for the carbonized residue, in gas producers, on stokers, or in briquetted form. Therefore it ought not to be difficult to market in one way or another either of these products no matter how large the demand for the other might become. It is not easy reasonably to conceive a limit to the market for sulphate of ammonia or hydrocarbon oils and tars.

These different products can be used in so many ways that an industry of this kind could readily be made to fit the industrial requirements of any ordinary community.

The carbonizing of this lignite will place the lignite-bearing regions on a par from a fuel and power standpoint with those parts of the country that are favored with bituminous coals. It will give a better domestic fuel in the way of carbonized lignite briquets, a better gas producer fuel in the form of carbonized lignite, enormous quantities of gas to be used for fuel or power purposes, large quantities of fertilizer in the form of sulphate ammonia, and a great amount of oils and tars. And the by-products derived from this process should more than pay the cost of making the transformation.

This project of developing our lignite resources is not a small matter.

Take the North Dakota section as an illustration:

Into this section there are now being imported a minimum annual tonnage of two million tons of bituminous coal and one million tons of anthracite, every pound of which should, and some day, will be replaced with fuel from the Dakota lignite field.

To replace these three million tons would require the carbonizing annually of six million tons of lignite, yielding three million tons of solid fuel, eighteen billion cubic feet of surplus gas (costing nothing), forty-five thousand tons of sulphate of ammonia, and sixty million gallons of tar distillates, comprising benzol, carbolic, creosoting and anthracene oils, paraffin, etc.

The waste in dollars and cents involved in two years' importation of the foreign coal into that territory would probably pay for all the equipment necessary to carry on the industry on the scale outlined.

Bear in mind, too, that the Texas lignite situation affords an even greater opportunity for economic saving. The opportunity in Alaska must be nearly, if not quite as large. And there are many smaller deposits of lignite scattered over the southern and western states where relatively smaller savings can be made in similar fashion.

In several sections of Texas there are merchantable deposits of iron ore. Limestone is close at hand. The development of these deposits has been unprofitable because of the high price of coke, but under the present stimulus of high war prices for pig iron, a blast furnace will soon be put into operation at Rusk, notwithstanding the fact that the Alabama coke which will be used will cost $16 per ton at Rusk. The carbonized lignite, or the carbonized lignite briquets, should replace this coke at not more than half the price. The lignite, iron, and limestone lie within a few miles of each other. The development of a steel industry in Texas surely should obviate the necessity of large shipments of iron products from eastern United States into that section.

ERRATUM

In POWER HOUSE for October, in the article on "Burning Lignite with the Mechanical Stoker," line nine should read: 9. Kind of Fuel used on test—Pembina lignite, pea 50 per cent.; slack 50 per cent.

TURBO-ALTERNATOR ROTORS; FEATURE OF MECHANICAL DESIGN

Continued from page 327

cent. greater than at the normal speed. The author holds the view that all parts of the rotor should be designed as if it were to run at 20 per cent. overspeed continuously. At the normal speed the stresses and pressures are 30.5 per cent. less, so that the factors of safety in the teeth and end-bells are then very satisfactory.

In summary, high overspeeds (1) do not test the most important requirement—capacity to withstand fatigue; (2) do not necessarily detect the presence of incipient flaws in the highly-stressed parts; and (3) do undoubtedly tend to damage the insulation. An overspeed of 20 per cent. is essential, but anything higher is undesirable.

In conclusion, the author begs to express his obligation to Mr. Douglas Vickers and Mr. W. Clark, directors of Messrs. Vickers, Ltd., for permission to read this paper. Also he takes the opportunity of acknowledging his indebtedness to his colleague, Mr. J. P. Nicholson, who conducted the various mechanical tests referred to in the paper.

TO ASCERTAIN THE SPEED AND DIRECTION OF AIRPLANES OVER THE WATER

The practicability of flying over long stretches of water is handicapped by the difficulty of determining the direction and speed of flight. Admiral Fiske proposed a means of overcoming this difficulty based on the idea of making an aeroplane follow the same general procedure as a ship does.

For long flights over water the machine should be made to fly quite close to the water and steer a straight course, not only laterally, but vertically, thus enabling the pilot to obtain information concerning the direction and speed of flight from the water itself by means of what may be called "an airplane log."

The direction can be ascertained by towing through the water a small object by means of a long and light steel wire. The small object will always be in the vertical plane containing the fight path, and the direction may be found by attaching the log line to the end of a pointer moving under the compass, or to a "dumb compass' kept in agreement with the compass.

To find the speed it would be necessary merely to tow a "Massey's log"—a simple contrivance towed by a ship and consisting of a sort of box fitted with a propeller that actuates dials on the surface of the box when it turns. The dials indicate the distance the box has been towed, and knowing the time, the speed can be determined. The error that might be made in calculating the speed is estimated at 2 per cent.—"Aerial Age Weekly."

The MacLean Publishing Company
LIMITED

(ESTABLISHED 1888)

JOHN BAYNE MACLEAN - - - - - President
H. T. HUNTER - - - - - - Vice-President
H. V. TYRRELL - - - - - - General Manager

PUBLISHERS OF

POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power, and to the design and operation of Refrigerating Machinery.

B. G. NEWTON, Manager. A. R. KENNEDY, Editor.

Associate Editors:

W. F. SUTHERLAND J. H. RODGERS (Montreal) T. H. FENNER

OFFICES

CANADA—

Montreal—Southam Building, 128 Bleury St., Telephone Main 1004.
Toronto—143-153 University Ave., Telephone Main 7324.
Winnipeg—1207 Union Trust Building, Telephone Main 3449.
Eastern Representative—H. V. Tresidder.
Ontario Representative—S. S. Moore.
Toronto and Hamilton Representative—J. N. Robinson.

UNITED STATES—

New York—A. R. Lowe, 111 Broadway, New York, Telephone 8971 Rector
Chicago—A. H. Byrne, 900 Lytton Bldg., 14 E. Jackson Street, 'Phone Harrison 1147
Boston— C. L. Morton, Room 733, Old South Bldg., Telephone Main 1024

GREAT BRITAIN—

London—The MacLean Company of Great Britain, Limited, 88 Fleet Street, E.C., E. J. Dodd, Director, Telephone Central 11960. Address: Atabek, London, England.

SUBSCRIPTION RATE

Canada, $1.00; United States, $1.50; Great Britain, Australia and other colonies, 4s. 2d. per year; other countries, $1.50. Advertising rates on request.

Subscribers who are not receiving their paper regularly will confer a favor by telling us. We should be notified at once of any change in address, giving both old and new.

Office of Publication, 143-153 University Avenue, Toronto, Ontario.

Vol. XI. NOVEMBER, 1918 No. 11

PRINCIPAL CONTENTS

The Historical Development of the Steam Turbine 311
Power Plant Management; Hand Firing 315
The Calculation of Alternating Current Circuits 318
Electricity and Hydraulics 321
Principles and Operation of Modern Electrical Equipment.
Turbo-Alternator Rotors; Features of Mechanical Design.....323
Notes on Lignite—Its Characteristics and Utilization 328
Editorial 332
Technical Journal Best Aid to Education 333
Perpetual Motion Some Distance Yet 334
Operators' Point of View 335
Selected Market Quotations 340
Trade Gossip 48

An Expert Engineer Needed

MEMBERS of the Canadian Manufacturers Association, either as a body or from the viewpoint of the largest coal consumers, should make a closer study of the problem of fuel economy than they have ever done before. We do not mean that they should seek to burn less coal, although such a thing might be cimmendable, but of primary importance, see to it that the coal that they buy and pay for is BURNED, not simply reduced to ashes.

From many inquiries made we believe that the number of power plants in Canada that have a high rating of efficiency in coal consumption and steam production is comparatively small. As coal burners they are wonderfully successful. As result-getters they are dismal failures.

There is room for the large fuel consumers to take intelligent action in this matter. It is not for them to look to the government, for the assistance they will get there may be advisory or legislative. The biggest chance is in raising the efficiency of the coal consuming departments of their business, and the place to start is in the boiler and engine room.

There are many plants that cannot afford to engage a competent engineer. Even were they able to pay the price they might not be able to secure the man they needed, for the studious engineer, the student in the game of combustion is not an easy man to find. He's not the is that he shall know just enough to find favor in the eyes common garden variety of engineer whose chief concern of the board of examiners.

The large coal consumers in the C.M.A. would undoubtedly find it to their interests to engage an expert engineer, who could check up the results that are being secured in the power plants concerned, and then proceed to visit the delinquents and find out where they can be put right. If such a man were engaged those engaging him would be entitled to expect results, and it is safe to presume that they would get them, and that they would be more than in keeping with the expense of appointment.

As has been pointed out before in these columns the bombarding of coal burners with government advice is wasted effort. The manufacturers know that coal costs money, and that it is hard to get. From that they can easily figure for themselves that it is good policy to save it and get the most out of it. If they didn't know that much they would have been out of business long ago. What is really needed is expert advice on the bringing of each individual power plant up to an efficiency standard of at least 75 per cent.

Coal Bins and Church Union.

THE Protestant churches in Brockville held union services last winter. It may have been that they were forced to do this because there was a shortage of coal. Against this, however, is the fact that they are doing it cheerfully on a large scale this winter because they want to do it, and have sent a letter to the Ontario fuel controller pledging support.

This sort of business is liable to do quite a heap of good apart from the coal that will be saved, and that should amount to quite a bit, for the average sexton is a pretty fair stoker when it comes to burning coal.

Not only so, but it must be some satisfaction for the pastors to get a chance to preach to a full house now and then. If there's anything that should put a preacher in shape for tremendous action it is a full house. If there's anything that would put the damper on this eloquence and the cold water on his fervor it would be a complement of empty seats. Somehow we've always felt sorry for the pulpiteer who has had to start his day's job with that won't-you-move-up-to-the-front look on his face. He may get off to a good start and keep going right to his "in conclusion," but at the same time he's got a handicap against him that puts him in the class of a lame horse pulling a stone boat.

By all means let the church goers save fuel. Let the Baptists sit in tight up against the Methodists, and let the stalwart Presbyterians be sandwiched with the Congregationalists. Nothing will harm them. Let them vie in matching pennies on the collection plate. Let 'em lift their voices higher than the rafters in praise and worship.

Technical Journal Best Aid to Education

Stationary Engineering Becoming Highly Technical and Specialized Avocation With Increasing Prestige—The Technical Press is Recognized as the Best Means For Procuring Advancement Through Increased Knowledge

By S. BALMFIRTH

IN these days of war, of coal shortage, and rumors of further shortage, the engineer is being called upon for increased efficiency as never before.

Coal, which two years ago was plentiful and fairly cheap, is now scarce, poor in quality (frequently) and high in price.

These conditions have resulted in a demand from manufacturers and governments for a more efficient and economical system of power generation. That is to say both manufacturers and governments are putting the question right up to the engineer as being the man most likely to produce the results required.

However the work of a steam engineer is not learned in a day, but is a long, tedious and very often painful process. The engineer, unlike most of the manual tradesmen, is never out of his apprenticeship. He is like a man rowing a boat upstream; if he stops rowing he drifts back. So it becomes every engineer worthy of the name to keep everlastingly at it. In fact in these days of progress and invention in every line of business, it is absolutely necessary that one devote a fair amount of time to learning the finer points of one's chosen line. Nowadays the up-to-date chief engineer is being classed, at least as a semi-professional man, which is only right for certainly steam engineering has got past the old rule-of-thumb days.

Time was when the fireman of to-day was the engineer of to-morrow. That is, the beginner in the steam engineering profession began as a fireman, and from the experience he got as such, and from his observation of what the engineer did and from what the engineer was willing to show him, he progressed slowly and laboriously until he had sufficient knowledge (or thought he had) to apply for a position as engineer. If he succeeded in getting a position as engineer, his troubles began. Then he found quite frequently that engineering was "not just what it's cracked up to be!" However, if he succeeded in keeping the wheels turning without having to call in outside help, in most cases he would be able to hold down the job long enough for him to learn more about his business.

Of recent years, however, in keeping with the general progress of education the engineer is fast coming into his own.

No longer is he known as "the man in greasy overalls carrying a monkey wrench," although both these articles are very necessary adjuncts, but he is being recognized as a very necessary and important man in any business, by the most prominent manufacturers.

It is not necessary for any engineer to depend entirely upon his own experience for his information. Nowadays there are books published for self education (some of which are suitable and some are not), correspondence schools, free libraries, night schools, engineers' associations and many other ways open to the seeker after knowledge.

The writer has used most of them, with varying success. Experience is, no doubt, the best teacher, but her course is very expensive. So it is very much less costly to use the other fellow's experience.

Any one can profit by his own mistakes, but it takes a wise man to profit by the mistakes of others. Of the sources of information mentioned above each has its good points, and each its disadvantages.

One of the disadvantages of the technical book, is generally speaking, it is not written for self education. It may be intended for that purpose, but very frequently falls far short of fulfilling its purpose. Many of them are couched in language entirely beyond the average engineer's education, and require a teacher to explain. Further, the best book written at once grows old and out of date the moment it is published.

Correspondence schools fill a great want in this regard, in that their text books are generally written for self instruction. Most of them are written in simple language, and carry the student along step by step from the first rudiments of the subject in hand to its final conclusion. Further the correspondence school saves the time required in travelling to and from home and school, and also makes use of any odd minutes that the student may have to spare. The writer put in a good many hours' study on the street cars.

Technical schools, that is evening classes, are an excellent means of providing higher technical education for the man who can attend. But right there is also the disadvantage. No course of lectures will benefit a man unless he can attend all, or at least the largest proportion of them, and the average plant engineer cannot be certain of being able to attend all lectures. Things have a habit of going wrong on class night, and one of the most important lectures is missed, and then the whole course is thrown up in disgust. Then again many engineers cannot attend by reason of the time of their watch, so that they have to forego the benefits of the night class.

Still for those who can attend the night technical school is an ideal means of acquiring an education; combining as it does the use of spare time with both practical and theoretical courses of study.

The engineers' association is a very good means of self improvement; in fact one of the best. If the association is at all alive, discussion of various subjects of interest to all engineers is the main part of the evening's business. Every one has a chance to express his opinion, and many and various are the opinions expressed at times. Still, by discussion one learns, and by friction a polish is given. So that even if one makes mistakes in giving expression to one's opinion, it is not often that one makes the same mistake twice. Then again a mistake made in discussion of any subject is much more easily rectified than a mistake made on the job; it is not likely to be so costly either. The older engineers are always ready to help the younger ones, by giving them the benefit of their experience.

But!——— if you wish to learn about any subject, write about it. One could safely say that what one writes about, one remembers best. Not only that, but what one writes about one generally takes care to be accurate.

So, the technical magazine has a field all its own. In it one can express one's opinion on any subject covered by the magazine. Not only that, but the criticism evoked is often constructive, in fact generally so. Further one can ask any question and be sure of geting an answer. There is generally someone who knows the answer to the question and is willing to pass the information along.

The technical magazine has one great point in its favor, that is, it is never out of date. One can always be sure of finding the latest improvements and the newest inventions in its pages. Then again the adveritsements are a fruitful surcoe of information of what is new and what is standard and reliable, so that, generally speaking,

the technical magazine may be made one of the best means of keeping up to date.

But to the engineer it may also be a source of revenue, besides being a general depot of information. If you have any experience that strikes you as being out of the ordinary, write to your magazine about it. If it's good enough to print, its good enough to pay for. It does not really matter if you never wroter for publication before, if the language you use is ungrammatical, or if your spelling is of an order not mentioned in "Webster's Unabridged"; send it in. The magazine has men whose special job it is to clothe your idea in suitable and proper language and fit it for presentation. If you can make a sketch to help illustrate your idea, all the better. It need not be a scale drawing or an artistic piece of work; if it expresses your idea, the artists on the staff of the magazine will make a good drawing of it.

Possibly a single instance may illustrate the idea. The writer had occasion to give a paper at one association meeting, which dealt with the writer's everyday work. The writer's opinion, when he began to prepare the paper, was that he knew sufficient about the subject to make preparation unnecessary. However, as the paper progressed the writer found that his knowledge of the subject was not quite so full as he thought, so he had to consult various works of reference, but by the time the paper was ready to present the writer knew what he talked about, and in the discussion which followed the paper the writer was able to answer every question and argument. Before the preparation of the paper the writer thought he knew, afterwards he did know. Writing about a subject impresses almost indelibly on the memory.

In the words of the advertisement: "To earn more—learn more." To learn more, write about it. Use your technical magazine.

PERPETUAL MOTION SOME DISTANCE YET

So Don't Lie Awake at Nights Wondering When It Will Respond to Your Own Genius

By J. H. R.

LIKE the measles or the mumps, most of us are afflicted at some time in our career with the idea that perpetual motion is not only feasible, but that we are probably the fortunate individual to discover the secret that has baffled scientific men for many centuries. This lapse of normal consciousness, however, is seldom of long duration, as the majority soon realize that it is a practical impossibility to obtain "something for nothing," a condition that must necessarily exist for such a thing as perpetual motion to become an established fact. To secure motion, be it ever so small, it is necessary to utilize a proportionate amount of energy, so that to attain the movement it is quite obvious that the power must be first generated; therefore, with a little thought the fallacy of perpetual motion will be readily acknowledged by anyone who will take the trouble to study, even briefly, the fundamentals underlying the mechanical sciences. However, advice in this connection will seldom be accepted by those who have once got the bug until they themselves are convinced to the contrary.

The writer himself is one of the many that has experienced the thrill of this visionary flight, but in a short time had to admit that the perpetual part of the task was in the seeking rather than in the achievement of the purpose. A temporary illness in this respect is frequently a good thing, but a prolonged sojourn from the more immediate and practical opportunities may prevent a man from applying his ingenuity to a better and more remunerative cause.

Should a man become persuaded that perpetual motion is to be the product of his own particular brain, it would be well to obtain some data on the subject before expending any time in experimenting, as in many books that have been published there is a more or less comprehensive treatise of those ideas that have encouraged many men to spend weeks, and months, and even years, of their lives in a vain effort to achieve a result that was expected to revolutionize the science of mechanical operations. A perusal of such literature may bring to light a duplicate of the very idea that has become the pet of their wakeful hours and the nightmare of their restless nights.

JUDGE A MAN BY STARTING POINT

Hugh Clark Worked and Asked Questions and Studied All At the Same Time.

EMPLOYEES of the Singer Sewing Machine Works at Clydebank, Scotland, at least those of the old guard whose memories go back 30 to 35 years, could tell you of a lad they all called Hughie. They could tell you how this little more than toddling lad worked in the packing rooms of that 30-acre plant. With reminiscent smiles they could tell you how, along in the year 1888, he soberly announced intention to go with his parents to Canada. And as he fitted the action to the word a few weeks later it is our privilege to report his measure of success in this land of recompense for intelligently directed effort.

HUGH CLARK

Hugh Clark, or "Hughie" still to his intimates, started work in Canada as a carder in the Standard Woollen Mills. With the lapse of 10 years in this Toronto plant he stood at the gateway to the age at which a young man either strikes out for the thing he wants to do most or passively accepts his lot and rears a grouch upon it. He could be a carder to the end of time or he could buckle down to grimy toil and lamentably neglected studies and so fit himself for the work he mightily wanted to do.

To his credit, young Clark arranged for a transfer to the fireroom in the Standard Mills. Here for four years he worked as a fireman in a double sense. That is to say, he stoked, and he fired questions at all and sundry who could let him into the mysteries of boilers, engines and anything and everything mechanical.

And at length, when he was ready, opportunity was ready too. The power plant of the W. A. Murray store, Toronto, needed an assistant engineer. Clark got the job.

Three years later this privately owned plant was closed. And where do you suppose was opportunity? Just a few blocks to the south-east or, to be precise, where Berkeley street is lost in a maze of railroad tracks, the Joseph Simpson Sons, Ltd., Knitting Mills had to have a night engineer. Clark proved that he was competent.

That is 13 years ago, and for these last 11 years he has been, and is to-day, mechanical superintendent of the Simpson Mills. So if you are ever tempted to doubt the value of a good correspondence course in steam and electrical engineering or to underrate the practical help a man can get from such a paper as CANADIAN MACHINERY. go and talk with Hughie Clark.

In the big game named "getting ahead in the world" he has made a creditable score. I say that well knowing it is never wise to measure a man by the position he holds to-day. Rather stand in his shoes, if you can, and drop your plumb line to the job at which he started.

The Operators' Point of View

MAKING A RECORDING STEAM CONSUMPTION METER

By T. H. FENNER, Associate Editor.

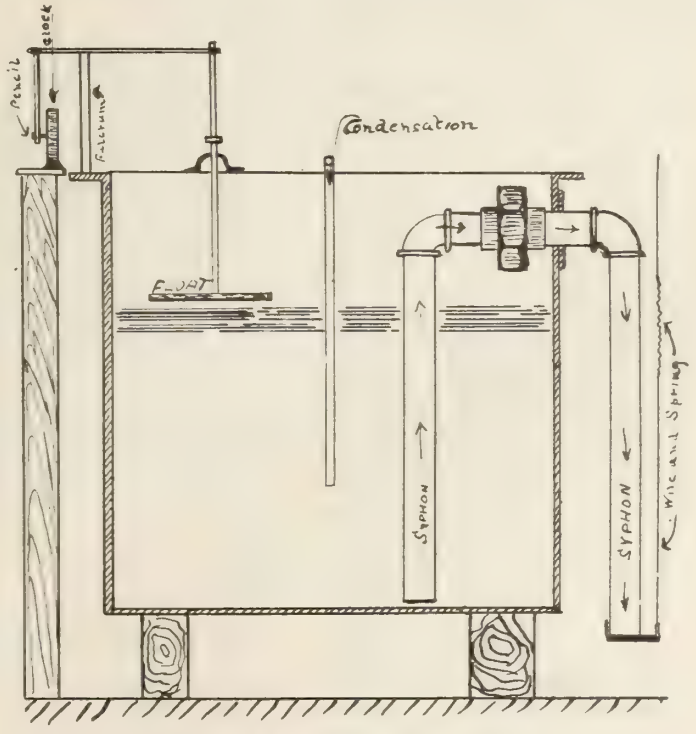
THE necessity often arises in plant and factory operation to determine the amount of steam consumed by a particular apparatus. This may be occasioned by the requirements of the cost accounting department, or by the desire to compare two different ways of operating the same unit, or the relative merits of two different appliances for the same purpose. For all these purposes, accuracy is the essence of the contract, while the question of obtaining accuracy with small expense is also important.

Methods of Measuring Water

If there are suitable tilting traps on the premises, to which a counter can be attached, registering the number of times the trap discharges in a certain time, then the volume of the trap being known fairly accurate results can be obtained. However, there is always room for inaccuracies to creep in, through leakage from glands, valves, etc. If all working parts are perfectly free to move, the trap will be sensitive, and open and shut promptly, while if the gland packings are at all hard, or unduly tight, the trap is slow to open and discharge and steam is blown through for a moment after the condensation has been removed. Errors like these are small in themselves, but multiplied by a large number of operations extending over days, they make a respectable total, and render valueless any test that does not take them into account. An ordinary water meter may be used, but these are by no means to be depended on. If a Venturi meter can be connected up to the return pipe, it is possibly the best means of securing the consumption, but a large number of plants do not possess these instruments, and where they are installed they are usually connected to the boiler feed, and are not easily moved.

Needed a Meter

The writer had occasion some time back to determine the steam consumption on a number of different kilns, used for baking Japan, varnish. etc., also lumber drying kilns. As the results were to establish the cost of production of various parts, accuracy was necessary, while at the same time it was not desired to go to much expense in securing the figures. Under these circumstances a search around the plant was made for suitable equipment. There were a variety of traps on the premises but none on which much dependence could be placed for a particular job of this kind, so they were eliminated from the list of possibilities. However, in looking around a store house of obsolete or unused machines, several steel tanks that had been used in the plating room, were discovered, and these suggested the idea of making our own measuring appliance, which was at once acted on, the result being a very serviceable instrument, at practically no cost.



HOME-MADE WATER METER

How It Was Made

The tank, as shown in the cut was mounted on skids, and kept about 18-inches off the floor. This was to give room for the discharge pipe to come below the bottom of the tank. The general arrangement can be followed easily by referring to the cut, and the action was as follows. The condensation was led into the tank from the kiln to be tested by a half-inch pipe. A 2-inch nipple with a long thread was screwed into the side of the tank near the top, and a union put on inside the tank, to connect the suction leg of the siphon pipe. The down leg of siphon was connected to nipple through the elbow outside the tank as shown ,and the pipe carried down low enough to give a good discharging head. On the end of the discharge pipe a clock valve was fastened by a hinge, and on the opposite side to the hinge a lug was carried out, to which was fastened a wire, the other end being fastened to a beam in the ceiling, and a light spring connected between. This valve and spring were the key to the whole affair, and some considerable experimenting had to be made before the correct strength of spring was arrived at. This spring had to have just enough tension to balance the column of water in the siphon pipe, so that the instant the water rose above the top of the pipe, the valve would open. This would start the siphon, and the velocity of the escaping water held the valve open till the water was emptied down

eo the level of the bottom of suction pipe. The spring would then close the valve, and the tank fill again. Here then, we had a definite quantity of water discharged, and all that was wanted was a means of recording the number of times the tank was filled and discharged in a definite period, and make one necessary correction. This correction was the quantity of water flowing into the tank from the return pipe while the siphon was discharging. This was merely a matter of placing a T on the return pipe, with a valve outside the tank. A pail was placed under this, and the tank watched carefully, and as soon as the siphon opened, the valve on the return pipe was opened and the water ran out into the pail instead of the tank. As soon as the tank was emptied, the valve was closed and the water in the pail weighed carefully. This weight had to be added to the weight of water discharging from the tank, to make it correct.

The Recording Chart

For recording the number of times discharged, a chart, registering automatically was required. This was secured by purchasing for 75 cents an ordinary domestic alarm clock. The fingers and dial were removed, and a tin dial soldered onto the spindle of the hour hand. Four small cleats were made on the new dial to hold a paper chart. A flat piece of wood, 1-inch thick by 6-inch. square formed a float into which was fastened a piece of ¼-inch round iron, which passed through a guide fixed on the flanged edge of the tank. A cross beam of wood was connected to the top end of this and this was supported on a fulcrum about two-thirds of its length away from the float rod. The other end carried a vertical rod, through which was passed the pencil. A stop was placed on the float rod, to hold the float up when the water dropped below a certain level. This level was adjusted to give just enough upward travel to the float when tank was filling, to make a mark of 1½-inch. long on the chart. The charts were placed on the dial at 7.00 a.m. and 7.00 p.m. and thus a continuous 12 hours record appeared on each chart. The position of the clock is shown on drawing. In the actual layout the clock was enclosed in a wooden box, to protect it from steam, and dirt in the air. The valve on the bottom of siphon pipe was made of two pieces of galvanized iron No. 16 gauge, one soldered to the other. The top piece was of just sufficient diameter to enter the pipe neatly, while the bottom piece was made to the outside diameter of the pipe, and two lugs made on it, one for the hinge the other for the wire. A piece of good 1-16 wire wove insertion was made to fit the end of the pipe, to form a joint, and fastened onto the valve to begin with by shellac. Otherwise, the rush of the water would have washed it off. Later on this insertion joint was replaced by a ring of square rubber, ¼-inch wide by ⅛-inch thick. This was more satisfactory. Later on two more tanks and clocks were added, to enable three different tests to be made at once. This method resulted in accurate figures being furnished, and the only new material was the three clocks costing $2.25. The pipe and fittings were all on hand, and the labor amounted to probably another $2.

EMERGENCY PIPE REPAIRS

By James E. Noble

While employed as engineer at the Hospital for Insane, Toronto, I made numerous repairs in what might be called, "hurry-up jobs," a description of some of them might interest your readers. Fig. 1 shows a cast iron water pipe which was broken in two as a A, caused by the building foundation sinking. Some of the stones were removed from around the pipe and a clamp made 6 inches wide and ¼ inch thick as shown in Figs. 1 and 2; sheet rubber was placed around the pipe over the break and pieces of sheet copper were used at DD, Fig. 2, where the ends of the clamp came together and all the bolts tightened up, this job was done about ten years ago, and so far as I know is still in use. To my own knowledge it was still in use about two years ago.

Fig. 3 shows a 6 in. cast iron pipe at the same institution. A two-inch pipe was screwed into a hole which had been drilled in the pipe, probably a strain had been placed upon the two-inch pipe for a long crack developed in the 6-inch pipe. A piece of ¼-inch plate was heated and bent to form a fit over the 6-inch pipe, a half circle was cut from one end to fit over the 2-inch pipe, as at A, Fig. 4 a piece of ⅛-inch sheet rubber was placed over the hole with the bent iron on top of it and all drawn up in place with two clamps as shown in Fig. 4. This job also is in use after many years.

A 3-inch steam coupling started to leak at the threads caused by the ends becoming corroded. A piece of galvanized sheet iron was bent around the coupling to form a sleeve, the space between

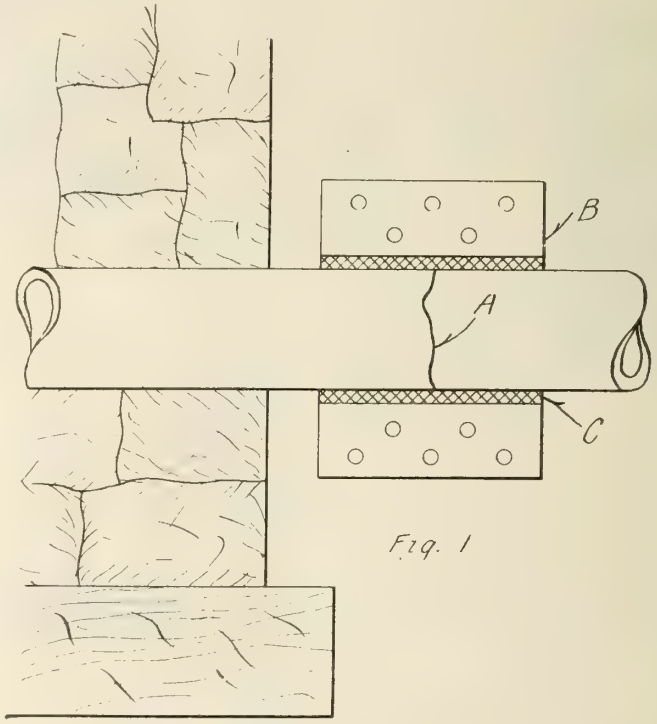


Fig. 1

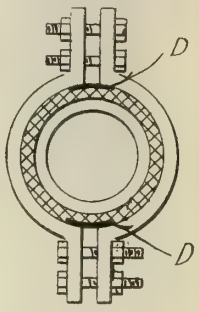


Fig. 2.

METHOD OF REPAIRING BROKEN MAIN

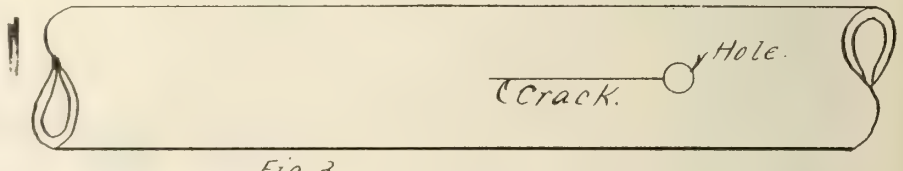


Fig 3.

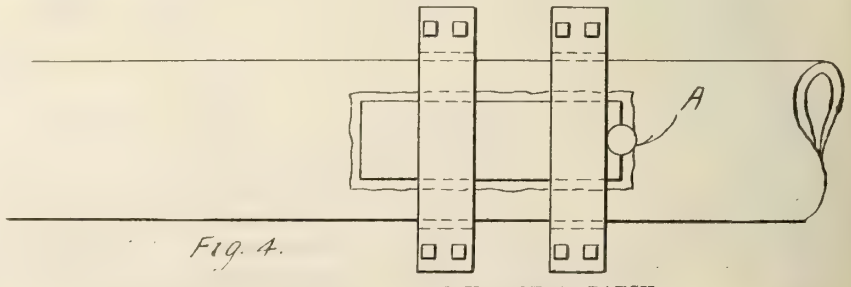


Fig. 4.

STOPPING CRACK AND THE USE OF A PATCH

the coupling and the sleeve was filled with elastic and dry smooth on cement mixed, heat was applied to it from a blow-torch for about half an hour, and in two hours steam was turned on and the leak was stopped.

While extending a water main in an outside town it developed that we were just 18 inches short. Instead of sending to the city for a pipe and sleeve we cut off a piece of larger pipe 24 inches long; this was slipped over the end of the pipe before making the lead joint at A, Fig. 6. Six turns of ordinary galvanized telephone wire were tightly drawn around the ends of the piece of large pipe and the joints packed and lead run in in the usual way, result being O. K.

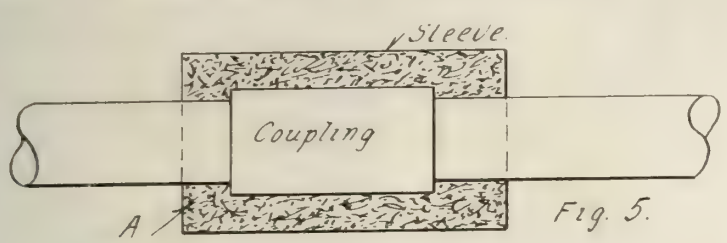


Fig. 5.

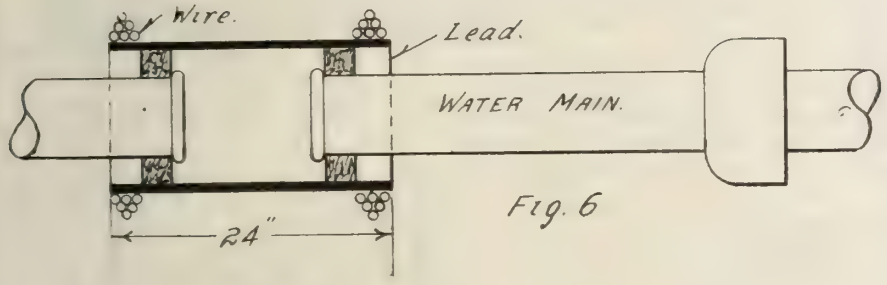


Fig. 6

WHAT IS AN ENGINEER

Being a subscriber to POWER HOUSE, a paper much appreciated by all operating engineers who handle it, I have been toiling around in large and small steam plants, fireman, oiler, and engineer, if it fits in to use the term. I have been approached by so-called union engineers with the question, "Are you making a living wage on an eight-hour day, or in other words, are you receiving sufficient wages per hour to allow you to live on an eight-hour day?" I know there are quite a few plants running on eight-hour shifts, but who are the engineers? It seems to me there is only one who is the chief, the rest are only handy helpers; and so we can go through Ontario, and but very few engineers are required, just one in each plant. Now I know there are plenty of good men in Toronto, good engineers, but are there positions for them? Experience tells me no, and I think quite a number of engineers will agree with me, as they have been placed in the same rut as myself in answering an advertisement for an engineer. The first question put to you is, "Have you got a certificate?" Naturally you have or you would not go after the job, and you say, yes. Then comes the conversation, "Well, you know we have no engine, just a motor and one, two, or three boilers just for heating the building; that doesn't need much of an engineer, so we expect you to give a hand at so and so in your spare time, and what is most important, having the buidling comfortable in the morning. Of course you must be on hand early every morning, but then you have it pretty easy all day up to 5.30 or 6 o'clock, when you will shut the plant down for the night, providing they don't work overtime. Oh yes, you must come down on Sundays and holidays! Saturday afternoons you have a good chance to do any boiler work or temporary repairs and be ready on Monday morning. The electrician will tell you he has charge of the building; that's the way us so-called engineers are up against it, at any rate I find it so after some forty years at the occupation. I ask, am I the engineer in charge or is the electrician? I am considered well paid with 18 or 20 dollars per week of about 70 or 80 hours. Of course you must keep all piping in repair and the boilers, ah yes, they must be O.K. when the inspector comes. In conclusion I would like to draw your attention to the advertisements coming out in the daily papers, quite a few of them for firemen to take charge of boiler or boilers, not a word about certificates at all.

Yours truly,
FRED. CLARKE.

CONVERTING A GROUCH

By J. James

A few days ago an engineer remarked to me, "These engineering journals make me weary." Said I, "What special ailment is bothering you now, my friend?" He elucidated somewhat as follows:

"The editors come at a fellow and call him down because he will not write about how he overcame some difficulty in connection with his work. They say, never mind if your sketch is crude and your letter shy on correct grammar, writing or spelling, we will polish them up for you, it is the idea we want, and we will cash up for that same idea, telling how you won out and so forth and so on. There am I taking their advice and using up my postage stamps, time and stationery to help them out, and every time my letters come back, not because they are not good enough, so reads their printed notice enclosed with the returned letter, but because they are not suitable for the journal. How do I know what will suit them? I send them power plant experiences all right, dang it all, my experiences are just as good as some of those I see in print, and better than a lot of them." At this point he paused, but before he got started on the second lap I cut in. "Will you allow me to throw some talk for awhile? I have written many hundreds of letters for these journals you talk about and have received cash for many of them; I have also had many of them returned as being unsuitable, perhaps the ideas therein were old and had been printed several times without my knowledge, in fact on two occasions when I thought I had solved some particularly difficult problem the editor made a note directing my attention to where practically the same idea had been printed many moons before I had sent in my MSS.

"Another way to look at things is this: The editor is the buyer for the publisher; he is paid for what he knows about goods that will give satisfaction to the publishers' customers; these are the subscribers as a whole, he is responsible for the material dished out in the editorial or reading pages. He does not want to tell a customer, who is trying to sell him some stale goods that the said goods are out of date, he just sends on a polite printed note letting him down easy, and perhaps the note contains a carefully hinted suggestion to try and bunco some other editor who may prove an easy mark." At this point I started talking again before my friend could do so.

"Suppose a traveling salesman for some goods of which you had a big stock on hand, called on you and insisted you buy more of the goods just because they were good, the fact that you did not want any more of them making no difference to him, what would you do, would you give in to him and buy something you did not want with your nice handy cash just because he thought he knew your business better than you did yourself?

"Perhaps you are in the same class, trying to sell something the editor has enough of or has had enough of. Try again, perhaps your next near original idea will catch him unprepared, and he may cause your chest to swell and your heart to throb when you receive his check for a whole lot of dollars, perhaps as many as two, but never forget he is the buyer and you the seller. If you cannot think up something original try and put a disguise on it and make it look original (this is my advice, not the editor's. I bet he won't print it), perhaps you may get by with it. An editor is only human—you may not believe this but it is true, so if you stick to it long

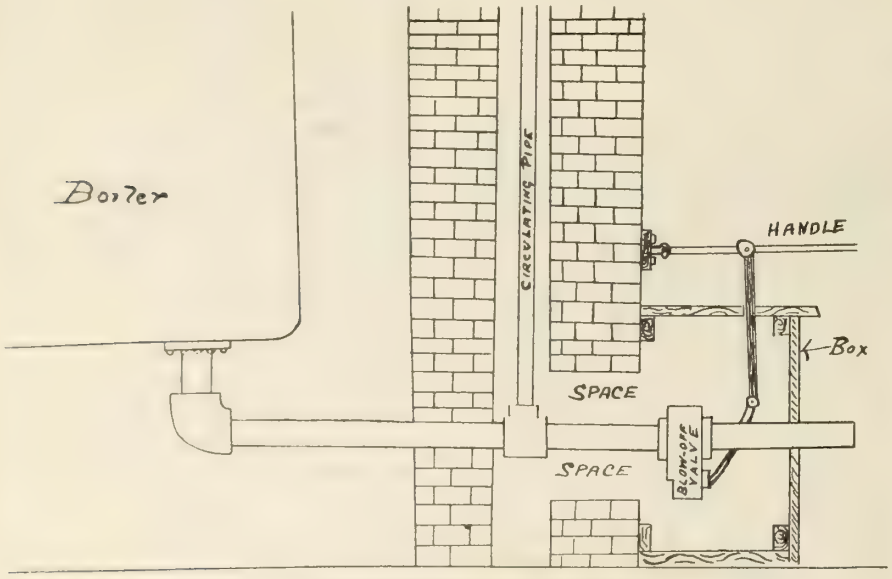
enough you are bound to get him some day and receive enough coin to pay for all the stamps and stationery you have used up in the past."

"Dang it," said my friend. "I thought I could talk, you are it, take some advice from me, quit engineering, go sell books, you will make a fortune. No one could choke you off. Say, I believe you have done me good, anyhow, I'll think better about those editor fellows, especially do I pity them if they have to watch out for fellows like you if you write as fast as you gas."

KEEPING BLOW-OFF FROM FREEZING

Restricted space was the reason for placing the steam boiler close to an outside wall. As the blow-off valve could not be run from the side wall for certain reasons it was connected as shown. This was all right during the summer but in the winter, with the temperature away down, things would freeze up. To prevent this happening a space six inches above and six inches below the pipe, that is a square hole eight inches in diameter was cut out of the brick wall at the pipe, and a wood box built around the blow-off valve outside. The box was made in sections so that it could be taken apart to make repairs to the valve or rods. The valve was opened or closed by raising or lowering the handle. The valve did not freeze up because enough heat from the boiler room came through the 8-inch hole to prevent this.

JAMES E. NOBLE,
Portsmouth, Ont.



ARRANGEMENT OF BLOW-OFF

THE CARE OF SCALES

By W. Schaphorst

Engineers and others in and about the plant often use scales in various ways without giving them much thought. It is generally assumed by the average engineer that if a scale "balances" before the load is put on, the weight registered will be "accurate," but such is not always the case. Much depends upon the care given the scale between weighings. It might, therefore, be a good plan to say a few words about scales in these columns for a change.

In Figure 1 is shown a so-called

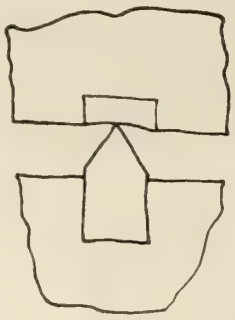


FIG. 1

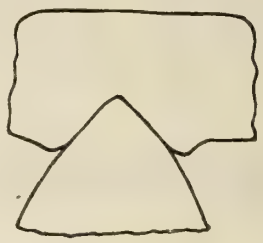


FIG. 2

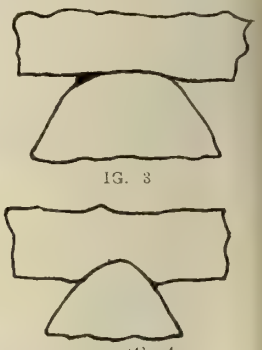


FIG. 3

FIG. 4

"knife-edge." On top of the knife-edge is the bearing. Both the bearing and knife-edge should be made of the same material, of equal hardness. The harder and stronger the material used the better, in most cases.

However, it is evident that we must have more than mere "line contact" when there is any sort of load on the scales. The knife-edge on a jeweler's scale may be so sharp that one could shave with it, but on the high capacity scales the knife-edge is really nothing more than a blunt edge, and in the largest scales is actually a flat surface without semblance of a point or "edge." Yet, they are "called" knife-edges, although the proper word would be "pivots."

Figure 2 is an imagined enlargement of what occurs where the knife-edge is harder than the bearing. It is evident that the principal deformation will take place in the softer metal.

Figure 3 shows a case where the knife-edge is soft and the bearing is hard. The knife-edge, of course, will be "blunted down" pretty much as shown.

Figure 4 shows a case where both metals are of the same hardness. That is the "ideal" case, although it would be much nicer if we could get away from surface contact altogether. Theoretically, the ideal case is a "line" pure and simple. If the line could be attained in actual practice things would be simplified very much for the designers of scales.

To keep a pair of scales in good condition it is, therefore, important that they be never overloaded. Overloading may deform the knife-edges of bearings permanently. Never allow a weight to drop heavily upon the scale platform, for blows are liable to deform the edges, too. And never allow a heavy weight to remain long upon the platform. Give the knife-edges an opportunity to return to their normal shape as soon as possible after the weighing. A long-sustained heavy load will cause the knife-edges to "flow" and remain deformed permanently.

To date, the best metal for knife-edges for use on high capacity scales is the high-speed steel that is used so much in machine tool work. A new metal called stellite, however, has lately been put on the market as superior to high-speed steel. It is exceedingly hard and will scratch the hardest hardened steel. There is no iron in stellite at all except as an impurity. Stellite is very likely the coming metal for knife-edges. It has another advantage over steel in that it does not corrode.

HOW MUCH HEAT IS LOST?

By W. F. SCHAPHORST.

How much heat is lost in allowing a boiler to cool off for cleaning and in starting it up again? There is a question that will cause many an engineer to stumble. It is much like the time-worn conundrum, "Which came first, the egg or the hen?" When a boiler cools off the heat is being dissipated into the air, true enough. And when the boiler and setting are being reheated, the heat out of the coal is all being apparently wasted. None of it is converted into work. The amount of heat lost on cooling is equal to the amount required to heat it all equally again, but the actual loss is "only one of them." Don't add them together. Or, add them and divide by two.

BOILER AND COMBUSTION APPLIANCES

The Defender Automatic Regulator Co. of St. Louis, Mo., manufacturers of automatic damper regulator, combustion appliances and instruments for the boiler room, moved to larger quarters on November 1, at 709 Pine street, and they have issued a new catalogue, No. 10, which shows some improved instruments and appliances, three of which we illustrate.

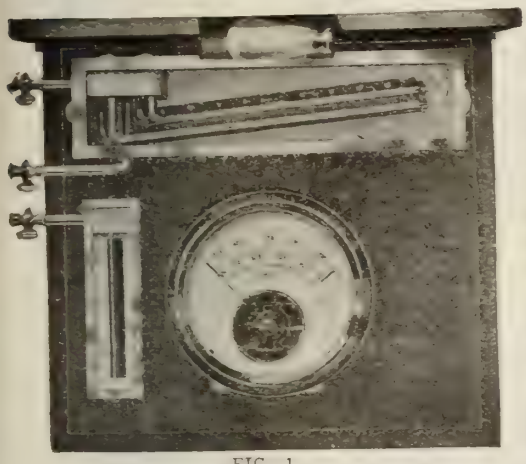


FIG. 1

Fig. 1 shows their control board for mounting on the front corner of a boiler; on same is mounted the Defender duplex draft gauge and flue gas pyrometer. As illustrated the board has a vertical gauge at the left to read the pressure in the blast below the grate on forced draft furnaces; for natural draft plants the board is furnished without the vertical gauge. The top hood, which has a shade for electric socket all cast in one piece, is attached on to the top of the cast back with a screw at each end, which allows the hood and light to be raised up when working on the instruments. When hood is in place it keeps the dust and water from falling on the gauges as well as illuminating the board; this is a big advantage in dark and dirty boiler rooms.

Fig. 2 illustrates the Defender cast iron gauge case for mounting on the boiler front. In same is encased their Duplex draft gauge and recording flue gas thermometer the same is furnished with any number of feet of bronze armor tubing, so that for water tube boilers the case can set on the front corner of the boiler where the firemen can see the instruments at all times.

Fig. 3 shows the cast iron case manufactured by this company for forced draft or under feed stokers. The three tube draft and pressure gauge is mounted in the bottom of the case. This gauge reads the pressure in the blast below the grate on the top tube, the draft over the fire on the centre tube, and the draft at the last pass of the boiler on the bottom tube. The difference between the reading on the centre and bottom tube being the drop in draft through the boiler, or what is commonly known as the differential through the boiler, this differential will increase and decrease as the boiler capacity increases and decreases. The flue gas pyrometer to read the temperature of the flue gas at the last pass of the boiler is mounted in the top of the case. The manufacturers claim that with a set of these instruments mounted on the front of each boiler and one of their cases for reading the per cent. of CO_2 in the flue gas, that the following indications and information are given to the operator at all times.

The exact conditions of the fuel bed at all times; fires too long or too thick; fires too short or too thin; too much or too little air; fires clinkered; when time to clean fires; percentage of excess air used; the total loss and avoidable loss of fuel on each boiler; the per cent. saving that can and should be made; if baffles are leaking; if soot is accumulating in boilers; when to use flue or soot blowers; how long to use them; if any good or any saving is made with the use of them; if one boiler is operating more efficiently or at greater capacity than others.

Fig. 4 shows the Defender case and single chamber orsat to read the per cent. of CO_2 at the last pass of the boilers. This is shown with four pipes from the last pass of four boilers run through the top of the case and the gas suction pump mounted on the outside of the case. With the use of this case piped up for the battery of boilers a sample of gas can be drawn from any of the boilers and an analysis made in less than one minute's time. After a few dozen readings for CO_2 have been taken on each boiler and the firemen once taught what the indications on the instruments are with the different percentages of CO_2, then the readings for the CO_2 do not have to be taken very often as the draft and flue gas temperature guides the fireman.

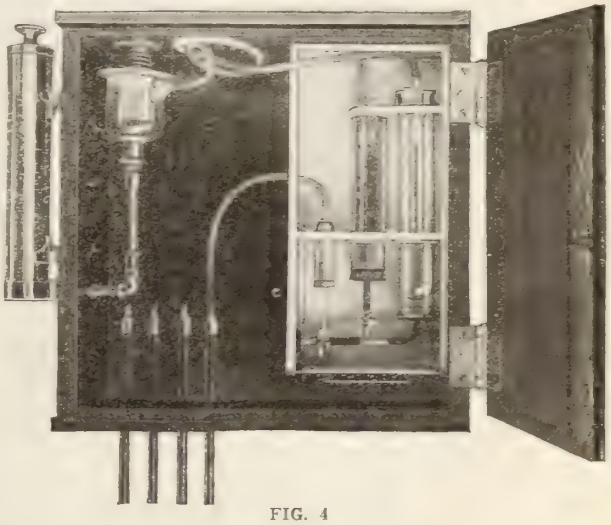


FIG. 4

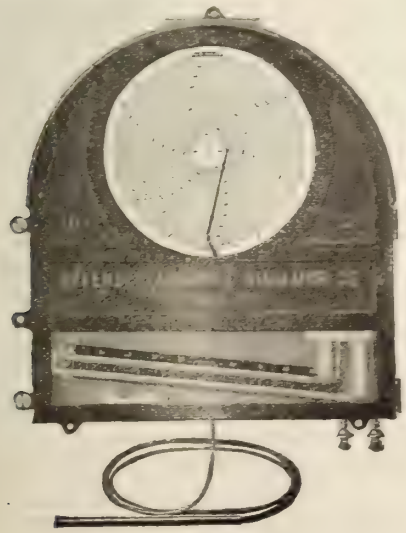


FIG. 2

FIG. 3

"The Heating of Houses, Coal and Electricity Compared" is the title of Bulletin No. 6 issued by the Honorary Advisory Council for Scientific and Industrial Research, Ottawa. This publication summarizes the advantages and disadvantages of both the methods of heating, and reduces their cost to an equal basis for a comparative purpose during the past few years and the fuel problem has become acute in Canada, and an idea appears to have been gaining ground that the immense water powers of this great country will amply suffice to meet all heating requirements. The climate of the greater part of Canada is so severe in the winter that even the immense potentialities of its water powers, if fully developed, would be altogether inadequate to cope with the demand for power for electric heating if this were increased to any great extent.

The advantages of electric heating and the difficulties preventing the adoption of electric heating on a large scale are dealt with, and the cost of heating a house electrically at a lowest domestic lighting rate is also given. This cost will be considerably lessened by the use of electricity supplied at power rates, but in this case even, it will not be possible to bring it within the cost of heating by coal.

SELECTED MARKET QUOTATIONS

A Record of Prices Current on Raw, Semi-finished, and Finished Materials Entering Into the Manufacture and Operation of Power Plant Equipment

BOILER TUBES

Size	Seamless	Lap-welded
1 in.	$36 00	$.....
1¼ in.	40 00	.....
1½ in.	43 00	36 00
1¾ in.	43 00	36 00
2 in.	50 00	36 00
2¼ in.	53 00	38 00
2½ in.	55 00	42 00
3 in.	64 00	50 00
3¼ in.	.....	58 00
3½ in.	77 00	60 00
4 in.	90 00	75 00

Prices per 100 feet, Montreal and Toronto.

PLATES

	Montreal	Toronto
Plates, ¼ to ½	$10 00	$10 00
Heads	10 30	10 25
Tank plates, 3-16 in.	10 50	10 10

WROUGHT PIPE

Effective Jan. 7, 1918.
Standard Buttweld.

Size.	Black Per 100 feet	Galvanized Per 100 feet
⅛ in.	$ 6 00	$ 8 00
¼ in.	5 16	7 29
⅜ in.	5 16	7 29
½ in.	6 55	8 12
¾ in.	8 28	10 41
1 in.	12 24	15 39
1¼ in.	16 56	20 82
1½ in.	19 80	24 89
2 in.	26 64	33 49
2½ in.	42 72	53 53
3 in.	55 85	70 00
3½ in.	70 84	87 86
4 in.	83 93	104 10
Standard Lapweld		
2 in.	29 60	36 08
2½ in.	44 46	54 70
3 in.	58 14	71 53
3½ in.	72 68	90 62
4 in.	86 11	107 37
4½ in.	97 79	122 56
5 in.	114 00	142 82
6 in.	147 80	185 28
7 in.	192 80	241 57
8L in.	202 50	253 75
8 in.	233 30	292 32
9 in.	279 50	350 18
10L in.	259 20	324 80
10 in.	333 70	418 18

Prices—Ontario, Quebec and Maritime Provinces

WROUGHT NIPPLES

4" and under, 45%.
4½" and larger, 40%.
4" and under, running thread, 25%.
Standard couplings, 4" and under, 35%.
4½" and larger, 15%.

IRON PIPE FITTINGS

Malleable fittings, class A, 20% on list; class B and C, net list. Cast iron fittings, 25% off list. Malleable bushings, 25 and 7½%; cast bushings, 25%; unions, 45%; plugs, 20% off list. Net prices malleable fittings: Class B black, 24½c lb.; Class C black, 15¾c lb.; galvanized, Class B, 34c lb.; Class C, 24½c lb. F.O.B. Toronto.

COLD ROLLED SHAFTING.

At mill ..... list plus 40%
At warehouse ..... list plus 50%
Discounts off new list. Warehouse price at Montreal and Toronto.

FINISHED IRON AND STEEL

Per lb. to Large Buyers	Cents
Iron bars, base, Toronto	$5 25
Steel bars, base, Toronto	5 50
Steel bars, 2" to 4" base	6 00
Iron bars, base, Montreal	5 25
Steel bars, base, Montreal	5 50
Reinforcing bars, base	5 25
Small shapes	5 75

SHEETS

	Montreal	Toronto
Sheets, Black, No. 28.	$ 8 00	$ 8 25
Sheets, Black, No. 10.	10 00	10 00
Canada plates, dull, 52 sheets	9 00	8 65
Canada plates, all bright	9 50	9 50
Apollo brand, 10¾ oz. galvanized	....	....
Queen's Head, 28 B.W.G.	....	....
Fleur-de-Lis, 28 B.W.G.		
Gorbal"s Best, No. 28.		
Colborne Crown, No. 28	....	....
Premier, No. 28 U.S.	....	9 20
Premier, 10¾ oz.	....	9 50

PROOF COIL CHAIN B

¼ in.	$14 35
5-16 in.	13 85
⅜ in.	13 50
7-16 in.	12 90
½ in.	13 20
9-16 in.	12 70
⅝ in.	12 50
¾ in.	12 40
⅞ in.	12 90
1 in.	12 65
Extra for B.B. Chain	1 20
Extra for B.B.B. Chain	1 80

ELECTRIC WELD COIL CHAIN B.B.

⅛ in.	$13 00
3-16 in.	12 50
¼ in.	11 75
5-16 in.	11 40
⅜ in.	11 00
7-16 in.	10 60
½ in.	10 40
⅝ in.	10 00
¾ in.	9 90

Prices per 100 lbs.

FILES AND RASPS

	Per Cent.
Great Western, American	50
Kearney & Foot, Arcade	50
J. Barton Smith, Eagle	50
McClelland, Globe	50
Whitman & Barnes	50
Black Diamond	37½
Delta Files	37½
Nicholson	37½
Globe	50
Vulcan	50
Disston	50
P.H. and Imperial	50

OILS AND COMPOUNDS

Castor oil, per lb.	....
Royalite, per gal., bulk	18
Palacine	21
Machine oil, per gal.	26½
Black oil, per gal.	15
Cylinder oil, Capital	49½
Cylinder oil, Acme	39½
Standard cutting compound, per lb.	06
Lard oil, per gal.	2 60
Union thread cutting oil antiseptic	88
Acme cutting oil, antiseptic	37½
Imperial quenching oil	39½
Petroleum fuel oil	13½

BELTING—No. 1 OAK TANNED.

Extra heavy, single and double	30-5%
Standard	40%
Cut leather lacing, No. 1	$1 95
Leather in sides	1 75

COAL AND COKE.

Solvay Foundry Coke	.....
Connelsville Foundry Coke	.....
Steam Lump Coal	.....
Best Slack	.....

Net ton f.o.b. Toronto.

BOLTS, NUTS AND SCREWS

	Per Cent.
Coach and lag screws	25
Stove bolts	55
Plate washers.....list plus	20
Machine bolts, 7-16 and over	net
Machine bolts, ⅜ and less	10
Blank bolts	net
Bolt ends	net
Machine screws, fl. and rd. hd., steel	27½
Machine screws, o. and fil. hd., steel	10
Machine screws, fl. and rd. hd., brass .....add	20
Machine screws, o. and fil. hd., brass .....add	25
Nuts, square blank .....add	$1 50
Nuts, square, tapped.....add	1 75
Nuts, hex. blank .....add	1 75
Nuts, hex. tapped .....add	2 00
Copper rivets and burrs, list plus	30
Burrs only list plus	50
Iron rivets and burrs	15
Boiler rivets, base ¾" and larger $8	50
Structural rivets, as above	8 40
Wood screws, flat, bright	72½
Wood screws, O. & R., bright	67½
Wood screws, flat, brass	37½
Wood screws, O. & R., brass	32½
Wood screws, flat, bronze	27½
Wood screws, O. & R., bronze	25

MISCELLANEOUS.

Solder, strictly	0 60
Solder, guaranteed	0 70
Babbitt metals	18 to 1 00
Soldering coppers, 3 to 6 lbs.	0 64
Putty, 100-lb. drums	5 20
White lead, pure, cwt.	16 20
Red dry lead, 100-lb kegs, per cwt.	15 50
Glue, English	0 35
Gasoline, per gal., bulk	0 33
Benzine, per gal., bulk	0 30½
Pure turpentine, single bbls., gal.	1 03
Linseed oil, raw, single bbls.	1 95
Linseed oil, boiled, single bbls.	1 98
Lead wool, per lb.	0 15
Plumbers' oakum, per cwt.	9 00
Sandpaper, B. & A....list plus	20
Emery Cloth.....list plus	20
Sal Soda	0 03½
Sulphur, rolls	0 05
Sulphur, commercial	0 04½
Rosin "D," per lb.	0 03
Rosin "G," per lb.	0 03½
Borax crystal and granula.	0 14
Wood alcohol, per gallon	1 80
Whiting, plain, per 100 lbs.	2 20

COPPER PRODUCTS

	Montreal	Toronto
Bars, ½ to 2 in.	$42 50	$43 00
Plain sheets, base 16 oz. and heavier	46 00	44 00
Copper sheet, tinned, 14x60 in., 14 oz.	48 00	48 00
Copper sheet, planished, base 16 oz. and heavier	57 00	45 00
Braziers' in. sheets, 6x4 base	45 00	44 00
Tubing T.P.S., base ¾ in. up to 3 in.	60 00	60 00

Above prices are full sheets and bars. Cut sheets and bars are 5c per lb. higher.

BRASS PRODUCTS.

Brass rods, base ½" to 1" rd.	$0 43
Sheets 24 oz. and heavier base	0 48
Brass tubing, seamless	0 55
Tubin, I.P.S., 1" base	0 55

POLISHED DRILL ROD.

Discount off list, Montreal and Toronto	Net

RUBBER BELTING

Standard	10%
Best grades	15%

WASTE

White.	Cents per lb.
XXX Extra	21
Peerless	21
Grand	19¾
Superior	19¾
X L C R	18½
Atlas	18½
X Empire	17¼
Ideal	17¼
X press	16
Colored.	
Lion	15
Standard	13½
No. 1	13½
Popular	12
Keen	10½
Wool Packing	
Arrow	25
Axle	20
Anvil	15
Anchor	11
Washed Wipers	
Select White	11
Mixed colored	10
Dark colored	09

This list subject to trade discount for quantity

MILLED PRODUCTS

	Per Cent.
Set screws	25
Sq. & Hex., Head Cap Screws	20
Rd. & Fil Head Cap Screws	Net
Flat & But. Hd. Cap Screws plus	Net
Fin. & Semi-fin. nuts up to 1 in.	25
Fin. and semi-fin. nuts, over 1 in., up to 1½ in.	20
Fin. and semi-fin. nuts, over 1½ in., up to 2 in., list plus	10
Studs	20
Taper pins	40
Coupling bolts, pins	10
Planer head bolts, without fillets .....list plus	10
Planer head bolts, with fillet list plus 10 and	10
Planer head bolt nuts, same as finished nuts.	
Planer bolt washers	net
Hollow set screws..list plus	20
Collar screws...list plus 30,	10
Thumb screws	20
Thumb nuts	65
Patch bolts .....add 40,	10
Cold pressed nuts to 1½ in. .....add	$4 50
Cold pressed nuts over 1½ in. .....add	$7 00

METALS

	Montreal	Toronto
Lake copper	$31 00	$29 50
Electro copper	31 00	29 50
Castings, copper	30 00	28 50
Tin	125 00	125 00
Spelter	11 50	11 00
Lead	10 00	10 00
Antimony	17 50	18 00
Aluminum	55 00	58 00

Prices per 100 lbs...

ROPES AND PACKING

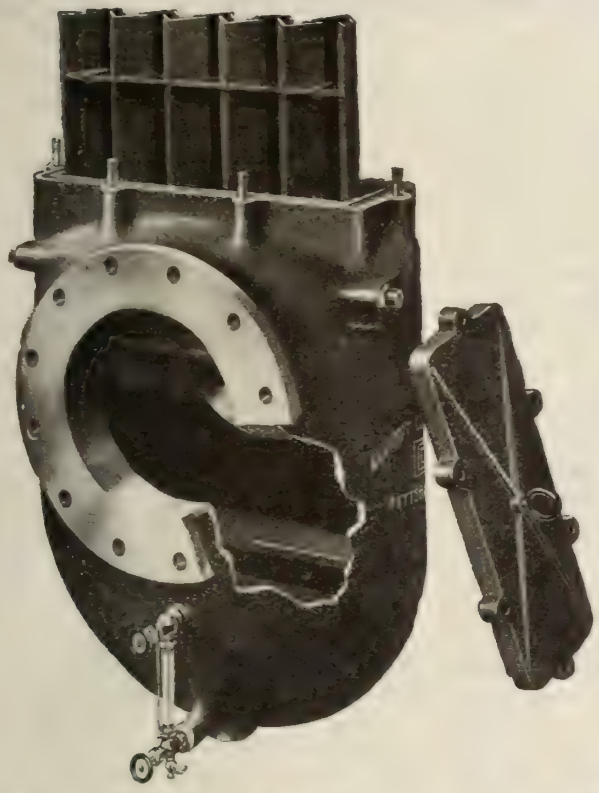
Packing, square braided	0 34
Packing, No. 1 Italian	0 40
Packing, No. 2 Italian	0 32
Pure Manila rope	0 39
Transmission rope, Manila	0 45
Drilling cables, Manila	0 41

LEAD SHEETS

	Montreal	Toronto
Sheets, 3 lbs. sq. ft. lb.	$12 00	$13 25
Sheets, 3½ lbs.	12 00	13 25
Sheets, 4 to 6 lbs.	13 00	12 50

Cut sheets, ¾c per lb. extra.
Cuts sheets to size, 1c per lb. extra.

Here's an Oil Separator that took on a "side line"—



You've had a grease salesman pull a sample of packing from his pocket and try to sell you some.

The grease salesman was carrying a "side line."

Same thing with this Elliott Oil Separator. Its main job was to take oil out of steam—but it had a side line.

The engineer of the plant tells the story.

"Before we installed our

ELLIOTT OIL SEPARATOR

we could not keep scale down," he said. "There was so much grease in the condensate which we fed back to the boilers that it left an accumulation on the flues. The boiler compound couldn't get in its effect.

"I could run my hand along any tube and have it come off dripping with oil.

"But the Elliott Oil Separator stopped the trouble. We can now keep the boilers in first-class condition."

Ever think of an Oil Separator handling a side line like **that!**

Don't be surprised that the Elliott Oil Separator handles the job so well either—

The Elliott Separator throws the oil **out of the path** of the steam. No chance of its getting back in again.

Furthermore, baffles in the Elliott Oil Separator are removable. **Easy cleaning!**

Bulletin "E" tells all about Elliott Separators. Write for your copy

ELLIOTT COMPANY

435 Grant Street, Pittsburgh, Pa.

Association and Personal

W. A. Black has been appointed locomotive foreman for the C. P. R. at Farnham in place of D. W. Watson, transferred.

Effective this date, J. A. Tobin is appointed assistant superintendent, Trenton division, office, C.P.R., Trenton, vice T. H. Hamilton, transferred.

John S. MacLean, advertising manager of the Canadian General Electric Company and also of the Canadian Allis-Chalmers for the past five years, has resigned.

Morriss and Company of Chicago have recently placed an order with the Locomotive Pulverized Fuel Co., 30 Church street, New York for a complete "Lopulco" system for crushing, drying, pulverizing and burning coal at their plant at Oklahoma City. They expect to use native coals and to make use of Texas lignite. The power plant contains seven Edgemoor boilers, having a total of 3,100 horsepower, all of which are to be equipped.

STOKER MANUFACTURERS' ASSOCIATION

At a meeting in Cleveland on August 1, 1918, an association was formed of the stoker manufacturers of the United States. The principal reason for getting together was to place at the disposal of the government the entire facilities of the stoker industry to the end that everything possible might be done to help out in the national emergency. Even after the war, however, it is expected that great benefit will be obtained by the association members in the discussion of subjects of interest and value to the stoker industry; in the advancement and improvement of that industry; in the standardization of stoker manufacture and application, and in the promotion of a spirit of co-operation among its members for improved production and increased application of stokers. Practically all of the builders of mechanical stokers are included as charter members of the association.

At the first meeting the following officers and executive committee were elected: President, P. Albert Poppenhusen, Chicago, Ill.; vice-president, S. L. Nicholson, E. Pittsburg, Pa.; secretary-treasurer, Fred H. Daniels, Worcester, Mass.; William F. Sauter, Philadelphia, Pa.; W. H. Rea, Detroit, Mich.

The Stoker Manufacturers' Association has been informed that it has been formally elected to membership in the Chamber of Commerce of the United States. A national councillor will be appointed by the association to represent it in the National Chamber, and through this national councillor the association will have an opportunity of expressing itself on national questions under discussion by the federal authorities.

The association, through its War Service Committee, has tendered to the federal government the entire resources and service of its members, and the committee is working with the Fuel Administration and the War Industries Board for the conservation of fuel, labor and raw materials. The association is prepared to do any and everything which may be necessary to prove that American business is ready to back up the government until victory is assured.

Chemical Products Wanted. — The Canadian Trade Commissioner in Manchester has been approached by British firms, who wish to form connections with recently developed chemical industries in Canada with a view to importing chemicals formerly obtained from enemy countries. The export of millboard and wood pulp board to Great Britain is a branch capable of great development, in Mr. Ray's opinion.

Power released.—Owing to the destruction of the munition plants at Trenton last month, the Hydro-Electric Commission power supply from the Trent for Eastern Ontario has greatly improved, as 4,000 horsepower was released by the Trenton catastrophe. As the result of this the Kingston Utilities Commission, which was laying in coal owing to the threatened limited supply of electrical energy, now finds that it will have coal on its hands, but Kingston householders will benefit as the result.

Want Government Aid.—At a general meeting of the council of the Canadian Manufacturers' Association at Montreal, attended by many leading manufacturers from all over Canada, it was decided to ask the Dominion government to take active steps in the reconstruction work and to make a grant of not less than $1,000,000 a year for research work to find new outlets for Canadian trade. It was further decided to represent to the government that no increase in export trade would be possible unless sufficient vessels were provided to take care of such trade, and representations will be made to the government requesting that strong action be taken to aid in the construction of sufficient shipping so that Canada's foreign trade is taken care of. President W. J. Bullman, Winnipeg, was in the chair.

Munitions Workers.—According to information sent from a number of the cities of Ontario this week, the following figures give the number of people in each place and the number engaged in the production of munitions:

	Population	Munition Workers
Preston	5,200	150
Paris	4,600	425
St. Thomas	15,000	300
Lindsay	8,000	600
Stratford	17,000	75
Belleville	12,620	130
Kitchener	19,266	40
Oshawa	8,240	125
Hamilton	104,491	10,000
London	60,000	500
Galt	12,000	1,200
Brantford	30,000	800
Guelph	18,000	1,000
St. Catharines	20,000	3,000
Welland	8,000	650
Owen Sound	12,612	100
Ottawa	100,500	360
Sarnia	12,000	310
Woodstock	11,000	140
Windsor	27,500	1,566

Hamilton Short of Gas. The gas shortage in Hamilton during the coming winter will be just as acute as it was last year. This was stated by E. S. Estlin, gas commissioner for Ontario, who was making an investigation for the Ontario Railway Board. Mr. Estlin urged that all citizens be asked to conserve gas to the greatest possible extent. He contended that those using it in furnaces were the worst offenders and would have to realize that conservation was absolutely essential. Mr. Estlin has made a survey of the number of industrial plants and business places using gas from the Selkirk fields and he found that there were 60. These had not yet been put on permits but this step would be taken at once, he stated. There are 150 applications for gas now on file at the office of the United Gas and Fuel Company, Hamilton. New consumers will not be taken on. Mr. Estlin instructed Mr. Byrnes that under no consideration would more consumers be added.

SPOT WELDED BRAKE HANGERS

The Portland Railway, Light and Power Co. finds that the half-ball brake hangers used on its Brill trucks can be repaired by spot welding. The repair costs less than a new part (besides eliminating delivery delays), and the repaired parts have longer life than the new equipment. The worn parts are sorted according to their condition and repaired to fit corresponding gauges.—"Electric Railway Journal."

Don't
Let Clinkers Freeze to the Sidewalls!

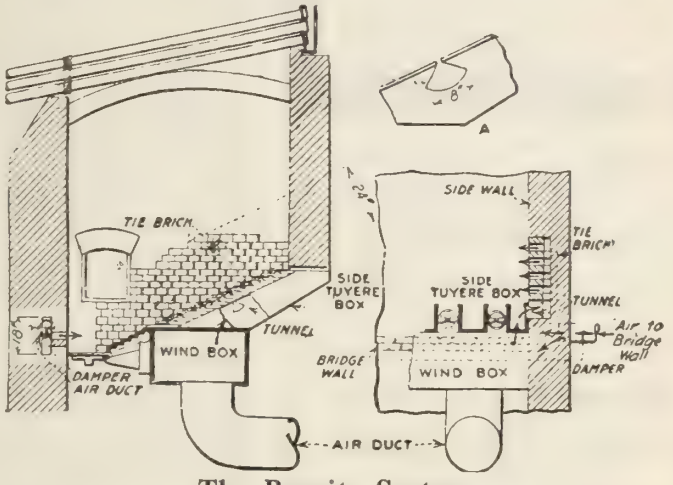
Wherever intense fires are maintained the coal will naturally slag down into clinkers. The clinkers will adhere to the sides of the furnace walls, and, fusing with the brick in large masses, extend over the grate and prevent the proper combustion of the adjacent coal. To break out such clinkers usually requires the dumping of the fire, and the use of heavy sledge-hammers and slice-bars, with the consequent damage to the side-walls.

The Bernitz Method Prevents It!

by arranging the bricks in the sidewalls and bridge walls in such a way as to allow a current of air to play around the bricks where they come into contact with the fire-bed, and by thus keeping them below the fusing point, prevent the clinkers "freezing" to the walls.

What is the Bernitz Method?

The Bernitz Method is a method of furnace wall construction of fire brick, having an air passageway inclosed in said wall, immediately back of the face brick, forming the furnace face which is directly in contact with the fuel in the furnace, and air passages opening from said inclosed passageway through the furnace face into the fuel, whereby a constant supply of air around the face brick in contact with the fuel bed, is provided.



The Bernitz System as applied to a Taylor Stoker Installation

The Bernitz Invention is Licensed, Not Sold

The Bernitz Method has received full patent protection in Canada and the United States and foreign countries, and licenses, under its patents, both issued and allowed, are now being granted on the basis of the H. P. rating of the boilers under which the Method is installed. Several installations in Canada.

Write for full particulars to

BERNITZ METHOD COMPANY

506-507 Tremont Building, Boston, Mass.

NON-CORROSIVE
CYLINDER OIL
MANUFACTURED ONLY BY
E. H. KELLOGG & CO.
NOS. 242 TO 244 SOUTH ST. NEW YORK, U.S.A.
FRICTION LOSS

An overload is often a necessity. But it is hard on an engine. To successfully carry an overload so that there will be no after effects on the engine a very careful selection of your oil should be made. An oil that is not free from impurities will cause a greater wearing on the bearings, a great friction loss will occur. You will need to fire the boiler more often because the engine will be harder to run. In this manner you lose out. You work harder, have larger operating costs, and less power all because of your oil. Do as a great many Canadian engineers have done—give Kellogg's "Non-Corrosive Cylinder Oil" a trial. Absolutely pure. Write us regarding it.

E. H. KELLOGG & CO.,
New York, U.S.A.

Walter J. Francis, C.E.
M. Can. Soc. C.E.
M. Am. Soc. C.E.
M. Inst. C.E.

Frederick B. Brown, M. Sc.
M. Can. Soc. C.E.
Mem. Am. Soc. M.E.
Mem. A.I.E.E.

WALTER J. FRANCIS & CO.
Consulting Engineers
Head Office, 232 St. James St., Montreal
Cable Address, "Walfran, Montreal"—W.U. Code. Long Distance Telephone, Main 5643.

MacKinnon Steel Co., Ltd.
Formerly
McKinnon, Holmes & Co. Ltd.
Sherbrooke, Quebec

Builders of
Coal Bunkers
Oil Tanks, Water Tanks and Receivers

We specialize in Bridges, Buildings, Towers, Tanks, Penstocks, Roof Trusses, Columns, Smoke Flues and Stacks, Coal Bin Ore Bins, Buckets, Refuse Burners, Stills, Air Receivers, etc.

Write for Prices

CATALOGUES

The saving of a piece of coal the size of an ordinary egg on each scoopful of coal used in locomotives would amount to 1,500,000 tons a year. Even when firing a freight locomotive on a heavy grade, one less scoopful of coal every fifteen minutes, or one less scoopful every three or four miles, would effect a similar saving. A little more personal interest on the part of railway officials and employees will reduce coal consumption even on railroads where the practice is already excellent and where an earnest effort is being expended to save coal. A study of the practice in the use of fuel on the railways, however, discloses many means of effecting even greater economy.

The Engineering Experiment Station of the University of Illinois has issued a circular, the title of which is "The Economical Use of Coal in Railway Locomotives," to present some suggestions concerning ways in which large coal savings may be made. The circular is printed in four colors.

The facts presented in this circular have been compiled by a special committee of the research staff of the Engineering Experiment Station, assisted by an advisory committee consisting of E. W. Pratt, Assistant Superintendent of Motive Power, Chicago and North-Western Railway Company, Chicago; W. L. Robinson, Fuel Supervisor, Baltimore and Ohio Railroad Company, Baltimore, Md.; A. N. Wilsie, Chairman, Fuel Committee, Chicago, Burlington and Quincy Railroad Company, Chicago; Timothy Shea, Acting President, Brotherhood of Locomotive Firemen and Enginemen, Cleveland, O.; A. B. Garrtson, President, Order of Railway Conductors of America, Cedar Rapids, Ia.; W. S. Stone, Grand Chief, Brotherhood of Locomotive Engineers, Cleveland, O.; O. P. Hood, Chief Mechanical Engineer on Fuel Conservation, U. S. Fuel Administration, Washington, D.C., and C. F. Richards, Dean of the College of Engineering and Director of the Enginering Experiment Station, University of Illinois.

Copies of this circular may be had by addressing the Engineering Experiment Station, Urbana, Illinois. The price is twenty cents.

"The Fusibility of Coal Ash and the Determination of the Softening Temperature" is the title of Bulletin 129, just issued by the Bureau of Mines, Department of the Interior.

In describing the purposes and scope of the investigations, the authors, A. C. Fieldner, Albert E. Hall, and A. L. Feild, say:

"As a safeguard against excessive clinker troubles, specifications for the purchase of coal can be drawn to include the 'softening' or 'fusing' temperature of the ash. The value of such information has been recognized by the Bureau of Mines and has induced the bureau to investigate laboratory methods of determining the fusibility of coal ash, and the bearing of the results on clinker formation in fuel beds. The bureau realized that the fusibility of a mixture of oxides and silicates such as is comprised in coal ash varies according to the conditions under which tests are made, and that in the absence of any generally accepted method, no agreement is to be expected among tests made in different laboratories. Indeed, L. S. Marks has recently called attention to differences as great as 390° C. that were obtained with the same sample of ash by two different laboratories. Therefore if a fusion-temperature clause is to have any place in specifications for coal, a standard method of testing should be adopted in order to insure comparable results by different laboratories and to obtain the softening or fusing temperature of the ash under conditions similar to those of a fuel bed. After a consistent method has been devised for obtaining comparable results at different laboratories there will remain the correlation of these results with those from the burning of coal in furnaces before the value of fusibility tests in coal specifications can finally be determined.

"The present publication reviews the literature on the subject and gives in detail the effect of various oxidizing, reducing and neutral atmospheres such as are found in various parts of the fuel bed on the softening temperature of ash when molded in the form of Seger cones. As a result of this study a practical method of determining fusibility has been developed whereby the ash is caused to soften and form slags in which the iron exists in approximately the same state of oxidation as the iron in fuel-bed clinkers.

"Although it is believed that this method will indicate the probable clinkering characteristics of a coal better than any fusion tests heretofore described, the bureau does not recommend the general use of this method in coal specifications until it is justified by actual trial in furnace tests of different coals. As no fusibility test of a well-mixed sample of the average ash of a coal takes into account the physical distribution of the impurities in the coal as burned, much additional investigation is needed to establish the exact relation of these laboratory fusibility tests to clinker formation. In order to correlate this proposed test of minimum softening temperature with clinker formation, the bureau is now making clinkering tests in a specially designed experimental furnace, in which different coals, having ashes that differ in fusibility are burned under similar and known conditions of combustion. The results of this investigation will be published in a subsequent report. In the meantime it is hoped that other investigators will obtain similar correlation data."

Copies of this bulletin may be obtained free of charge by addressing the Director of the Bureau of Mines, Washington, D. C.

STANDARD SPECIFICATIONS FOR BABBITT METALS

THE American Society for Testing Materials, at its annual meeting at Atlantic City, N.J., June 25-28, 1918, proposed the following specifications for babbitt-bearing metals, designated as grades Nos. 1 to 12:

TABLE NO. 1—FORMULAS.

	Copper Per Cent.	Tin Per Cent.	Antimony Per Cent.	Lead Per Cent.
No. 1	4.5	91.0	4.5	....
No. 2	3.5	89.0	7.5	....
No. 3	8.33 1/3	83.33 1 3	8.33 1 3	....
No. 4	3.0	75.0	12.0	10.0
No. 5	2.0	65.0	15.0	18.0
No. 6	1.5	20.0	15.0	63.5
No. 7	...	10.0	15.0	75.0
No. 8	...	5.0	15.0	80.0
No. 9	...	5.0	10.0	85.0
No. 10	...	2.0	15.0	83.0
No. 11	...	....	15.0	85.0
No. 12	...	....	10.0	90.0

TABLE NO. 2—PHYSICAL PROPERTIES OF METALS.

	Deformation of Cylinder 1¼" diameter, 2½" high at 70° Fah. in			Melting Point. Degrees.	
	At 1,000 lbs.	At 5,000 lbs.	At 10,000 lbs	Fah.	Cent.
No. 1	0.0000	0.0010	0.0150	453.2	234
No. 2	0.0000	0.0015	0.0120	460.4	238
No. 3	0.0010	0.0045	0.0070	462.2	239
No. 4	0.0005	0.0025	0.0090	365.0	185
No. 5	0.0010	0.0030	0.0090	.....	...
No. 6	0.0015	0.0050	0.0180	.....	...
No. 7	0.0010	0.0050	0.0230	464.0	240
No. 8	0.0020	0.0090	0.0630	469.4	243
No. 9	0.0040	0.0120	0.0840	469.4	243
No. 10	0.0010	0.0100	0.1540	471.2	244
No. 11	0.0010	0.0100	0.1190	474.8	246
No. 12	0.0025	0.0170	0.2850	474.8	246

The society wisely refrained from recommending these formulas for any special purposes; confining themselves to the statement that "these specifications cover the range of alloys commercially used."

It is regretable that these tables do not also give the coefficients of friction as this information would have been perhaps the most useful aid in determining the relative values of these twelve bearing metals—especially if tests had been made with water lubrication. But the society has made a good start and doubtless they will give these frictional coefficients at some future time.

However, the data furnished in these tables is useful for purposes of comparison, and the object of this article is merely to point out certain facts in connection with these figures that may have escaped general notice.

Many users of babbitts, especially those required for heavy duty, are very careful to specify "copper-hardened" metals, and certain manufacturers of babbitts, knowing this pedilection, boost copper-hardened products. In this connection we call attention to formulas Nos. 3 and 8, given in above tables.

No. 3 is a tin base metal and contains 8 1-3 per cent. copper, the highest percentage of copper in any of these formulas. This composition, under 1,000 lbs. pressure per square inch, compressed to only 0.0010, or one one-hundredth of an inch, and its melting point is 462.2° Fahr.

No. 8 is a lead base metal, which contains no copper, under pressure of 1,000 lbs. per square inch, compressed to only 0.0020, or two one-hundredths of an inch, and its melting point is 469° Fahr.

The difference between these two alloys under 1,000 lbs. pressure per square inch is only one one-hundredth of an inch, which is in width about equal to a line made by the stroke of a hard lead pencil, and the same relative difference between these two metals is maintained at 5,000 lbs. pressure per square inch.

As to the melting point of these two alloys, the lead base metal has the better of it by about 7° Fahr.

When you consider that the tests shown in Table No. 2 were made by compressing a small cylindrical-shaped block, and that in actual use a babbitt metal would, in most cases, be supported by a backing and further bolstered by recesses, the difference in sustaining powers between a tin base copper hardened metal and a lead base metal is practically nil.

Table No. 2 also gives a good illustration of the influence of lead in tin alloys, as shown by No. 4. This composition contains but 10 per cent. lead, yet this small quantity was enough to reduce the melting point to 365° Fahr., which is about 5° lower than the fusibility of half and half solder.

Attention is also called to the fact that the compressive strength of Nos. 10 and 11, which contain neither tin nor copper, is equal to that of No. 3 at 1,000 lbs. pressure per square inch, but at the higher pressure the No. 3 shows greater sustaining strength, due doubtless to its greater malleability, but such high pressures are rarely, if ever, used in actual practice. It is rather anomalous that alloys Nos. 1 and 2, which contain less copper and antimony than No. 3, should show greater resistance to pressure.

The conclusion that can be drawn from

The LONG Patent Steam Trap

Automatically drains jacket kettles, separators and steam mains. Nine hundred to 1,500 feet of one-inch pipe isn't beyond its ability. Also used with splendid success in drying room systems.

Only One Movable Part

Works against 1 and 200 pounds of pressure—no possibility of freezing. Has **two outlets** so it can be installed in any position.

Circular gives full particulars.

Write to-day.

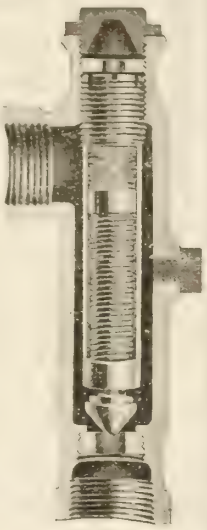
J. T. LONG
84 Adam Street
MONTREAL, CANADA
If your dealer does not sell it, write direct

R.D. Wood & Co.
Philadelphia, Pa., U.S.A.

Water and Gas Work Supplies,
Cast Iron Pipe and Castings,
Mathews Hydrants and Valves,
Hydraulic Presses and Accumulators,
Operating Valves,
Mechanically Operated Gas Producers.

When writing to advertisers kindly mention this paper.

There is
Nothing Complicated
about the
Steam Trap
SARCO



It is just a plain steam trap which can be put straight on to the line like an elbow and without foundation or building up.

It traps the steam and releases the condensation.

It does not need to store the condensation as a bucket or float trap does, and because it needs no bucket or tank it is much cheaper.

It saves first cost.

It saves installation and repair cost.

It saves valuable space—and

It does save steam.

There is no other expansion trap operating on the same principle, and that the principle is right is proved by the fact that upwards of a million steam traps of this type have been supplied in the eight years it has been on the market.

Send for Bulletin J-6.

Sarco Company Inc.

Woolworth Bldg., New York City

Ellicott Square, Buffalo
New Telegraph Bldg., Detroit
Drexel Bldg., Philadelphia
Monadnock Block, Chicago
Williamson Bldg., Cleveland
Healey Bldg., Atlanta,
and representatives in all principal cities.
Canada, Peacock Brothers, Montreal.

the foregoing figures is very favorable to the use of lead base alloys for all bearing purposes except in cases where malleability is a prime requisite and paramount to all other considerations on certain forms of thin, loose shell bearings.

The lead base metal is unquestionably superior anti-frictionally to the tin base metals and by reason of that quality it wears longer, runs cooler and protects the bearing from the injurious effect of frictional heat, and it is very much cheaper.

The lead base metal also has an advantage in pouring as the tin base metal with high copper content has to be brought to a much higher heat to obtain the proper fluidity to obtain a good casting.

These figures of tests are doubtless dependable, and assuming that they are at least approximately correct, they unquestionably show the fallacy of using the copper-hardened tin base metals merely to obtain compressive strength and apparently authorities in these matters have been taking a good many things for granted.

The fact that lead base metals are being used successfully under extremely high pressures is evidence that their failure in some instances where the tin base metals succeed is doubtless oftentimes due to improper handling rather than fault of the metal.

THE DEVELOPMENT OF NITROGEN FIXATION IN AMERICA

In a lecture on the nitrogen problem, by Professor A. A. Noyes, at Washington recently, the author said that as regards "fixation" processes, America is now working, to a greater or less extent, all the methods which have been developed during the past fifteen years. Even before the war the American Cyanamide Company at Niagara Falls was producing about 20,000 tons of cyanamide a year, largely for use in agriculture. By the action of steam upon this substance it is practicable to get substantially all the original nitrogen in the form of ammonia. This process is capable of a great extension, and has already reached considerable proportions in Germany, where it competes with the Haber process. The American government is building a cyanamide plane with a capacity of 110,000 tons of ammonium nitrate at Muscle Shoals, Alabama, and a third plant has been authorized for the production of another 110,000 tons in Ohio. The cyanamide process has the advantage that it can be installed in many places in the country, and that it requires little power. It has probably a great future before it—certainly immediately—but whether it is ultimately destined to be supplanted by the synthetic process time alone can show.

SLIPPING OF BELTS

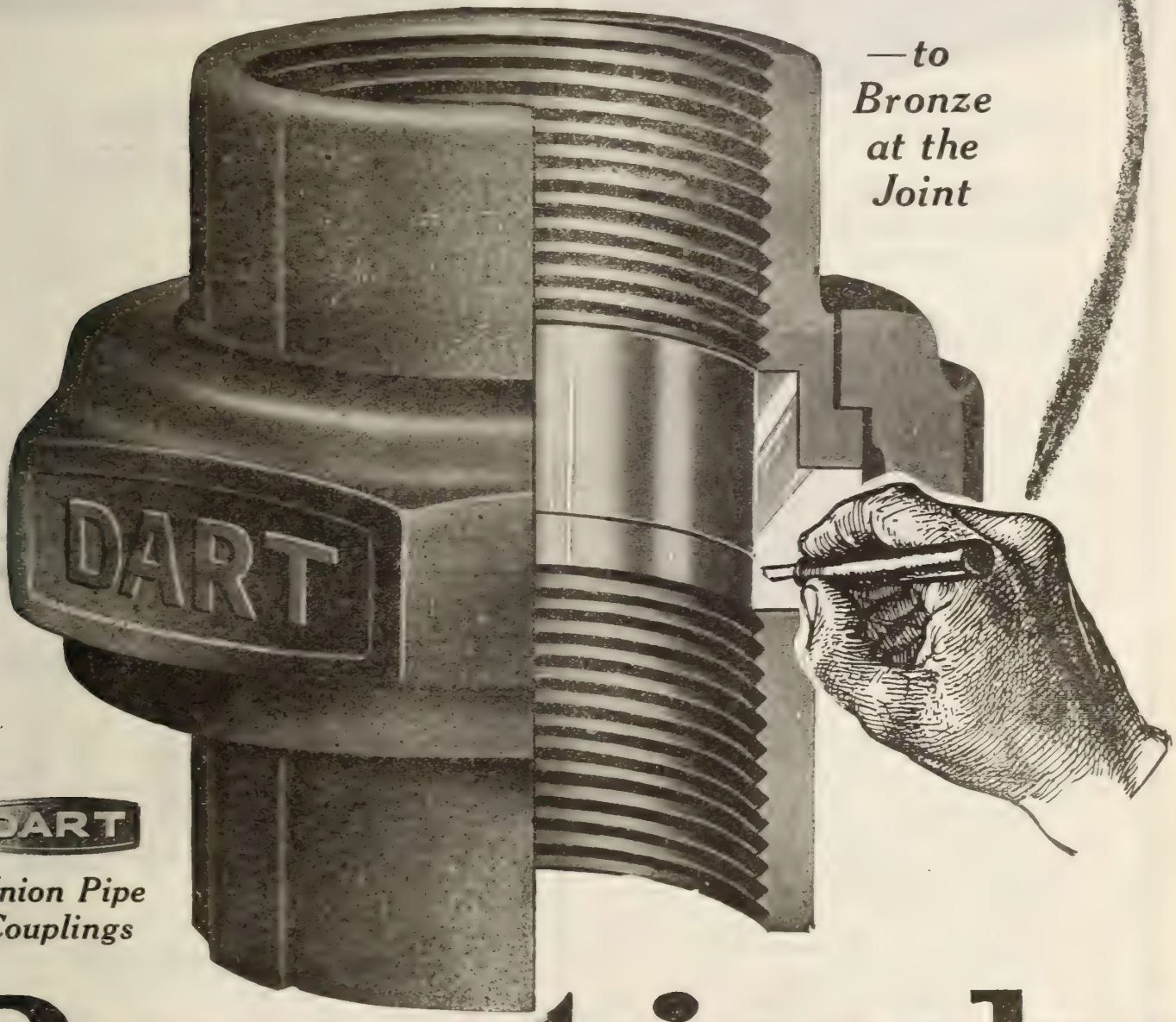
By M. E.

Belts, when running slowly and transmitting little power, may run a considerable time without giving evidence of slip, but when running at recognized speeds for the transmission of power, the slip may be considerable, although it is hardly a subject for calculation. Many factors may enter into the causes of slipping, slackness being the most important. Slipping, once begun, may polish the inner side of the belt and reduce its adhesion. A layer of air is said to enter between a high-speed belt and its pulley, serving as a lubricant and reducing adhesion. As a remedy, perforating the pulley with holes has been tried, but without definite results. Centrifugal action has also been suggested as a cause for slipping; but, when reduced to calculation, the centrifugal of a piece of belt x weight running at w speed round a pulley by radius would be a very small amount compared with the united pull of the driving and returning sides of the belt. There is another consideration, usually neglected, that may account for what might be called the permanent slip of all belts that are to any degree elastic. The driving and return sides of a belt work under different stresses, and as it passes from driving tension to return tension it is altering in length to the measure of its elasticity. When entering on the driven pulley it travels partly round before meeting the pull of the driving side, which takes place before it reaches the point of release. It is here that the belt is stretched and the permanent slip or creep takes place, which, in every elastic belt, is unavoidable. A properly adjusted steel belt should be free from this peculiarity and should ensure an accurate transmission of speed in all machines except those in which the respective revolutions of axis bring about fixed recurrent relations as in clockwork. Irregularities of belt transmission arise from dirt adhering to the pulleys or to the belts, and also from the action of heat and moisture. All belts and cords contain some moisture, and any increase or decrease of this moisture affects their length. A leather belt shortens on drying and elongates on becoming wet. Hair has the same property as leather, and this property is utilized in the hair hygrometer for measuring atmospheric humidity. Cotton cords and belts, on the contrary, shrink when moistened and elongate when dry.

MONCRIEFF'S "UNIFIC"
WATER GAUGE GLASSES
Stand in a Class by Themselves for Quality, Efficiency and Economy
A trial will convince you. Write for Catalog
W. J. WALL, 134-136 BLEURY ST., MONTREAL
(Canadian Representative)

Brongo

—to Bronze at the Joint



DART

Union Pipe Couplings

Positively

No Leaks. No Upkeep Cost. No Replacement Cost.

Couple up the pipe lines with Dart Unions and you will be forever free from leaking connections.

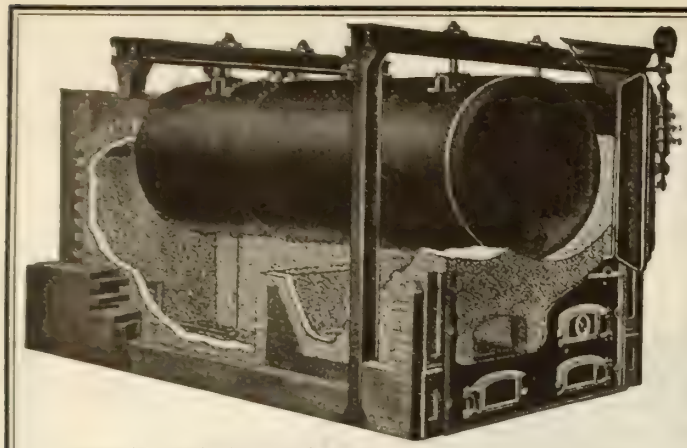
Dart Union Pipe Couplings stay tight because the Bronze faces will not rust or corrode, and the heavy iron parts will not stretch or pull apart.

Dart Unions are easy to use because of the Ball-Shaped joint which enables you to connect pipes quickly, whether pipes are in or out of alignment.

ORDER FROM YOUR JOBBER.

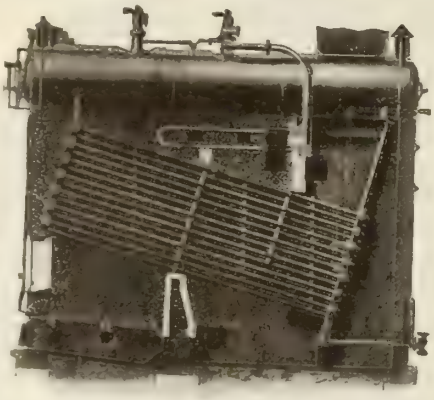
He has them in all convenient types.

Manufactured by Dart Union Co., Ltd., Toronto, Ont.



Betson's Plastic Fire Brick Lining, including fire box, front wall and arch, furnace side walls, bridge wall, combustion chamber walls and rear arch.

Your Own Men Can Put In A Betson's Plastic Fire Brick Furnace Lining



Betson's Plastic Fire Brick as used for B & W setting, including side and front walls, bridge wall and vertical baffles.

No need to wait for expert masons, or for shipment of special fire bricks or blocks.

Betson's Plastic Fire Brick replaces ordinary fire brick in about the same thickness and is adapted for lining any kind of boiler setting, including front and side walls, door arches, combustion chambers, rear arches, in any bridge and wing walls, baffles, etc. It comes in a plastic condition, is placed in chunks, consolidated with a mallet and smoothed with a trowel. No special forms are necessary, except of simple sheet iron to support door arches and light boards and braces for overhanging arches and walls. During the four or five hours of light firing required to dry and set the material these wooden supports are burned out, and the setting can then be put into full service immediately.

Betson's forms a one-piece lining without joints or cracks. Is perfectly gas-tight and much more durable than separate blocks or bricks. Betson's Plastic Fire Brick is shipped at once from stock carried in the following cities:

New York, Chicago, Philadelphia, Detroit, Cincinnati. St. Louis, Providence, Kansas City, Denver, New Orleans, San Francisco, Toronto, etc.

Ask for booklet "How Anyone Can Form a One-Piece Boiler Furnace Lining from Betson's Plastic Fire Brick."

BETSON'S

REG. U.S. TRADE MARK PAT. OFF.

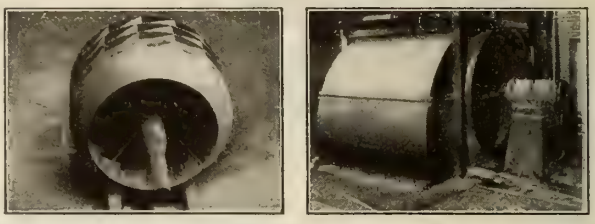
PLASTIC FIRE BRICK

Betson Plastic Firebrick Co.

P.O. Box 1537, Rome, N.Y.

New York Office, 30 Church St.

BETTER FANS—



Green's Forced Draft Fan.
210,000 cu. ft. per min. at 6" pressure.

GREEN'S
HI-EFFICIENCY HI-SPEED
RADIAL FLOW FANS

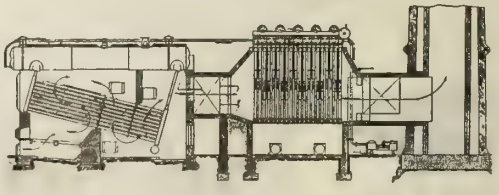
as their name indicates, require less power to drive and operate at higher speeds allowing direct connection to smaller motors or turbines than are usually required.

Our Engineers will be glad to quote on your needs.

GREEN'S ECONOMISER, LTD.
TORONTO

MONTREAL WINNIPEG NEW YORK

ARE YOU SAVING TO HELP WIN THE WAR?



GREEN'S ECONOMISERS

save 10 to 15 per cent. of your coal bill by using heat that would otherwise be wasted up the stack.

They have been doing this for 75 years.

Our Engineers will be glad to explain their operation.

GREEN'S ECONOMISER, LTD.
TORONTO

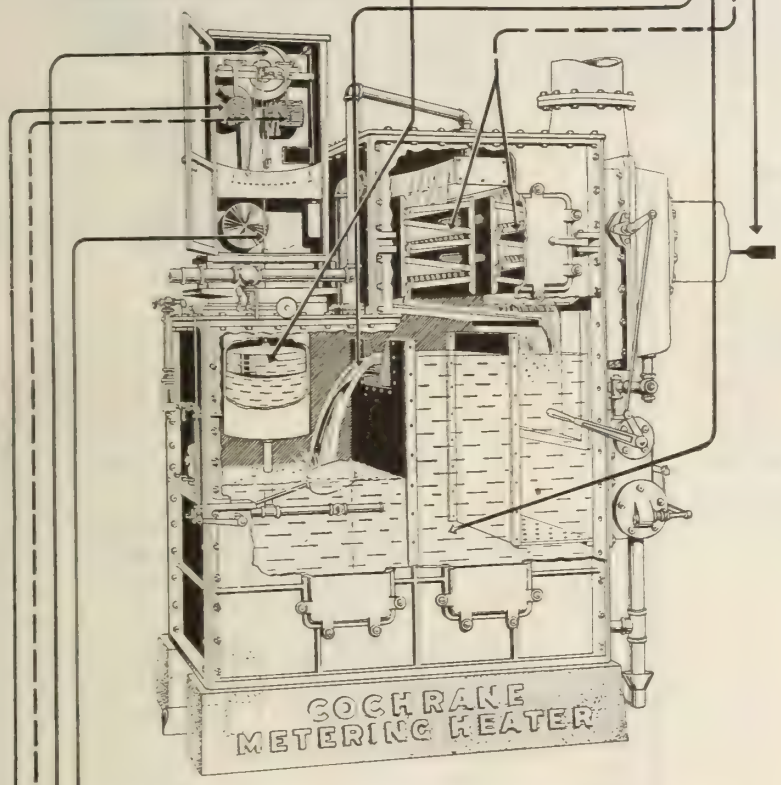
MONTREAL WINNIPEG NEW YORK

Finding and Stopping Waste

in

Modern Boiler Rooms

1 Steam purified of oil.
2 Water heated.
3 Hot water delivered to still water chamber.
4 Water flows over weir.
5 Level of water in still water chamber ascertained by float.



6 Float stem actuates spiral cam.
7 Cam moves pen carriage equal distances for equal increments of flow.
8 Pen records on clock driven chart.
9 Integrator driven from clock actuated disk.

That's all there is to it.

KEEPING BOOKS WITH THE BOILER

How many pounds of water are your boilers evaporating per pound of coal?

Are they doing 6 or 7 pounds, or just a shade better, or are they up to the top notch, say 10 or 11 pounds of water evaporated per pound of combustible?

The Cochrane Metering Heater tells how much you are getting for your money

Send for Catalogue No. 820.

Other Cochrane aids to boiler room economy include open feed water heaters, steam stack and cut-out valve heaters and receivers, metering heaters and independent meters. Sorge-Cochrane hot process water softeners, steam and oil separators, and multiport back pressure, atmospheric relief, flow and check valves.

Head Office: Toronto. Sales Offices: Montreal, Halifax, Sydney, Ottawa, Cobalt, South Porcupine, London, Winnipeg, Calgary, Edmonton, Nelson and Vancouver.

CANADIAN ALLIS-CHALMERS
LIMITED

Power Plant Equipment, Mining, Crushing, Hydraulic and Milling Machinery, Contractors' Plant and Architectural Bronze and Iron Work.

Self-Lubricating

In Bulk

SAFETY PLASTIC

METALLIC PACKING

FOR STEAM, WATER, AIR, GAS, ETC.

Pat. Dec. 22, 1903 Highest Award World's Fair, St. Louis, 1904

GUARANTEED TO LAST THREE YEARS

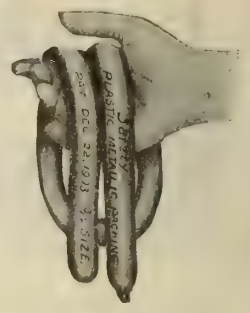
WITHOUT RENEWAL

Drop us a line and let us tell you all about this Remarkable Packing.

STEEL MILL PACKING CO., WINDSOR, ONT. Established 1899

AGENTS WANTED

Practically Frictionless



In Cotton Tubes

ADVERTISING to be successful does not necessarily have to produce a basketful of inquiries every day.

The best advertising is the kind that leaves an indelible, ineffaceable impression of the goods advertised on the minds of the greatest possible number of probable buyers, present and future.

WILLIAMS' "VULCAN" DROP-FORGED CHAIN PIPE VISE

THREE SIZES—⅛ to 8 inch PIPE
GRIP POWERFUL
READILY ADJUSTED
INDIVIDUAL CAPACITY LARGE
ATTACHABLE ANYWHERE
GUARANTEED FULLY
BOOKLET FREE

J. H. WILLIAMS & CO.

"THE DROP-FORGING PEOPLE"

78 Richards St. Brooklyn, N.Y.

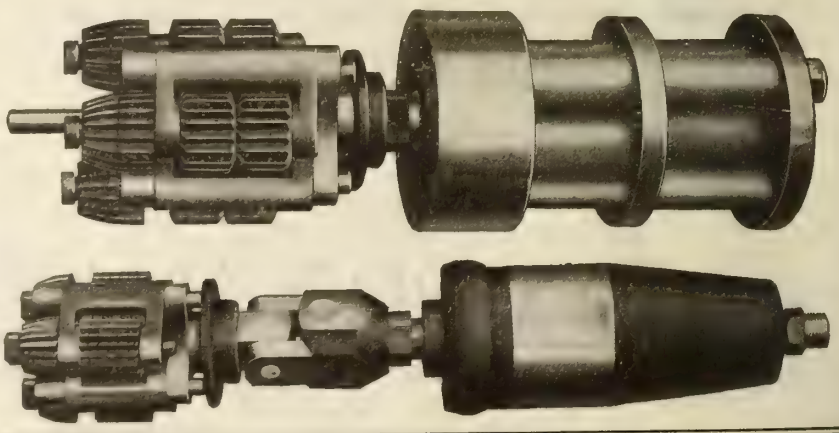
The A. G. Low Co., Ltd.,
78 Pacific Avenue, Saskatoon, Saskatchewan.
Agents for Manitoba, Saskatchewan, Alberta and British Columbia.

ROTO TUBE CLEANERS

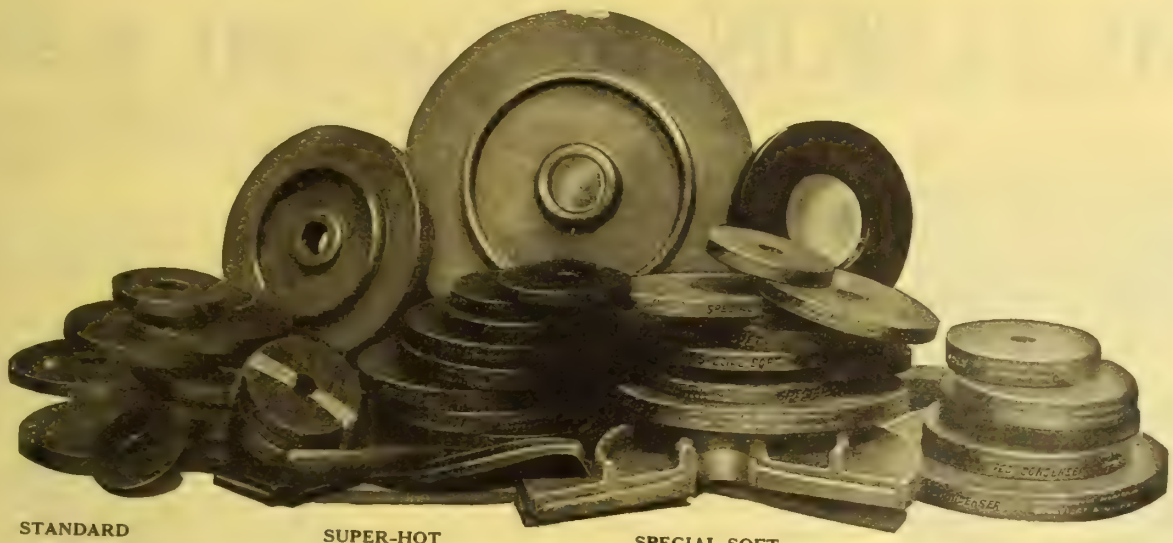
Type A.D.—Driven by Air or Steam
Type W.D.—Driven by Water Pressure

The use of Roto Cleaners is essential to the most efficient operation of Boilers, Condensers, Economizers, Evaporators, etc.
Roto succeeds where all others fail. It is faster, safer, more thorough and the standard of the largest steam power plants.

THE ROTO COMPANY
HARTFORD, CONN.
WRITE FOR CATALOG



THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED



STANDARD SUPER-HOT SPECIAL SOFT RED CONDENSER

Rub-Steel Valves

"THE VALVE WITH A BACKBONE"

WHAT IS IT? The RUB-STEEL VALVE is a valve made by a combination of rubber and steel.

THE CONSTRUCTION The construction consists of a plate of high grade steel placed in the centre of the valve with a specially tough and lasting rubber composition on each side and edge, attached securely and lastingly to the metal by the Elchemo process, which chemically unites the rubber and steel.

THE PURPOSE The steel plate gives such strength to the valve that the highest pressure cannot warp, twist or in any way get it out of shape, while the rubber surfaces afford the proper seating qualities. **"Better than Metal Because of the Rubber—Better than Rubber because of the Metal."**

WHAT IT ACCOMPLISHES It gives the valve a rigidity of form. It keeps the surface of the valve in its normal true position and insures a better seating quality. It prevents the high pressure from forcing the valve through the grating. It prevents the rubber from breaking up and the pieces causing trouble. It holds the surface of the valve in shape, so that when one side becomes worn the valve can be reversed without dressing. It is thinner and therefore gives greater efficiency to the pump. It permits the use of a softer valve for hot water, thus securing a better seat on worn or uneven "grids." It ensures an even distribution of the pressure, preventing "dishing" and the consequent cutting of the valve.

WHY YOU WANT IT **Because** its ultimate cost is less than that of ordinary type valves. **Because** it will last longer than other valves. **Because** it saves time and annoyance of replacement. **Because** its construction at once appeals to you as practical and sensible.

SOLE CANADIAN AGENTS

The Canadian Fairbanks-Morse Co., Limited

St. John, Montreal, Quebec, Ottawa, Toronto, Hamilton, Winnipeg, Saskatoon
Calgary, Vancouver, Victoria

THE CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

METLSKIN does prevent scale

Send for this illustrated booklet. It explains the dose, the method of action, and other important details

Some of Canada's and the United States' biggest and most representative plants have learned the truth of the above statement from first-hand experience.

So many "compounds" and "cure-alls" have been foisted upon unwary power-plant owners that the feeling, common to many of them, is one of doubt, of skepticism. And small wonder!

METLSKIN is not a "compound," nor does it work on the same principle. It is a boiler metal treatment, a boiler preservative that gradually removes scale by a safe process.

When the scale has been entirely removed METLSKIN forms a minute, grayish-white skin or covering over the bare metal.

So long as the daily dose is continued the scale-forming particles in the feed-water cannot adhere to the metal. Nor will METLSKIN work injury to any part of the boiler or system. That is one of the strongest features of the GUARANTEE BOND.

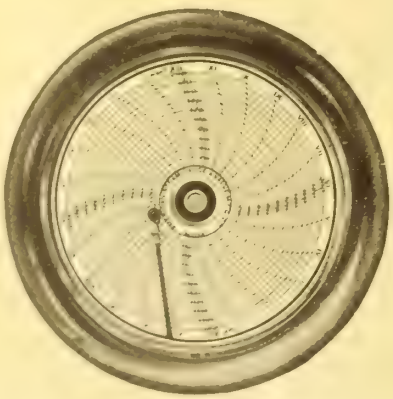
METLSKIN cannot contaminate the steam. It may be used safely in any plant where live steam comes in contact with the manufactured product.

If you are a skeptic, a doubter, ask for the booklet, GUARANTEE BOND, prices, etc. You will be interested, we know.

CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED

ST. JOHN QUEBEC MONTREAL OTTAWA HAMILTON TORONTO
WINDSOR WINNIPEG SASKATOON CALGARY VANCOUVER VICTORIA

American Recording Gauges



Help to maintain Uniform Pressures and to make permanent Records of Efficiency.

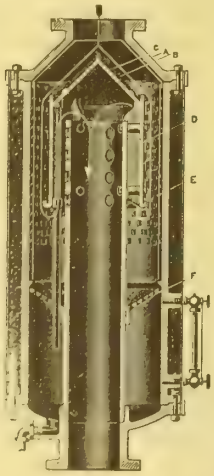
Send us details of your needs

Canadian Agents: Canadian Fairbanks-Morse Co., Limited
MONTREAL, TORONTO, QUEBEC, ST. JOHN

AMERICAN STEAM GAUGE & VALVE MFG. CO.
New York, Chicago, BOSTON, Atlanta, Pittsburg

III IMPORTANT THINGS

TO CONSIDER ABOUT A SEPARATOR.



I. THE PLAN—Is it sensible, will it work, no matter how large the Separator or how well made?

II. THE SIZE—Is it big enough regardless of plan, will it hold a good dose of water?

III. THE CONSTRUCTION—Is it strong enough, are flanges heavy, how will it look by the side of a nicely finished engine? Send for catalog and note these points in

Sweet's Separators

DIRECT SEPARATOR COMPANY
820 Geddes Street - SYRACUSE, N.Y

General Sales Agents:
Canadian Fairbanks-Morse Company, Limited
St. John, Montreal, Quebec, Ottawa, Toronto, Hamilton, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria

THE CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED.

A Double Service Belt

The side of Spar Oak next the pulley is Spartan leather, giving the maximum grip on the pulley.

The outer part of Spar Oak is firm, heavy selected, special oak tanned center stock.

Most good belts are built so as to have either fine pulley-gripping surface and less ruggedness, or plenty of ruggedness and less traction.

Spar Oak, one of Graton & Knight Standardized Series Leather Belts, is a unique belt because it has super-gripping power and the firmness that resists the mauling of hard usage.

The side of Spar Oak next to the pulley is Graton & Knight Spartan—the belting leather with the highest co-efficient of friction ever attained in any belting material; the outside is the finest quality of Graton & Knight special oak tanned, extra firm center stock. Combined, they form a belt of absolutely unique quality.

Spar Oak Belting

Spar Oak stands high speeds without slipping or burning. It stays flat under strain. The punching of shifters and rapping of pulley flanges affect Spar Oak surprisingly little. Spar Oak belts in actual use carry their traction power up to speeds of more than a mile a minute. In the hard test of "mule spinning," Spar Oak has set new standards of what belting efficiency is.

If you have a vexatious belting problem, tell us about it and let us tell you whether or not Spar Oak is the belt required. There are thousands of cantankerous drives in the United States that will lose much of their crankiness when operated by Spar Oak. If you have such a one, it is well worth your while to write us about it.

Write for information about Standardization as applied to Belting

THE GRATON & KNIGHT MFG. CO.
WORCESTER, MASS., U.S.A.

Oak Leather Tanners, Makers of Leather Belting, Lace Leather, Packing and Specialties
Branches and Distributors in all Principal Cities

Canadian Graton & Knight, Ltd., Montreal. Canadian Representatives: The Canadian Fairbanks-Morse Co., Ltd., St. John, Montreal, Ottawa, Toronto, Hamilton, Quebec, Calgary, Saskatoon, Vancouver, Windsor, Winnipeg, Victoria.

GRATON & KNIGHT

GRATON AND KNIGHT

Standardized Series

LEATHER BELTING

Tanned by us for belting use

GRATON AND KNIGHT

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

DURABLA GASKETS

cut from
Durabla Asbestos Sheet

Note the Trade-Mark on every gasket

The following Specifications of Gaskets for your *Power Plant Piping* insure uninterrupted power service.

Gaskets for **Steam Lines** **Boiler Feed Lines** **Blow-Off Lines** **Exhaust Lines**	**All gaskets to be "DURABLA" 1/16 in. thick, ring type, fitting inside bolt holes.**

For all Extra Heavy Fittings order

Durabla Gaskets for Extra Heavy Flanges and for all Standard Fittings

Durabla Gaskets for Standard Flanges

We can fill your orders promptly from stock.

Write to-day for List of Sizes and

Price List No. 104

DURABLA
TRADE MARK REGISTERED

Durabla Manufacturing Co.
New York

Distributors for Canada:
The Canadian Fairbanks-Morse Co., Ltd.

Consult Power House Buyers' Directory

If what you want isn't advertised in this issue, consult our Buyers' Directory. If it isn't listed in our Directory, write us and we will give you the information.

P&C CO

Valves and Asbestos-Packed Cocks

Send for Catalog

PRATT & CADY COMPANY, INC.
HARTFORD, CONN.

Canadian Representatives

The Canadian Fairbanks-Morse Company, Limited
Halifax St. John Quebec Montreal Ottawa Toronto Hamilton
Windsor Winnipeg Saskatoon Calgary Vancouver Victoria

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

"PALMETTO"

PACKING

CAN HELP YOU
TO SAVE THE STEAM
THAT THE
COAL SHORTAGE
HAS MADE EXPENSIVE

Scarce and High Priced Fuel

demands that every pound of steam produced performs service and does not leak through poor packing in the stuffing box.

"PALMETTO" is a packing that can be absolutely depended upon to keep the stuffing boxes steam tight, because it's made of the right materials and in a manner necessary for **LONG SERVICE.**

Working samples to prove unusual quality—No charge.

GREENE, TWEED & CO.

SOLE MANUFACTURERS

109 Duane St. - NEW YORK

The Canadian Fairbanks-Morse Co., Limited, St. John, Toronto, Quebec, Hamilton, Montreal, Ottawa, Vancouver, Victoria.

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

Proof Against Contraction or Expansion Strain

Here's a water heater whose small corrugated tubes are absolutely non-splitting. For these tubes are pure copper and they expand into floating heads independently of the cast iron shell. The advanced principles of design and the superior construction of this

ALBERGER
Multi-Head Water Heater

effectively combine to eliminate those bothersome and costly troubles common to most heaters.

Nor is that all. Here's a heater that transmits over 50% more heat than any plain-tube heater of similar size. It heats so fast that there can be hot water as fast as it can be drawn.

This Heater transmits over 50% more heat than any plain-tube heater of the same size.

ALBERGER HEATER COMPANY, BUFFALO, N.Y.

GENERAL SALES AGENT:
CANADIAN FAIRBANKS-MORSE COMPANY, Limited
St. John Montreal Ottawa Toronto Hamilton Quebec Calgary
Windsor Vancouver Winnipeg Victoria

Tuxeda
SWING JOINTS
Provide one of the easiest ways to save coal

Every pound of steam that escapes through a leaky connection represents a certain amount of coal wasted. Do you know that an average leak will waste 3,400 pounds of steam a month? Investigate your flexible steam connections at once and then investigate the Tuxeda Swing Joint.

A Guaranteed Solution for Your Flexible Connection Problems

Send for Bulletin "A" to

FRANKLIN WILLIAMS, INC.
New York City
General Sales Agents: Canadian Fairbanks-Morse Co., Ltd.

FOR Steam or Air Drill, Pneumatic Tools, Boiler Flue Cleaning, Syphon Connections, Suction Lines.

For all kinds of Oil, Gasoline, Paints, Hydraulics, Gas.

"PENFLEX" METAL HOSE
INTERLOCKING

An all Metal Flexible Hose. Manufactured in Bronze or Galvanized Steel. Will withstand highest pressures. Is unsurpassed for durability and pressure resisting qualities.

Large Stock Carried in Canada

Pennsylvania Flexible Metallic Tubing Co.
Philadelphia, Pa.

Canadian Agents:
The Canadian Fairbanks-Morse Co., Limited
St. John, Quebec, Montreal, Ottawa, Toronto, Hamilton, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria

THE CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED

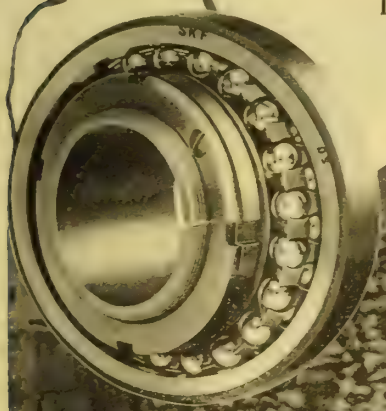
More Power From Less Coal

If your line shafting is equipped with self-aligning ball bearings marked S K F, it is the most frictionless link in the route power must take from your coal pile to your machines. Such bearings reduce power losses 15 to 33%—lubrication expenses 60 to 80%, and eliminate hot boxes.

Ball bearings marked S K F, through their self-aligning feature and double row of balls, enable your plant to turn with the same power on less fuel. They abolish power waste. They save power. Power saved means fuel saved, and fuel costs money. For particulars send for Transmission Catalog and testimonial letters.

CANADIAN SKF COMPANY, LIMITED
TORONTO, ONT. MONTREAL, QUE.

Agents for SKF Transmission Bearings:
THE CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED
St. John, Quebec, Montreal, Ottawa, Toronto, Hamilton, Windsor, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria.



SKF

"The Power of the West"

AS soon as peace is in sight, politics will again come into play in Canada and then the West may hold the balance of power. Such is the prediction made by J. K. Munro, special political writer, in November MACLEAN'S. He thinks that the Western tail may wag the Canadian dog and that this explains why statesmen and others are trying to-day to get both hands on the tail. An outspoken article—incisive, humorous, fearless, unbiased. Read it—"The Power of the West."

Germany Should Pay Canada's War Debt

Had Germany won the Junkers intended to seize and divide Canada. Writing in the November issue of MACLEAN'S MAGAZINE, Lieut-Col. J. B. Maclean contends that the war debt we have piled up should be paid in cash by Germany as one of the terms. He makes a vigorous presentation of Canada's case.

Chronicles of the Klondyke

The real story of the great gold boom is being told for the first time by E. Ward Smith, who was treasurer, assessor, clerk and tax collector of Dawson City during the Yukon stampede. His series starts with "My Recollections of Early Strikes"—Strange stories of how men stumbled on tremendous fortunes in the frozen North. The author knew everyone in the Klondyke and saw everything that went on at first hand.

Bright Stories—Vital Articles—Famous Writers

The important articles and the big stories that are being written in Canada by the best Canadian writers are always found nowadays in MACLEAN'S. Here's a partial list of the November bill:—

The Minx Goes to the Front — **C. N. and A. M. Williamson**

Better Dead—The Silly World of the Spiritualists — **Stephen Leacock**

The Strange Adventure of the Staring Canvas — **Arthur Stringer**

Family Pride - **Theodore Goodridge Roberts**

The Three Sapphires - - **W. A. Fraser**

The Life of Mary Pickford - **Arthur Stringer**

We Must Tighten Our Belts - **Henry B. Thomson (Chairman, Canada Food Board)**

Lenix Ballister—Detective - **A. P. McKishnie**

Business Outlook — **Investment Situation**

Women and Their Work — **Books of the Month**

World Happenings in a Nutshell.—"Review of Reviews Dept."

The periodicals of the world are searched to get the best articles on current events. For instance, November MACLEAN'S contains: The Starving of Lille, The True Story of the Jameson Raid, Germany's Fleet Will Come Out? Mysterious New City in France, The Woman Who Caused Russia's Defeat, Hypnotism Cures Shell Shock, How Turkey Planned to Butcher British, Queen Mary is Accomplished Letter Writer, Why Palestine Was Captured.

Buy an *Extra* Copy for Husband, Brother, Friend, and Send Overseas

Over 60,000 Canadian Families Buy

MACLEAN'S

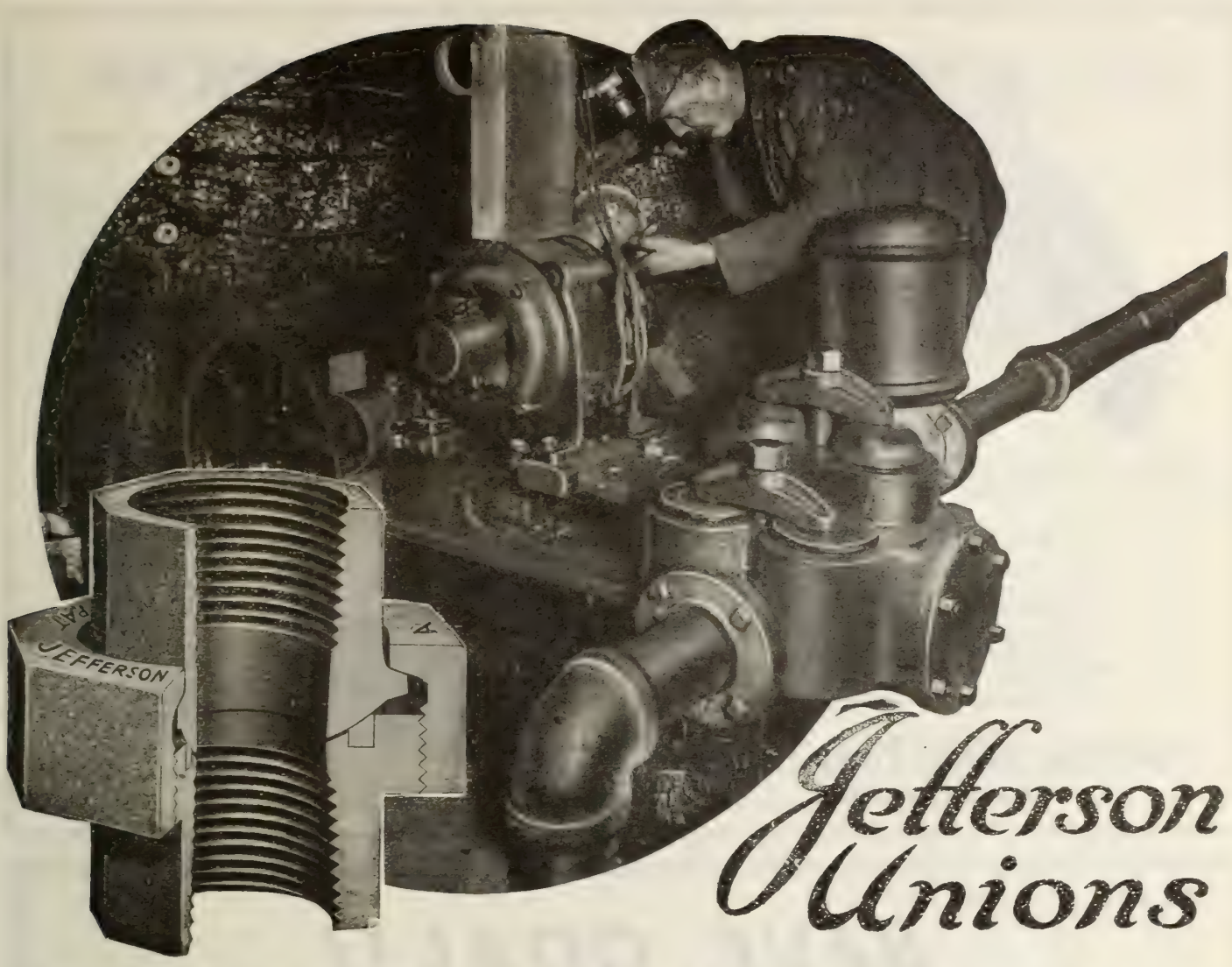
"CANADA'S NATIONAL MAGAZINE"

NOVEMBER ISSUE

Now On Sale
At All News Dealers

20c Per Copy. $2.00 Per Year.

Dealers who have not been handling MACLEAN'S should secure copies at once from their nearest Wholesaler.



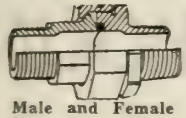
Jefferson Unions

Prevent Pipe Troubles In the Power House

The unprecedented demand for coal makes continuous productive operation more important now than ever. Time lost through shutdowns is "comfort to the enemy."

Jefferson Unions are built with the rugged strength which adapts them perfectly to the severe conditions of coal mining service. There are no "fads" on the Jefferson—they are the product of specialists whose sole purpose is to make unions—better unions—Jefferson Unions.

Be sure to get JEFFERSONS. Look for the name on the nut. It is your protection against costly shutdowns. The "just-as-good" union may look all right but you cannot afford to take chances where superstrength is required. **Ask your jobber to tell you all about Jeffersons. He knows their strong points and will be glad to help you select the right union for your job. Mail the coupon to-day.**



Male and Female Union, Style F, a short style which allows the use of any kind of a wrench.

Union Elbow. An economizer of the most pronounced type. Also made all female.

Jefferson Union Company
Lexington, Mass.

Jefferson Union Co., Lexington, Mass.
Gentlemen: Mail me postpaid and without any obligation to me, copy of your **New Catalog** and the name of your nearest dealer.

Name .....
Firm Name .....
Address .....

P.H. 11 18

This book should be in the hands of every pump user. A postal will bring your copy promptly

MARSH and AMERICAN

Steam and Power Driven Pumps and Air Compressors

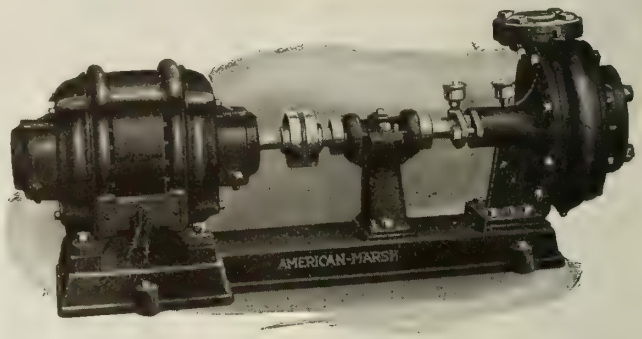
Marsh and American Pumps are especially adapted for long, hard service because they are *extra heavy* in design and of *extremely rigid construction*. Every unit is built amply strong to withstand 24-hour-a-day service and to stand up under any unforeseen strain which may be placed upon it. Piston rods on the steam pumps are extra large and made of solid bronze. The water ends are equipped with heavy cast bronze removable bushings.

This superior construction not only insures continuous and satisfactory operation, but practically *eliminates expensive shut-downs*. Marsh and American Pumps are the product of over 25 years' experience in the design and construction of high grade pumping machinery. Over 135,000 in actual service throughout the world.

The AMERICAN-MARSH LINE OF CENTRIFUGAL PUMPS is composed of both single and double suction types which are designed for heads up to 125 feet. They are equipped with wide ring oiled bearings and the single suction type has overhanging casing enabling the discharge to be taken at any angle desired.

CANADIAN AGENTS

A. R. Williams Machinery Co., Toronto.
Williams & Wilson, Montreal.
London Engine Supplies Co., London, Ont.
Stuart Machinery Co., Winnipeg.
Mechanics' Supply Co., Quebec, Que.
Gorman, Clancy & Grindley, Limited, Edmonton and Calgary.
Taylor Engineering Co., Ltd., Vancouver, B.C.



American-Marsh Centrifugal Pump.

American Steam Pump Company

Battle Creek, Mich.

SAVE COAL!!

USE

ECONOMIC BOILER COMPOUND

The cry for economy has gone through the land as a war necessity, so why not cut down your COAL CONSUMPTION? If you will send us a piece of scale from your boilers we will analyze same and send you our ECONOMIC BOILER COMPOUND, which we will guarantee to remove the scale from your boilers, or no pay for same.

ECONOMIC BOILER COMPOUND

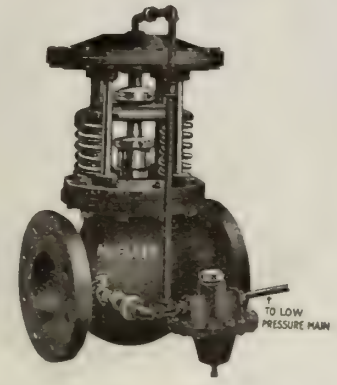
Manufactured by

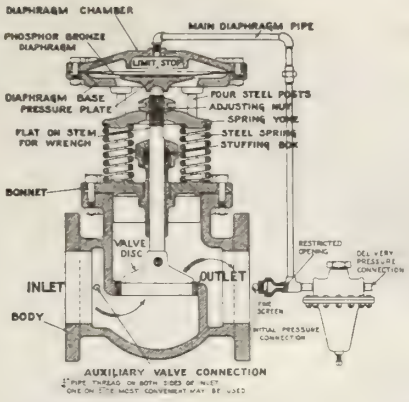
Canadian Economic Lubricant Company, Limited

MONTREAL

MUELLER Reducing and Regulating Valve

SINGLE SEAT ; AUXILIARY OPERATED





E5030 for Water, Gas and Air
E5130 for Steam
(Flanged or Screwed.)

Very Popular with Shipbuilders

USES

This valve is for use on exacting installations. It will make any desired reduction and will maintain a constant delivery pressure regardless of fluctuations of the intial pressure.

CONSTRUCTION OF STOCK REGULATORS

All valves have iron bodies, bronze stem and stuffing box, phosphor bronze diaphragms, seats of composition suitable for the required service; iron diaphragm chamber and steel springs. The main valve is controlled entirely by the small auxiliary valve. This auxiliary valve closes and opens the main valve by admitting initial pressure to, and releasing it from, the diaphragm chamber of the main valve according to the demands of the delivery side. Regulators of this description are suited for pressures up to 150 pounds, and will be furnished at above prices. When regulators are required for pressures in excess of 150 pounds we will furnish of suitable material. Prices upon application.

STRAINER

In all cases it is advisable to use a strainer to prevent obstruction from grit, scale, cuttings, etc. Blow out pipes thoroughly before installing valve.

INFORMATION IN ORDERING

In ordering give highest and lowest initial pressure and required low or delivery pressure, approximate quantity or volume to be used per minute, size of high pressure pipe and low pressure pipe.

In ordering flanged end valves give diameter of flanges and bolt circles and the number and size of bolts.

INSTALLATION

Note.—Any proper working regulator acts as a check valve. Where the building up of the pressure is to be avoided use our diaphragm operated relief valve E5060.

We will not be responsible for improper selection of valves.
Consult us regarding the best type for your service.

H. MUELLER MFG. CO., LIMITED

SARNIA - CANADA

VALVES

BRASS
OR
IRON BODY
SCREWED
OR
FLANGED

Suitable
FOR
STEAM
WATER
GAS
AIR
ACID or
OIL

Sizes
¼" to 12"
Carried
in Stock

For
Pressures
125 to
500 lbs.

Globe, Angle, Check & Gate

T. McAVITY & SONS
LIMITED

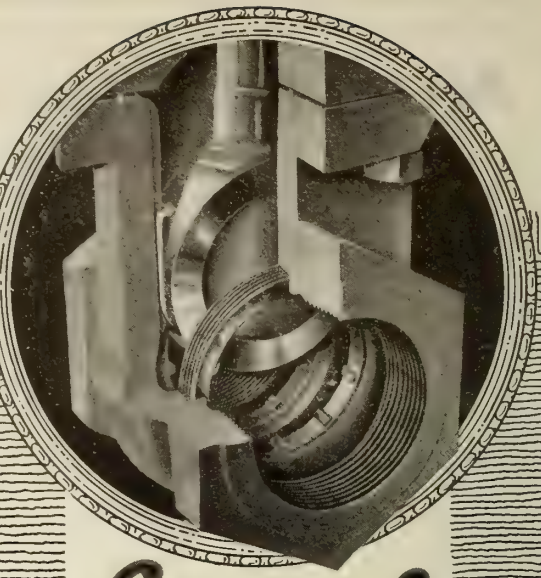
Hardware and Metal Merchants
Brass and Iron Founders

ST. JOHN, N.B.

MONTREAL
T. McA. Stewart
157 St. James St.

TORONTO
Harvard Turnbull & Co.
207 Excelsior Life Bldg.

WINNIPEG



Giving service

And it is **service** by which the value of valve equipment should be determined.

LUNKENHEIMER "VICTOR" GATE VALVES

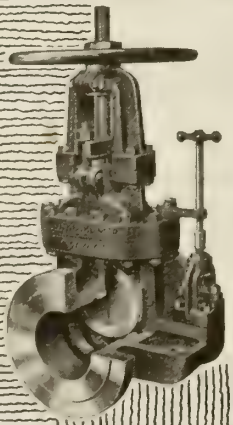
Because of the high quality materials used and their practical design, give that continuous service necessary for maximum production, and economy in plant maintenance. Their construction also embodies the added advantage of the renewability of all the parts. This permits the repair or replacement of a part should necessity require, and not only saves considerable time and expense but also aids in the conservation of equipment.

Write for descriptive literature.

THE LUNKENHEIMER CO.
"QUALITY"
Largest Manufacturers of
High Grade Engineering Specialties in the World
CINCINNATI, O., U.S.A.

New York
Chicago
Boston
London

6-19-49



Our "WAR-PERIOD" Appeal
ENGINEERING APPLIANCES ARE PRIME WAR ESSENTIALS
Stocks of distributors and facilities of manufacturers must be adjusted to care for essential needs. Lunkenheimer patrons are earnestly requested to assist in the common cause by confining their requirements to War Period specifications for essential plants, craft, vehicles, or equipment.
"On to Victory"
THE LUNKENHEIMER CO. "QUALITY" CINCINNATI

TRADE
JENKINS
MARK

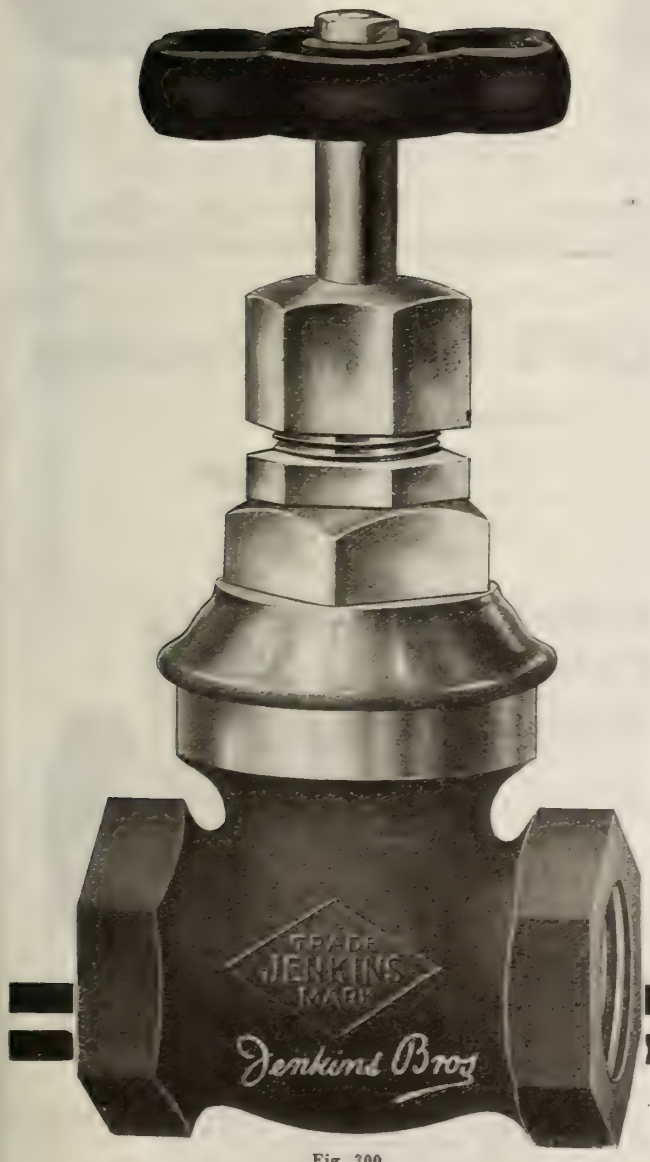


Fig. 300
Type "K" Brass Gate Valve
Screwed

Jenkins Bros

The Guide to Better Valve Service

A TRADE-MARK means nothing unless it is backed by a good reputation.

For over fifty years thousands of plants and buildings have been using Jenkins Bros'. Valves. They know that the "Diamond" Trade-Mark is a guarantee of absolute dependable service.

Jenkins Bros'. Type "K" Brass Gate Valves are popular with Gate Valve users everywhere, and like others of the Jenkins Bros'. line, are fully guaranteed.

Specify them and look for the "Diamond" Trade-Mark before buying.

Let it be your guide to better Valve Service.

STOCKS AT ALL DEALERS

Jenkins Bros. LIMITED

Head Office and Works:
103 St. Remi Street,
Montreal, Canada

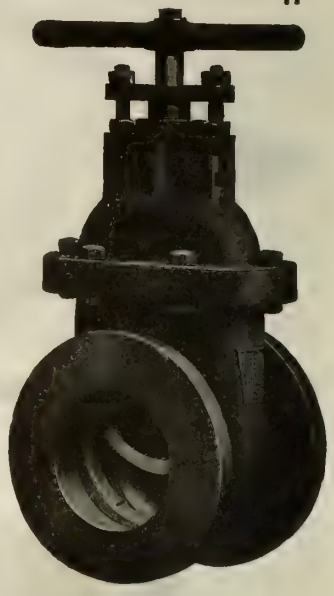
Agencies in all
Principal Countries
of the World

European Branch:
95 Queen Victoria Street,
London, E.C. 4, England

KERR
("New KEYSTONE" Pattern) GATE VALVES

If you have not used any of these New Pattern Valves, specify "KERR" in your next order. We want you to get acquainted with the most reliable valve on the market.

If you have been using them, we are confident that our satisfaction will bring us your repeat orders. These valves will never cause you or your customer the slightest trouble. Their high quality is consistent.



When you buy a "KERR" Valve you get a guaranteed article that is backed by a reliable firm. Many of the largest distributers of valves in Canada have sold "KERR" Valves for over 25 years, and are still recommending them as the "Best Valve." Write us for particulars.

Kerr Engine Co., Ltd., Valve Specialists **Walkerville, Ont.**

Homestead

Quarter Turn Valves close with a quarter-turn and remain tight without dripping or leaking. They're built to stand greater pressure than that for which they are recommended.

QUARTER TURN **Valves**

Up against the hardest proposition in your plant, Homestead Quarter Turn Valves will quickly earn their cost by eliminating leakages. No matter how severe the service, you need not worry; use Homestead Quarter Turn Valves for absolute safety. Use them wherever other valves fail.

Write to-day for a Homestead Valve.

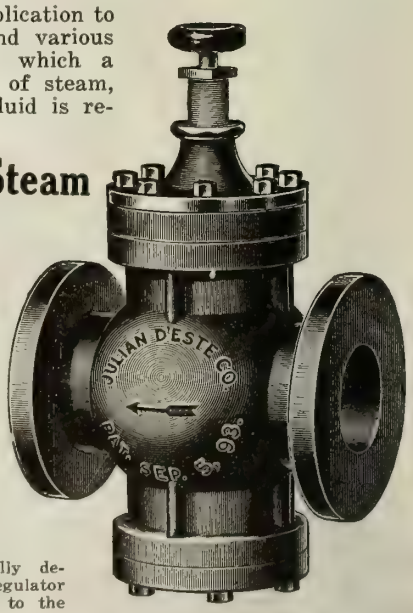
Homestead Valve Mfg. Co.
HOMESTEAD, PA.

CURTIS Engineering Specialties

Universality!

For universal application to all the varied and various conditions under which a reduced pressure of steam, water or other fluid is required the

Improved Steam Pressure Regulator



has no equal.
It is compact and self-contained, without levers, weights or projections.
No glands or packing; no drip or leak of steam or water. Suitable for any boiler pressure; made entirely of metal: is a lock valve, very simple and sensitive.
Send for leaflet fully descriptive of this Regulator (contains price list) to the manufacturers.

MANUFACTURED BY THE

JULIAN D'ESTE COMPANY
Main Office, 26 Canal St., Boston, Mass.
Agencies: 216 FULTON ST., NEW YORK CITY; 174 N. MARKET. ST., CHICAGO, ILL.

CONSERVATION

lies at the very base of the Government's War Programme. The Allies must have more oil. Production of oil is at its height. More oil for war purposes can be had only by rigid conservation.

Oil must not only be conserved by "Stopping the Leaks and Saving the Drops,"

but also

"By making Every Drop Work."

"TO SAVE THE DROPS" the most efficient OIL STORAGE AND HANDLING SYSTEMS ARE absolutely indispensible.

BOWSER ESTABLISHED 1885

Systems are

LEAKPROOF
FIREPROOF
LOSSPROOF
DETERIORATION PROOF
EVAPORATION PROOF
RAPID
CONVENIENT
HIGHLY EFFICIENT

"TO WORK THE DROPS" properly, oil must be used over and over again until it is actually worn out. This does not mean until it is full of impurities, but actually worn out.

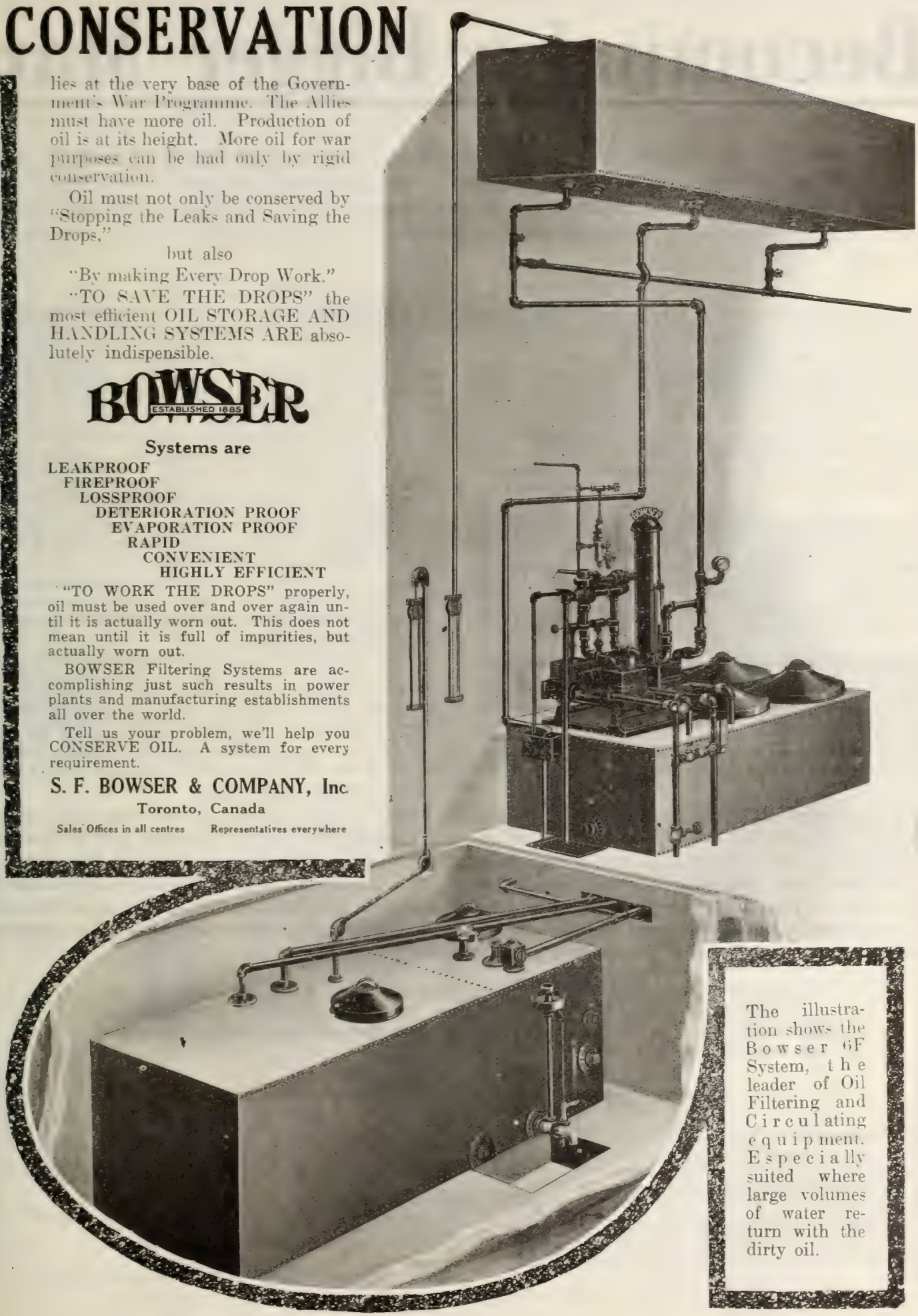
BOWSER Filtering Systems are accomplishing just such results in power plants and manufacturing establishments all over the world.

Tell us your problem, we'll help you CONSERVE OIL. A system for every requirement.

S. F. BOWSER & COMPANY, Inc.

Toronto, Canada

Sales Offices in all centres Representatives everywhere



The illustration shows the Bowser 6F System, the leader of Oil Filtering and Circulating equipment. Especially suited where large volumes of water return with the dirty oil.

Becoming a Bigger Man

WHAT is the difference between some men you know and others known to you? Why are some men earning $3,000 a year and some $30,000? You can't put it down to heredity or better early opportunities, or even better education. What, then, is the explanation of the stagnation of some men and the elevation and progress of others?

We are reminded of a story. A railroad man, born in Canada, was revisiting his home town on the St. Lawrence River. He wandered up to a group of old-timers who sat in the sun basking in blissful idleness. "Charlie," said one of the old men, "they tell me you are getting $20,000 a year," "Something like that," said Charlie. "Well, all I've got to say, Charlie, is that you're not worth it."

A salary of $20,000 a year to these do-nothing men was incredible. Not one of the group had ever made as much as $2,000 a year, and each man in the company felt that he was a mighty good man.

Charlie had left the old home town when he was a lad. He had got into the mill of bigger things. He developed to be a good man, a better man, the best man for certain work. His specialized education, joined to his own energy and labor sent him up, up, up. To put it in another way: Charlie had always more to sell, and the world wanted his merchandise—brain, skill and ability. Having more to sell all the time, he got more pay all the time.

Charlie could have stayed in the old home town; could have stagnated like others; could have been content with common wages. In short, Charlie could have stayed with the common crowd at the foot of the ladder. But Charlie improved himself and pushed himself, and this type of man the Goddess of Fortune likes to take by the hand and lead onward and upward. Almost any man can climb higher if he really wants to try. None but himself will hold him back. As a matter of fact, the world applauds and helps those who try to climb the ladder that reaches towards the stars.

The bank manager in an obscure branch in a village can get out of that bank surely and swiftly, if he makes it clear to his superiors that he is ready for larger service and a larger sphere. The humble retailer can burst the walls of his small store, just as Timothy Eaton did, if he gets the right idea and follows it. It is not a matter of brain or education so much as of purpose joined to energy and labor. The salesman or manager or bookkeeper or secretary can lift himself to a higher plane of service and rewards if he prepares himself diligently for larger work and pay. The small manufacturer, the company director, the broker—all can become enlarged in the nature of their enterprise and in the amount of their income—by resolutely setting themselves about the task of growing to be bigger-minded men.

Specialized information is the great idea. This is what the world pays handsomely for. And to acquire specialized information is really a simple matter, calling for the purposeful and faithful use of time. This chiefly.

One does not have to stop his ordinary work, or go to a university, or to any school. One can acquire the specialized information in the margin of time which is his own—in the after-hours of business. Which means: If a man will read the right kind of books or publications, and make himself a serious student at home, in his hours—the evening hours or the early morning hours—he can climb to heights of position and pay that will dazzle the inert comrades of his youth or day's work.

IF business—BUSINESS—is your chosen field of work, we counsel you to read each week THE FINANCIAL POST. It will stimulate you mentally. It will challenge you to further studious effort. It will give you glimpses into the world of endeavor occupied by the captains of industry and finance. With the guidance of the POST, and with its wealth of specialized information, you, a purposeful man, aiming to go higher in life and pay, will find yourself becoming enlarged in knowledge and ambition, and will be acquiring the bases and facts of knowledge which become the rungs of the ladder you climb by.

It is the first step which costs. But this cost is trivial—a single dollar. We offer you the POST for four months for a dollar. Surely it is worth a dollar to discover how right we are in our argument. If yoou have the will to go higher in position and pay, sign the coupon below.

THE MACLEAN PUBLISHING COMPANY, LIMITED,
.—143-153 University Avenue, Toronto.

Send me THE FINANCIAL POST for four months for one dollar.

Money to be enclosed remitted

Signed .....

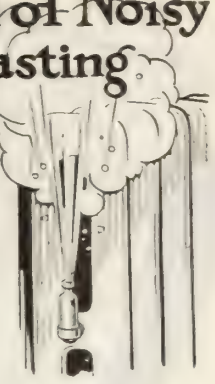
P. H. .....

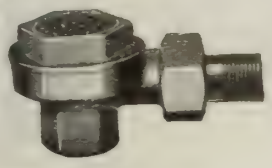
One Practical Way to Save Coal

Coal waste usually advertises itself; that is why we repeat our warning to watch your heating system. You cannot use your coal economically when the heat it makes is wasted by inefficient traps or air valves.

We are willing to spend our time and money to see whether your heating system is toeing the mark for efficiency. Are you willing?

Get Rid of Noisy Heat-Wasting Valves!





The Dunham Radiator Trap

Automatically removes the coal-wasting air and water from radiators; stops the pounding and hissing; quickly saves enough coal to pay for itself.

The DUNHAM HEATING SERVICE

The Dunham Radiator Trap is only one element in the Dunham Heating Service—a service that stops coal-waste from boiler to return pipe. We shall be glad to give you facts and figures on installations that are now making remarkable fuel-saving records.

Are you willing to hear the facts?

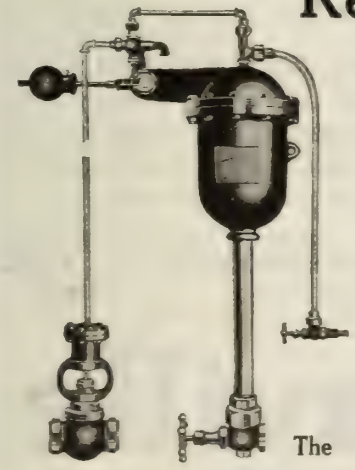
C. A. DUNHAM COMPANY, LTD., Toronto, Ontario

Branch Offices: Halifax, Montreal, Ottawa, Winnipeg, Vancouver, Calgary

Change-Over Work Our Specialty

VIGILANT

Automatic Feed Water Regulator



Regardless of load or firing, our latest Improved Vigilant feeds water to boilers automatically and keeps the level constantly within ¼ inch of middle gauge.

The Vigilant calls for no attention. It does its work automatically. With it installed you know there is no need for worry. You know there is nothing about it to get out of order.

And it's a fuel saver, too.

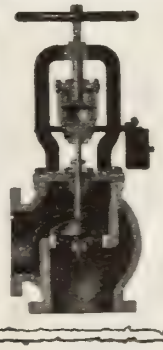
Ask for Catalog.

The Chaplin-Fulton Manufacturing Company

28 Penn Avenue - Pittsburgh, Pa.

DAVIS

Check Valves INSURE SAFETY



One of the Davis Steam Savers

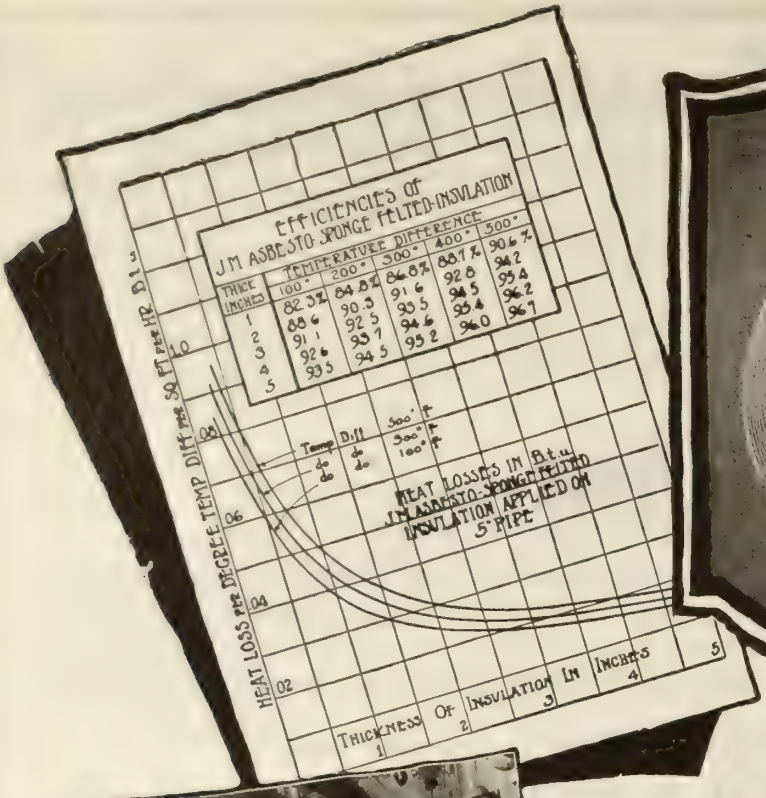
Let the Davis Stop and Check Valve insure safety in your plant by preventing boiler accidents. This valve automatically closes on a reverse flow of steam. An outside oil dash-pot, away from the effect of the steam, makes the action positive and absolutely reliable. The counter-weight lever is an indicator showing the valve action—can be tested by hand. It is as simple as a common stop valve, and requires no more attention.

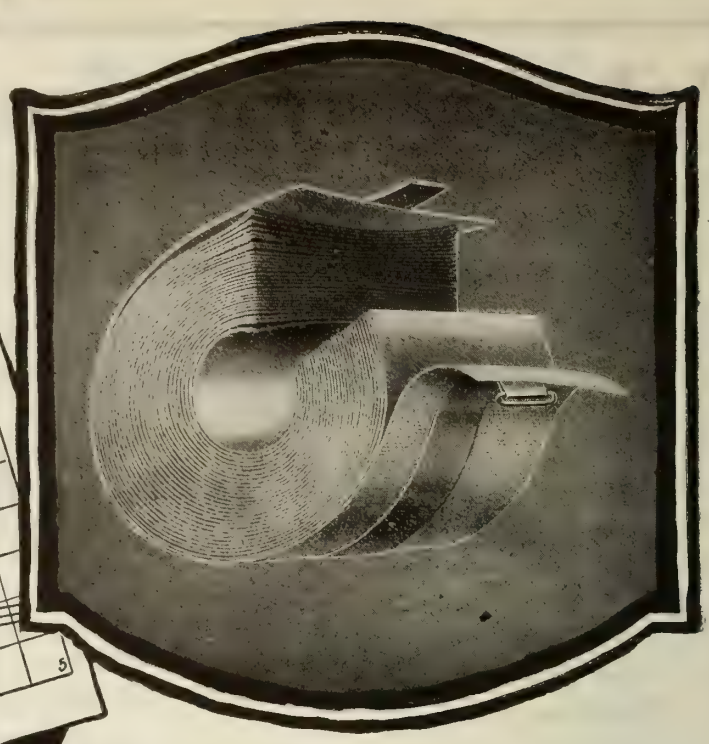
For your copy of the Davis valve booklet, just address the G. M. Davis Regulator Co., 434 Milwaukee Ave., Chicago. Branches in principal cities.

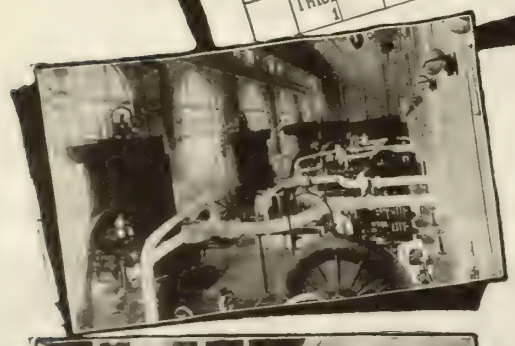
DAVIS VALVE SPECIALTIES

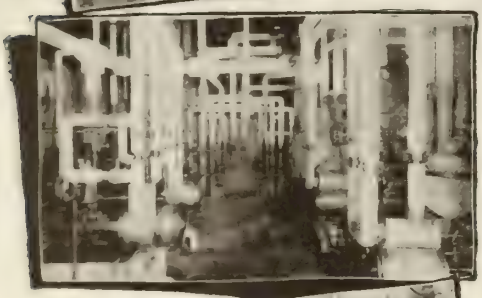
STEAM SAVERS SINCE 1875

If any advertisement interests you, tear it out now and place with letters to be answered.









90% Efficient
—and how you can know

YOU can't tell the efficiency of insulation by looking at it—or merely by price comparison. It must be a proven saver of heat. And nothing but laboratory and service tests will prove or forecast the saving. It is by data so obtained that the value of Johns-Manville Insulations are determined.

Johns-Manville engineers, with the service-proven efficiency records of each type before them, base their recommendations on a searching analysis of your service requirements.

They select from the several Johns-Manville Insulations that type that will most efficiently meet your requirements—not only on basis of heat saved but on basis of heat saved per dollar of expenditure. This is Johns-Manville Insulation Service.

The Canadian H. W. Johns-Manville Co., Ltd.

MONTREAL TORONTO VANCOUVER WINNIPEG
HAMILTON LONDON OTTAWA

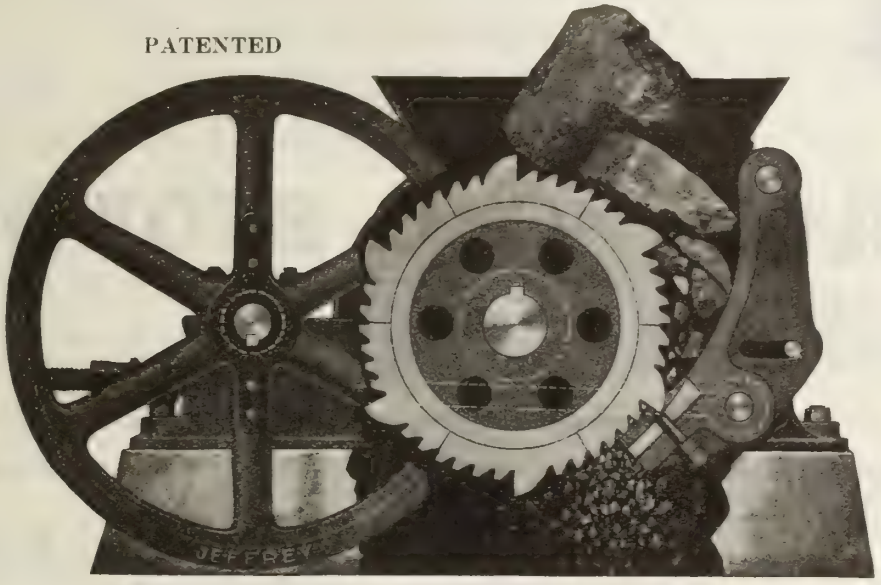
JOHNS-MANVILLE SERVICE
COVERS THE CONTINENT

Johns-Manville Heat Insulation

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

Where is Your Supply of Stoker Coal to Come From?

From all indications a repetition of last winter's coal shortage is inevitable. Manufacturers, power companies and railroads are storing coal in large quantities and the coal operator ships the sizes most easily loaded, that is, Run-of-Mine or Lump.



Make the Desired Sizes of Coal Yourself

By Using The

JEFFREY SINGLE ROLL COAL CRUSHER

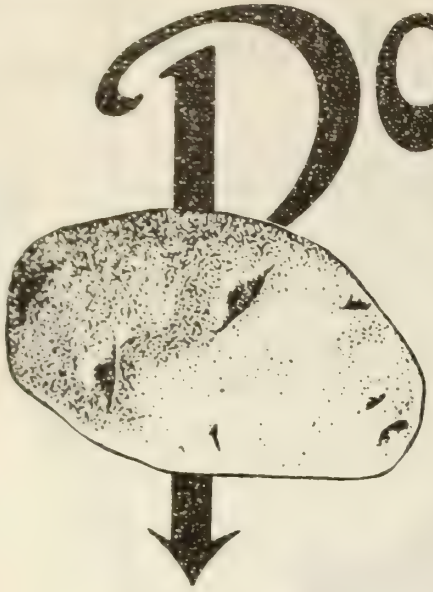
In a single operation this machine reduces Run-of-Mine or Lump to the proper size for maximum heat efficiency in stokers.

Bulletin No. 141-4 gives complete information why the Jeffrey Crusher safeguards your coal supply and eliminates the worry of buying properly sized coal. Write for copy.

THE JEFFREY MFG. CO.

Canadian Branch and Warerooms:
MONTREAL

Headquarters for Chains and Attachments, Sprockets, Elevators, Buckets, Boots, Casings, Spiral and Belt Conveyer, Gears, Etc.



POTATO SCALE POWDER

A Simple, Inexpensive Means of Saving Fuel

Canada will face a serious fuel shortage next winter. Every pound of coal should be conserved—right now. A little POTATO SCALE POWDER in the feed water of your boilers each day will save many tons of coal for Canada in the course of a few months. POTATO SCALE POWDER removes old scale from the boilers and prevents any new scale formations, thus your boilers are able to do maximum duty with a minimum amount of fuel. No pitting, foaming or other troubles, due to impurities in feed water, where POTATO SCALE POWDER is used.

Made to suit feed water conditions and contains nothing that will cause the slightest injury to boiler metal or fittings.

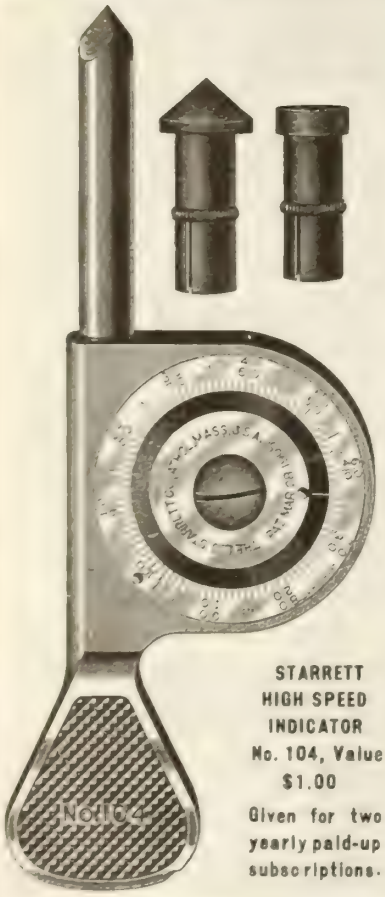
Large power plants in Canada and United States are constant users of POTATO SCALE POWDER. Positively guaranteed. Try a barrel and watch the result.

BOILER CLEANSER

C. C. SNOWDON

Oils Refiner, Manufacturer and Importer, Pennsylvania, Lubricating and Refined Oils, Gasoline, Potato Scale Powder, Liquid Soap, Disinfectants, Polish, Waste, Oil Tanks, etc.

Winnipeg—Cor. Notre Dame and Pine Streets, P.O. Box 1984. **Vancouver**—823 Powell Street. **Calgary**—1810-1840 Eleventh St. East, P.O. Box 1384, P.O. Drawer 166. **Edmonton**—Cor. 13th Ave. and 83rd St., P.O. Box 877.



STARRETT HIGH SPEED INDICATOR No. 104, Value $1.00 Given for two yearly paid-up subscriptions.

You May Have This Speed Indicator without Spending a Cent

if you are a subscriber to "POWER HOUSE." If you are not a subscriber, send in your own subscription together with two others, and the indicator you are entitled to will be mailed to you immediately.

To subscribers who send us two NEW yearly paid-up subscriptions we will send this $1.00 indicator.

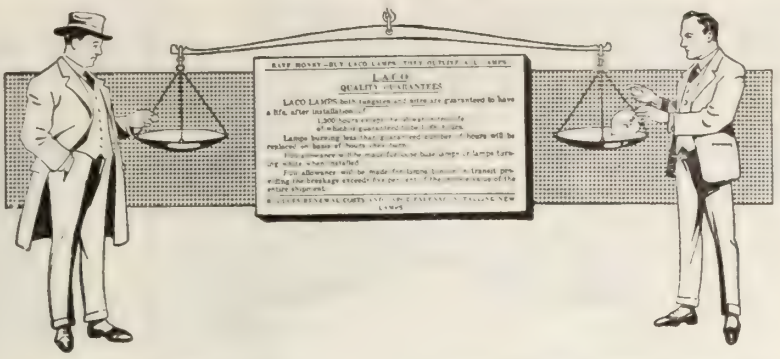
"POWER HOUSE" is designed to give Canadian Engineers, Superintendents and Power Users all the latest and best information in the engineering field. A little work among your engineer friends and acquaintances will earn for you this handy indicator without any trouble. Try it and see how easy it will be.

PUBLISHED MONTHLY AT $1.00 PER YEAR
Start in TO-DAY to earn one of these Handy Tools

POWER HOUSE 143 University Ave., **Toronto**

"Rock Bottom" Lamp Prices

The Value of a Lamp Depends upon Three Factors:—



INITIAL COST

One 40-watt LACO Tungsten costs 40c. One "ordinary" 40-watt Tungsten costs 38c.

LENGTH OF LIFE

But two 40-watt Laco Tungstens burn 3000 hours, while it takes at least three ordinary lamps to last as long.

CURRENT CONSUMED

And Laco Lamps have been proved to burn 25 to 50% less current, to effect the same light.

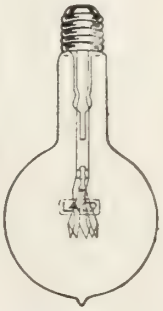
The savings on other styles and sizes of Laco Lamps are equally great.

Laco Lamps Are Guaranteed for 1500 Hours Useful Life
(excepting 60-Watt Nitro—guaranteed for 1000 hours life.)

No other Lamp is guaranteed for more than 1000 hours. Laco Lamps are also guaranteed to give the Candle-Power U. S. Standard Specifications provide.

Laco Lamp Prices Give the Purchaser Greatest Lamp Value

Let the Laco Engineers investigate your lighting problems and devise the correct installation to meet your needs.



LACO LAMPS

CANADIAN LACO-PHILIPS CO., LIMITED

MONTREAL TORONTO WINNIPEG VANCOUVER

PACKINGS AND ENGINEERS' SUPPLIES FOR Satisfactory Service

Thomson-Gordon Limited

Hamilton, Ont.

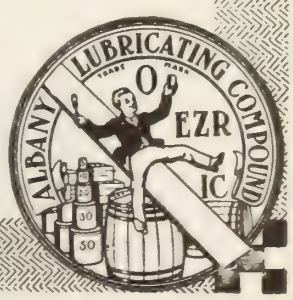
Albany Grease

has just rounded out a half century of usefulness. Its incomparable record of lubrication service during the past 50 years stamps it as a most efficient and economical lubricant. For

50 YEARS

Albany Grease has been used by engineers on the bearings of engines, motors, pumps, compressors, line shafting and all their other equipment. If you are not using Albany Grease send for samples and try it.

ALBANY LUBRICATING COMPANY
708-10 Washington Street
NEW YORK U.S.A.
Established 1868



If any advertisement interests you, tear it out now and place with letters to be answered.

In Canada's Biggest Industries

Where absolute certainty must be counted upon at all times, no chance can be taken with equipment.

In the big industries, especially, must every detail be efficient—the blow-off valve as well as the boilers, pumps and engines.

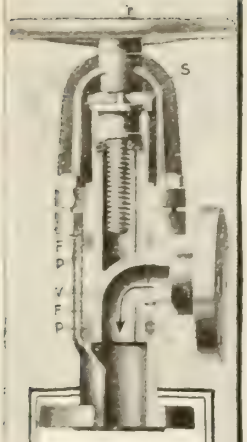
So, when the big Canadian corporations such as the following instal Yarway (formerly Simplex) "Seatless" Blow-Off Valves, their choice becomes an endorsement of the very highest character.

Canadian Explosives Co., Ltd., have 11.
Dominion Iron & Steel Co., Ltd., have 20.
Canadian Pacific Ry. Co. have 24.
Bathurst Lbr. Co. have 8.
Montreal L. H. & P. Co. have 24.
International Eng. Wks., Ltd., have 13.

and there are many others.

With the Yarway (formerly Simplex) "Seatless" Blow-Off Valve there can be no sudden opening and closing to injure tubes; the operation is simple, certain and safe; the valve does not leak; it requires but little attention as there are no weak places such as seats or discs to cut and scar; even the packing lasts for years. You can verify each of these claims by testing the Yarway on one of your boilers for 60 days. Return it if not satisfactory.

Write to-day, stating size of line, and whether screwed or flanged, angle or straight-way.

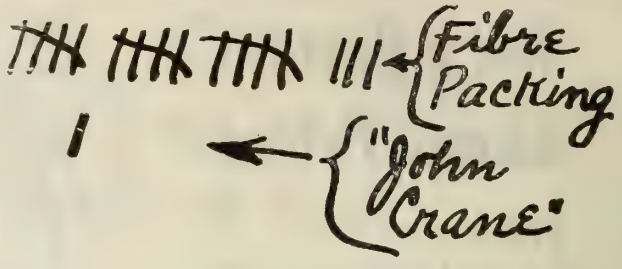


Operation: In closing valve shoulder "S" on plunger "V" engages the loose following gland "G" compressing packing "P" above and below the port, making an absolutely tight valve.

Yarnall-Waring Company
7604-20 Queen Street
Chestnut Hill Phila.

Canadian Representatives:
A. McLELLAN
400 Read Bldg., Montreal
CUNNINGHAM HARDWARE CO.
New Westminster, B.C.
JAS. ROBERTSON CO., Montreal, Que.

YARWAY
Seatless Blow Off Valve
formerly the
SIMPLEX



THE ANSWER IS NEVER!

How often should "John Crane" Soft Flexible Metallic Packing be renewed? Never. Six years ago an engineer started keeping tab on his fibre packing renewals. So far he has renewed it 18 times.

Six years ago a great many engineers installed "John Crane" Soft Flexible Metallic Packing for the first time, and they haven't renewed it yet. It still appears to be good for another six years and THEN SOME.

When you pack a plunger or rod with "John Crane," you don't pack it for months, but for YEARS. You don't take it out to renew it—just add another ring. There is no waste.

Simplicity, flexibility and ingenious mechanical construction of "John Crane" assure permanent freedom from expensive packing difficulties.

"John Crane" is made of sheet babbitt, wound evenly and spirally and lubricated between every sheet. Flexible and compressible as flax, yet better than flax in many ways.

No. 1 tells all. It also tells about our trial offer.

We cannot tell you all about "John Crane" here, but Bulletin

Crane Packing Co.
Box 241, Windsor, Ont.
General Office and Factory
CHICAGO, - ILL.
NEW YORK
121 Park Row Bldg.
PHILADELPHIA
507 Colonial Trust Building

"Cut-and-Come-Again"

There is an old-fashioned flower called "Cut-And-Come-Again," which always makes us think of

VULCABESTON

Red Fibre Sheet Packing

TRADE MARK
"VULCABESTON"
REG IN U.S. PAT OFFICE
RED FIBRE
STEAM
AIR ETC.
AMMONIA
SHEET PACKING
MFD EXCLUSIVELY BY The Johns-Pratt Co. HARTFORD CONN. U.S.A.

because people who cut up a sheet for packing always come again for more.

The increased demand for Vulcabeston is based solely on its demonstrated merit. People who use it find it unequalled in endurance, easily handled and adaptable to every service.

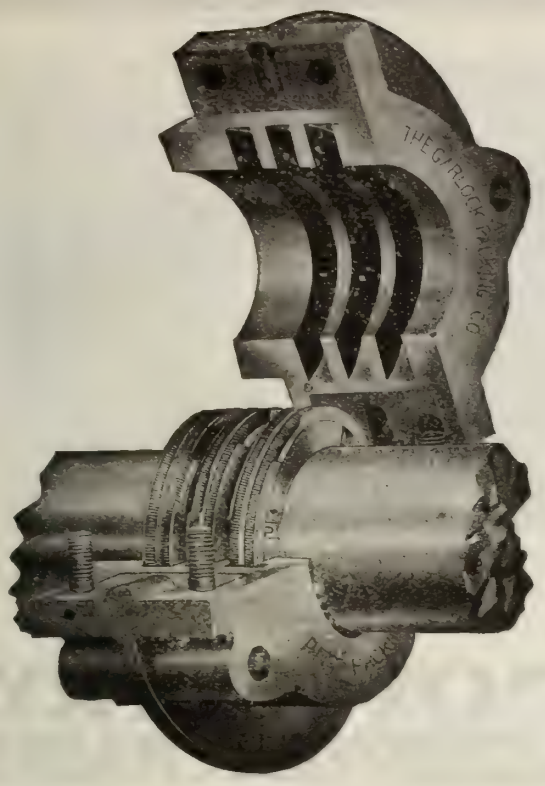
For economy's sake, try and see for yourself.

The Johns-Pratt Company

Hartford, Conn., U.S.A.

Montreal, Que., Ross & Greig; Toronto, Ont., James Morrison Brass Mfg. Co., Ltd.; Vancouver, B.C., Victoria, B.C., Fleck Bros., Ltd.; Winnipeg, Man., Crane Co.

J-P J-P



GARLOCK Metal Packing

OUR position in the metal packing field is based on the principle that "No one style of metal packing can be made to meet all conditions." Working on this basis our experts study carefully the conditions surrounding each case, and with strict regard for mechanical principles, determine which type of packing is best suited to the conditions.

¶ The accompanying illustration shows our Flexible Packing, with split case, which is the most popular style and best all-round packing for stationary work, and when recommended by us to meet stated conditions, is guaranteed to give satisfactory service. This style is also made with solid or split-case to fit inside of stuffing-box, when packing space is sufficient to permit inside application of case and segments. All of our metal packings are so designed that the piston rod has absolute freedom of lateral movement without affecting the efficiency or increasing the friction of the packing.

¶ Next to correct mechanical design the most important feature of metal packing is the material used in the bearing rings. Our materials are made from formulas which long experience has shown to give the best results. A special grade of cast iron is generally used for bearing segments, in order to secure minimum wear and friction, but under unusual conditions, or when considerable condensation enters stuffing-box, bronze rings or segments of softer metal have to be used in the wearing parts.

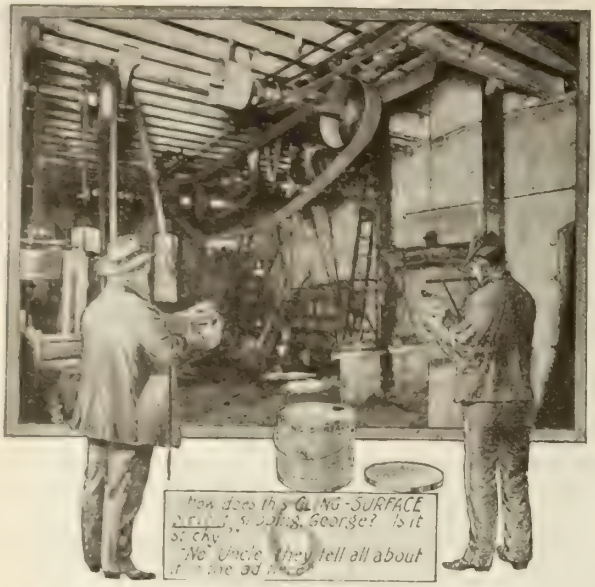
¶ We can solve your metal packing problems, and we will give the usual Garlock guarantee of satisfactory service, if conditions are such as will admit of the successful use of any metal packing.

Write for catalog describing our many styles of metal and fibrous packing.

The Garlock Packing Company, - Hamilton, Ontario

BRANCHES:

Montreal, Quebec - 409 Shaughnessy Bldg.
Toronto, Ontario - Continental Life Bldg.
Winnipeg, Manitoba - - Galt Building
Calgary, Alberta - - 211 8th Ave. West



WHEN "Mike" spits on his hands he does a very natural thing. The tool is slipping because his hands are hard and slippery. Of course he could hold it tighter, but it's easier to soften up the skin. So "Mike" spits on his hands.

We looked at the belt problem this way more than twenty years ago. A leather belt and the palm of the hand are not so very different. Both are skin —one's thicker than the other, that's about all.

The leather is a growth of millions of separate fibres, and is porous. Unlike the hand, it has no life of itself—no natural oils to moisten it—but must be kept mellow and pliable.

A grease should be worked into the belt, where it can surround each fibre and lubricate it from its fellows. Thus they will "run in grease" and slide easily as the belt bends, instead of grating harshly together. The belt becomes pliable and mellow instead of dry and harsh. The surface of the belt will be clean, yielding, "velvety," yet not sticky, and will COHERE with the pulley faces.

Now, any grease so used has got to be a real preservative food, with no harmful acids, and should not oxidize, turn rancid, form sediment, or become stringy. Rosin and rosin oil is condemned by all belting authorities, and various vegetable and mineral oils, in their natural state, cause cracking or rotting within the belt and eventually destroy it.

Sticky belt dressings, while they stop the slipping for a time, are about as bad as glue upon the hands, and for the same reasons.

CLING-SURFACE is a **real preservative** treatment.

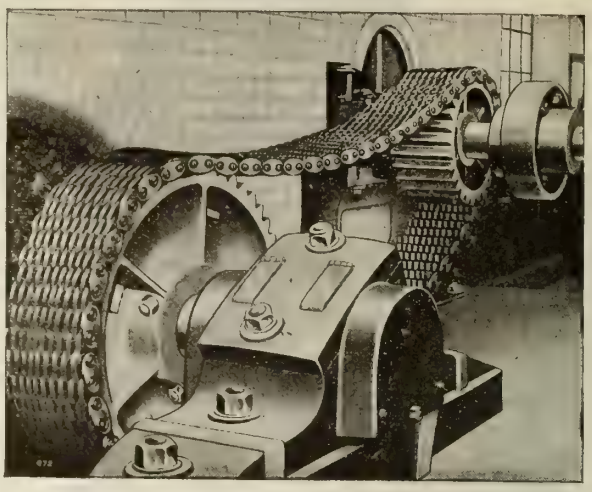
A CLING-SURFACE treated belt will run perfectly in all weathers, easy or slack under big overload, without slipping. It will not warp, tear at the laces, separate at the joints or gather static electricity. With CLING-SURFACE the life of the belt is prolonged, and its capacity for work greatly increased. It immediately becomes a cheerful, obedient worker, soon needing little or no attention, take-up or protection other than the occasional treatment with CLING-SURFACE, and always working easily, silently and efficiently.

CLING-SURFACE can be applied to **your** belts by any workman in a few hours. A treatment now means a definite step toward permanent freedom from all belt trouble, and money in your pocket, with practically no effort to put it there.

Our co-operation will assist you in this work. Let us send you a can for sixty days' trial.

Remember, use CLING-SURFACE and you won't need belt

Cling-Surface Co.
1057 Niagara Street
Buffalo New York



Colliery Fan Drive, 250 h.p. at 210 r.p.m. to 130 r.p.m. Ratio of reductions 1.7-1.

COVENTRY NOISELESS CHAINS

Form the ideal transmission from electric motors. Positive yet flexible drive, combining the advantages of gears and belts without their corresponding disadvantages. They increase production and improve quality of work. Gearing arrangements are more easily made. Specially applicable where centres are too long for gears and too short for belts.

THE COVENTRY
Registered Trade-Mark

"The Coventry" Chain Co., Ltd.
Coventry, England

Cables. "Chains Coventry."
Codes. A.B.C. 4th and 5th Edn. and Western Union.

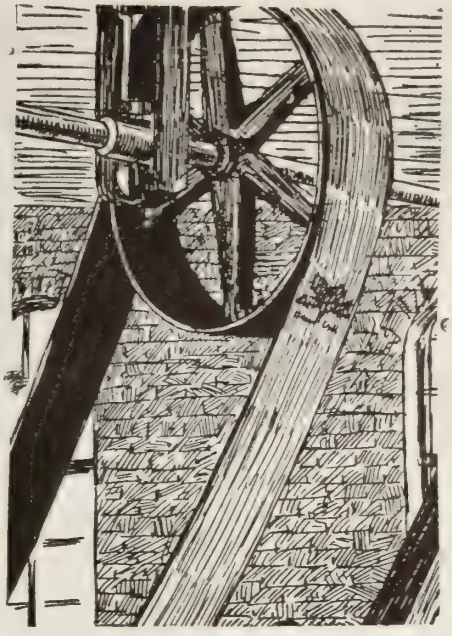
Mr. Chief Engineer—

Be able to say

"It's Working FINE"

when the Superintendent asks about the new belt you got your plant to buy.

Be sure to specify



D. K. McLAREN'S

Genuine British Oak-Tanned

LEATHER BELTING

when putting in your requisition for a new belt. And you'll ensure a long, trouble-free, efficient service.

Think what being able to say "It's working fine," will mean to you instead of having to report trouble every little while, as is the case in many places where precaution is not exercised in the purchase of belting.

D. K. McLaren's Leather Belting is made exclusively from close-trimmed butts of the finest selected hides, tanned by the old-fashioned but the proven most effective British Oak Tanning Process.

It doesn't require the attention and expense that is common where ordinary belting is used, because there is practically no slip, and it seldom requires tightening.

Many of the largest Canadian Plants are our steady customers. If you wish to ask them how they like this belting, we will be glad to send you their names and addresses.

GENUINE OAK

REGISTERED TRADE-MARK

This trade-mark guarantee is on every piece of D. K. McLaren's Leather Belting. Look for it.

D·K·McLAREN LIMITED

Head Office and Factory:
351 St. James St., Montreal, P.Q.

TORONTO, ONT.
194 King St. West

VANCOUVER, B.C.
849 Beatty St.

ST. JOHN, N.B.
90 Germain Street

Dominion Belting Company, Limited
Hamilton, Canada

Sole manufacturers of the celebrated "MAPLE LEAF" Brand Stitched Cotton Duck Belting and Belt Dressing.

The demand for our products has steadily increased because the standard of quality has been maintained.

We make only one grade, the best that can be produced.

"MAPLE LEAF" is the strongest, truest running, most economical and efficient belt on the market for transmission of power, conveying, etc.

Being thoroughly waterproof it is suitable for running in wet or dry places. **"MAPLE LEAF"** Belt Dressing is different to others offered in that it is equally good for all kinds of belting, leather, rubber or Balata, as well as our own make.

Write us for prices, and if desired we will be pleased to furnish samples and further information.

A trial order will convince you of their utility.

DOMINION BELTING CO. Ltd., Hamilton, Canada-Quebec Branch: 51 Duluth Bldg., Montreal

TRADE MARK

TRADE MARK

EXTREME HEAVY DUTY

REVERE RUBBER COMPANY,
Makers of United States Tires,
Providence, R.I.

Feb. 13th, 1918.

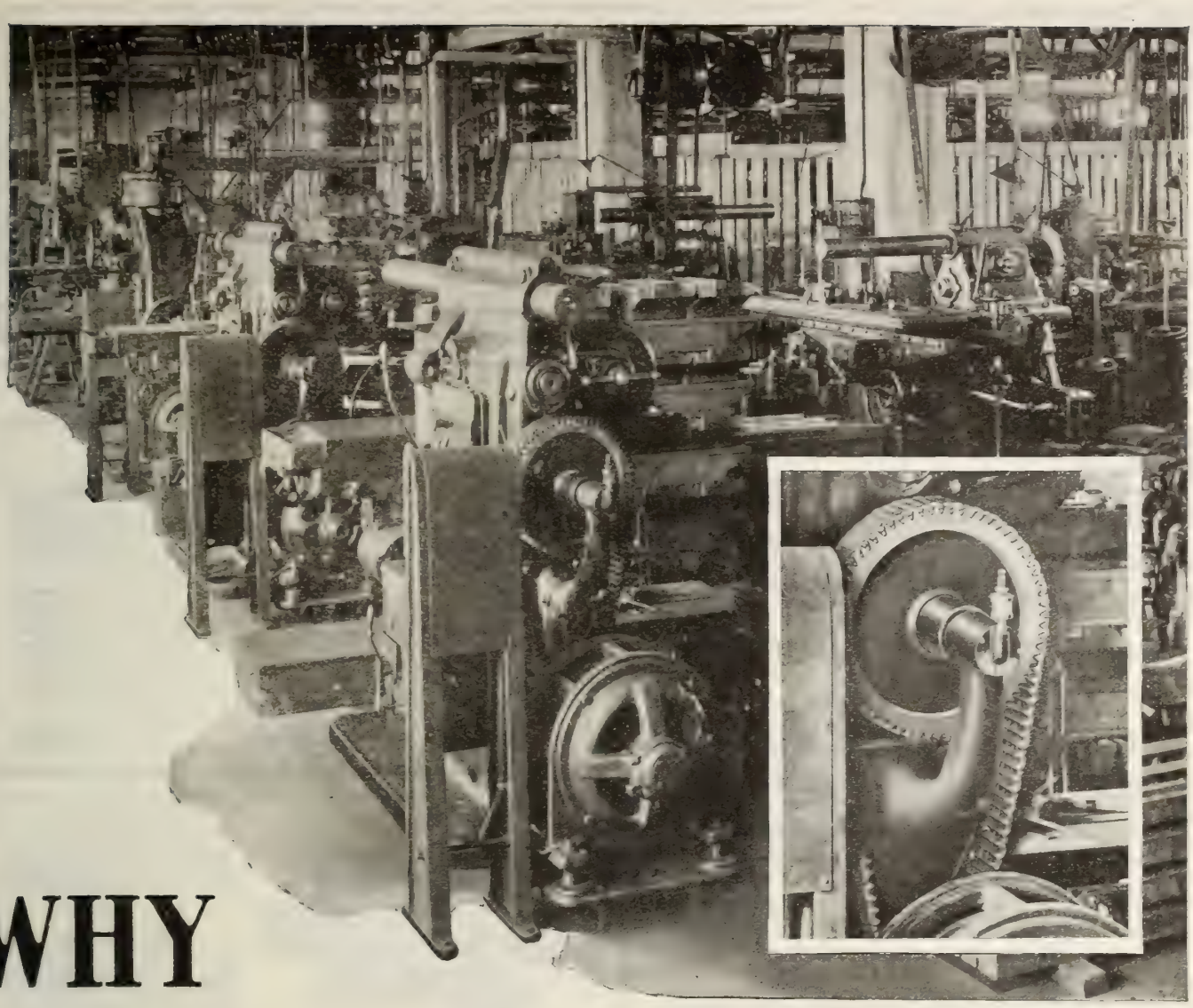
Gentlemen: I have been a user of Magnolia Metal for several years, and can say that it has given satisfaction wherever I have used it, finding it a good metal to use where I have extreme heavy duty on the Bearings, both as to its long life and durability.

Yours very truly,
REVERE RUBBER CO.,
W. T. Mead, Master Mechanic.

PRACTICAL ENGINEER POCKET BOOK
Over 600 Pages
A valuable reference work imported from England and sold as an advertising medium at the low price of 40c post paid.
Address Montreal Office

SOLD BY LEADING DEALERS EVERYWHERE OR BY
MAGNOLIA METAL CO.
OFFICE AND FACTORY:
225 St. Ambroise Street, MONTREAL

If what you need is not advertised, consult our Buyers' Directory and write advert isers listed under proper heading.



WHY

Group of Milling Machines

Do Modern Shops Use "Morse"?

Machine Tools driven through "Morse" Silent Chains are positively connected to motor—instantaneous motion, no slip, no backlash. 99 per cent. efficient, compact, flexible, positive.

"MORSE" Drives have every quality of

EFFICIENT POWER TRANSMISSION

STRENGTH SIMPLICITY ENDURANCE SILENCE

Conserve Power *Before Buying Pulleys and Belting investigate, know the facts* **Increase Production**

Are you under your conditions producing maximum output with minimum cost?

MORSE CHAIN CO. Largest Manufacturers of Silent Chains in the World ITHACA, N.Y.

MORSE ENGINEERING SERVICE ASSISTANCE WITHOUT OBLIGATION

Address Nearest Office

BOSTON, Mass. .....141 Milk Street
CHICAGO, Ill. .....Merchants Loan & Trust Bldg.
CLEVELAND, OHIO .....421 Engineers Bldg.
DETROIT, Mich. .....1003 Woodward Ave.
GREENSBORO, N.C. .....805 Ashboro Street
NEW YORK CITY .....50 Church St.
PITTSBURGH, Pa. .....Westinghouse Bldg.
SAN FRANCISCO, Cal. .....Monadnock Bldg.
ATLANTA, Ga....Earl F. Scott, M.E., 702 Chandler Bldg.
CANADA ..... Jones & Glassco, Reg'd Montreal, St. Nicholas Bldg. Toronto, Traders' Bank Building.
MINNEAPOLIS, Minn. .....Strong-Scott Mfg. Co. 413 Third St., S.
ST. LOUIS, Mo....Morse Engineering Co., Chemical Bldg.
Licensees for Europe and Eastern Hemisphere, The Westinghouse Brake Co., Ltd., 82 York Road, King's Cross, London, N.

HINTS TO BUYERS

DOMINION COAL COMPANY LIMITED

"Dominion" and "Springhill" BITUMINOUS STEAM and GAS COALS

GENERAL SALES OFFICE

112 St. James St. Montreal

NOTICE

TO

Stationary and Hoisting Engineers

Everyone operating a STATIONARY steam plant of 50 h.p. or over in the Province of Ontario must hold a Stationary Engineer's Certificate from the Board of Stationary and Hoisting Engineers. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary and Hoisting Engineers' Act.

Everyone operating a HOISTING steam plant working at a pressure of 20 pounds or over, irrespective of horse power, and used for hoisting in structural operations or excavating purposes, in the Province of Ontario, must hold a Hoisting Engineer's Certificate from the Board of Stationary and Hoisting Engineers. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary and Hoisting Engineers' Act.

Application forms for obtaining STATIONARY or HOISTING Engineers' Certificates, may be had upon applying to the Chairman.

HON. F. G. MACDIARMID, Minister of Public Works and Highways.
W. C. McGHIE, Chairman of Board.
W. A. RIDDELL, M. A. PH. D., Superintendent, Trades & Labour Branch.

NATIONAL BOILER GIRTH SEAM PROTECTORS

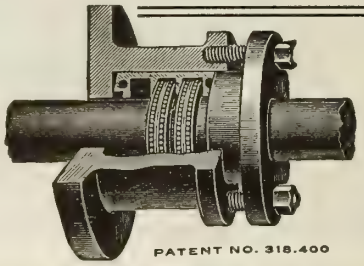
If your Boiler is not fire-cracked it eventually will; prevent this by putting on a National Boiler Protector. You will save cost in repairs and prolong life of the boiler. All new boilers should be protected.

Write Us for Particulars.

National Boiler Protector Co.

New Toronto Address

ROOM 24, LOMBARD BUILING



PATENT NO. 318,400

PAT. NO.	500,899	PAT. NO.	829,116
" "	534,104	" "	830,530
" "	602,328	" "	856,103
" "	654,541	" "	878,238
" "	654,542	" "	894,537
" "	725,368	" "	895,791
" "	774,490	" "	898,066
" "	775,193	" "	905,103
" "	775,194	" "	934,829
" "	791,300	" "	979,206
" "	805,669	" "	1000,76

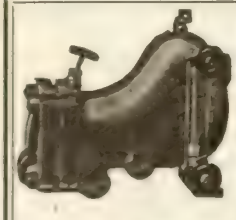
Why not Buy the Best, when in market for Packing?

HOLMES' Metallic Packing Is Guaranteed 3 Years

Lasts many times longer. 30 days' trial. Less oil. No cutting. Easily applied to any Steam Engine, Air Compressor or Gas Engine. Satisfaction or no pay. Write us.

HOLMES METALLIC PACKING CO., Wilkes-Barre, Pa.

Incorporated 1897



McDANIEL IMPROVED STEAM TRAP

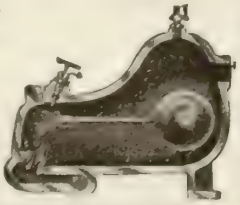
FOR HIGH OR LOW PRESSURE.

Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

MAY WE SEND ONE FOR TRIAL?

Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators.

SEND FOR CATALOGUE.

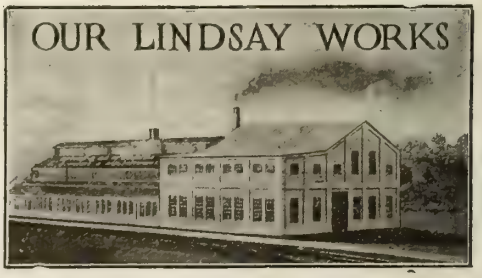


THE GARTH COMPANY
26 Craig Street MONTREAL, CAN.

WATSON & McDANIEL CO.
No. 146 N. 7th Street. PHILADELPHIA, Pa.

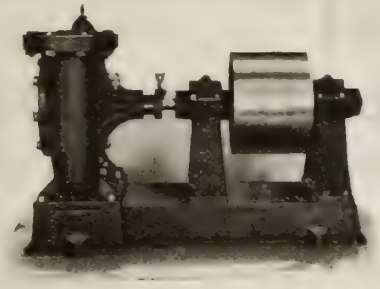
Water Turbines, Hydraulic Governors, Centrifugal Pumps

OUR LINDSAY WORKS



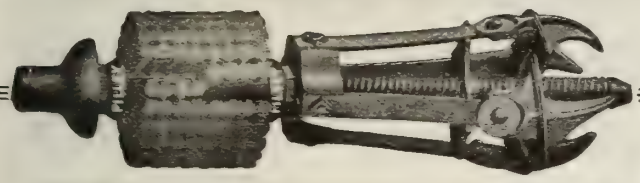
Boving Hydraulic & Engineering Co., Limited
Lindsay, Ontario

If any advertisement interests you, tear it out now and place with letters to be answered.



Send that PUMP inquiry to

The Smart-Turner Machine Co.
LIMITED
HAMILTON, CANADA



Half the trouble of cleaning day is of your own making. To get the best results you must have an efficient tool. Next time you buy a flue cleaner, ask to see

Pilleys Combination Flue Brush and Scraper

Examine it carefully. Note the design—material—workmanship. Then you will understand why it has satisfied discriminating engineers for more than 12 years.
For sale by leading Canadian Jobbers.

PILLEY PACKING & FLUE BRUSH MFG. CO.
623 South Third Street - - - - ST. LOUIS, MO.
Eastern Office: 71 Fulton St., New York.

"Tight Boiler Settings an Aid to Economy"

"Saving Coal by the Elimination of Air Leakage."

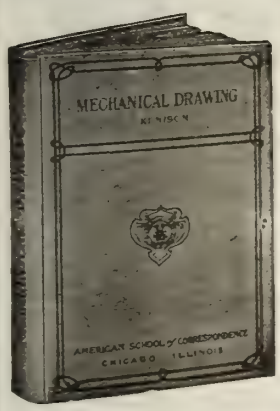
THE good articles headed as above in last month's issue of "Power House" should convince all Engineers of the necessity of making Boiler Settings tight.

PLIBRICO (JOINTLESS) AND PLIBRICO-BOND (HIGH TEMPERATURE)

for interior linings and AEREX Plastic Cement for exterior brick work will assure you of this.

Mill Supply Dept.

BEVERIDGE PAPER CO., LTD.
Montreal and St. John, N.B.
TORONTO: SHELL BAR BOICO SUPPLY, LTD.



Mechanical Drawing

By Ervin Kenison, S.B.

Instructor in Mechanical Drawing, Massachusetts Institute of Technology

176 pp., 140 illus. Cloth binding. Gives a course of practical instruction in the art of Mechanical Drawing, based on methods that have stood the test of years of experience. Includes orthographic, isometric and oblique projections, shade lines, intersections and developments, lettering, etc., with abundant exercises and plates.

Price, $1.00

MacLean Publishing Co.
Technical Book Dept.
143-153 University Ave., Toronto

THE LADD VERTICAL WATER TUBE BOILER

The Goldie-McCulloch Co., Ltd.
Galt, Ontario

Canadian licencees under patents 162401 and 162402 dated May 4, 1915.

The George T. Ladd Company,
Pittsburgh, Pa.

Owners and manufacturers for the United States.

Write for new Catalogue No. 17.

BOILER INSPECTION

The Steam Boiler Act, Chapter 252 R.S.O., 1914 With Amendments Chapter 58—6, George V.

STEAM BOILERS.

All Steam boilers constructed for use in Ontario must be built from designs which have been approved and allotted a registration number by the Steam Boiler Branch.

Used boilers, boilers sold or exchanged, and unregistered boilers brought into the Province must be inspected prior to being put into operation.

Notice of repairs to steam boilers, stating the nature and extent of same, must be sent to the Steam Boiler Branch, and should such repairs be considered extensive by the Chief Boiler Inspector, the boilers will require to be inspected.

In each and every case the inspections must be made by Inspectors authorized to inspect boilers under the Steam Boilers Act, who are employed only by the Steam Boiler Branch of the Department of Public Works. Official certificates with the maximum working pressure stated thereon are issued to the owners of the boilers so inspected.

STEAM PIPING.

Drawings and Specifications of all high pressure steam piping must be approved and registered by the Steam Boiler Branch before any work of installation is commenced. The drawings submitted should show clearly the dimensions and layout of the main steam lines. Full particulars should be given as to the material used in the construction of the piping, and all valves and other fittings used in connection therewith must be of approved make.

Any deviation from the above requirements shall be deemed a violation of the Steam Boilers Act.

All communications in this respect should be addressed to the Steam Boiler Branch, Department of Public Works, Parliament Buildings, Toronto.

HON. F. G MACDIARMID, Minister of Public Works and Highways

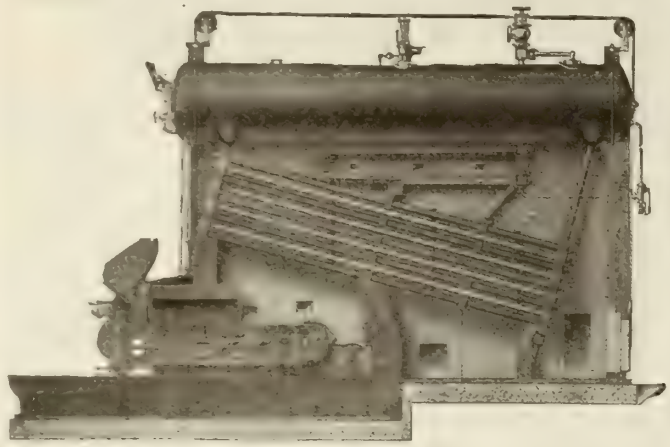
W. A. RIDDELL, M.A. Ph.D., Supt. Trades & Labour Branch

D. M. MEDCALF,
Chief Inspector of Steam Boilers.

If any advertisement interests you, tear it out now and place with letters to be answered.

"ALL BRITISH"
"B.&W." PATENT WATER TUBE STEAM BOILERS

HIGHEST ECONOMY, SAFETY, DURABILITY. OVER 20,000,000 H.P. IN USE.



Babcock & Wilcox Patent Water Tube Steam Boiler, Superheater and Mechanical Stoker.

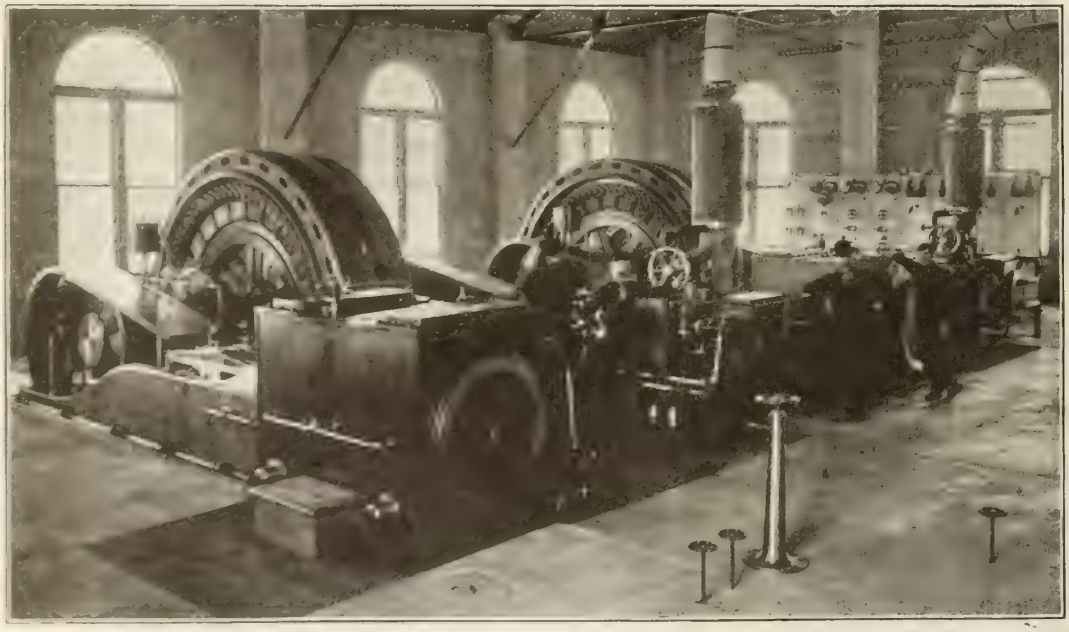
ALSO

Steam Superheaters
Mechanical Stokers
Coal-Handling Machinery
Piping, Feed Water Heaters
Water Softeners and Purifiers
and **ELECTRIC CRANES**

BABCOCK & WILCOX, Limited

HEAD OFFICE FOR CANADA - COLLEGE ST. (ST. HENRY), MONTREAL
TORONTO OFFICE, TRADERS BANK BUILDING

25 Cycle Engine Generator Sets For Sale



1—250 KW.
1—300 KW.

25 Cycle
3 phase
Westinghouse
Generators
Direct
connected to
McIntosh &
Seymour Cross
Compound
Gridiron Valve
Engines 150
R.P.M.

These units were in use only seven months and are in first class condition.
Write for further particulars and quotations.

Power Plant Equipment Co., Dominion Bank Building **Toronto, Ont.**

POWER HOUSE BUYERS' DIRECTORY

If what you want is not listed here write us, and we will tell you where to get it. Let us suggest that you consult also the advertisers' index facing the inside back cover, after having secured advertisers' names from this directory. The information you desire may be found in the advertising pages. This department is maintained for the benefit and convenience of our readers. The insertion of our advertisers' names under proper headings is gladly undertaken, but does not become part of an advertising contract.

AIR COCKS
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

AIR VALVES
Mueller Mfg. Co., H., Sarnia, Ont.

AMMETERS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. H. W. Johns-Manville Co., Toronto, Ont.

AMMONIA VALVES AND FITTINGS
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Frick Co., Waynesboro, Franklin Co., Pa.
Homestead Valve Mfg. Co., Pittsburgh, Pa.
York Mfg. Co., York, Pa.

AMMONIA PURIFIERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Mfg. Co., York, Pa.

AMMONIA TANKS
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford, Ont.

ARCHES, COMBUSTION CHAMBER
Canadian Fairbanks-Morse Co., Ltd. Montreal.

ASH CARRYING SYSTEMS
Babcock & Wilcox, Ltd. Montreal.
Waterous Engine Works Co., Brantford, Ont.

ASBESTOS SPECIALTIES
Durabla Mfg. Co., New York, N.Y.
Garlock Packing Co., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

AUTOMATIC ICE RECORDING DOORS AND CHUTES
Jamison Cold Storage Door Co., Hagerstown, Md.

BABBITT AND ANTI-FRICTION METAL
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Hoyt Metal Co., Toronto.
Magnolia Metal Co. Montreal.
Wm. C. Wilson & Co., Toronto.

BALL BEARINGS
Can. S K F Co., Toronto, Ont.

BALLCOCKS
D'Este Co., Julian, Boston, Mass.

BATTERIES AND ACCESSORIES
Can. H. W. Johns-Manville Co., Toronto, Ont.

BELT CEMENT
Graton & Knight Mfg. Co., Montreal.

BELT DRESSING
Cling Surface Co., Buffalo.
Dominion Belting Co., Hamilton, Ont.
Graton & Knight Mfg. Co., Montreal.

BELT LACING, LEATHER
Graton & Knight Mfg. Co., Montreal.

BELT TIGHTENERS
Waterous Engine Works Co., Brantford, Ont.

BELT PULLEYS
Waterous Engine Works Co., Brantford, Ont.

BELTING, BALATA
Federal Engineering Co., Toronto, Ont.

BELTING, LINK
Graton & Knight Mfg. Co., Montreal.
Waterous Engine Works Co., Brantford, Ont.

BELTING, STITCHED COTTON DUCK
Dominion Belting Co., Hamilton, Ont.

BELTING, LEATHER
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Garlock Packing Co., Hamilton, Ont.
Graton & Knight Mfg. Co., Montreal.
D. K. McLaren Ltd., Montreal.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

BELTING, RUBBER
Can. H. W. Johns-Manville Co., Toronto, Ont.
Jeffrey Manufacturing Co., Montreal.
Thomson-Gordon, Ltd., Hamilton, Ont.

BELTING, WOVEN COTTON
Federal Engineering Co., Toronto, Ont.

BINS, COAL, COKE AND ORE
Jeffrey Manufacturing Co., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford, Ont.

BLOWERS
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Coppus Eng. & Equip. Co., Worcester, Mass.
Green's Economiser, Ltd., Toronto.

BOILER COVERING
Beveridge Paper Co., Montreal, Que.

BOILER COMPOUNDS
Beveridge Paper Co., Montreal, Que.
Can. Economic Lubricant Co., Montreal, Que.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Metlskin Mfg. Co., Rochester, N.Y.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Wm. C. Wilson & Co., Toronto.

BOILER COMPOUND FEEDERS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Morehead Mfg. Co., Woodstock.
Lunkenheimer Co., Cincinnati, O.

BOILER FEED PUMPS
American Stean. Pump Co., Battle Creek, Mich.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Steam Boiler Equipment Co., Toronto, Ont.
Darling Bros., Ltd., Montreal, Que.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Laurie & Lamb, Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

BOILER FEED REGULATORS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Beveridge Paper Co., Montreal, Que.
Darling Brothers, Ltd., Montreal, Que.
Mason Regulator & Engineering Co., Montreal.

BOILER MOUNTINGS
Babcock & Wilcox, Ltd. Montreal.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Ltd., Montreal, Que.
Inglis Co., The John, Toronto, Ont.
Lunkenheimer Co., Cincinnati, O.
Mason Regulator & Engineering Co., Montreal.

BOILER PRESERVATIVES
Johns-Pratt Co., The, Hartford, Conn.
Metlskin Co., Inc., Rochester, N.Y.

BOILER HOUSE ACCESSORIES
Babcock & Wilcox, Ltd. Montreal.
Cole, Ltd., Geo. W., Toronto.
Green's Economiser, Ltd., Toronto.
Mason Regulator & Engineering Co., Montreal.

BOILER SEAM PROTECTOR
National Boiler Seam Protector Co., Montreal.

BOILER SETTINGS
Beveridge Paper Co., Montreal.
Gates, John W., St. James St., Montreal.

BOILERS, HORIZONTAL, RETURN, TUBULAR AND WATERTUBE
Babcock & Wilcox, Ltd. Montreal.
Cole, Ltd., Geo. W., Toronto.
Goldie & McCulloch Co., Galt.
Frick Co., Waynesboro, Franklin Co., Pa.
Inglis Co., The John, Toronto, Ont.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Jones Underfeed Stoker Co., Toronto.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Ladd, The Geo. T., Co., Pittsburgh, Pa.
McAvity, T., & Sons, Ltd., St. John, N.B.
Waterous Engine Works Co., Brantford, Ont.

BOILERS, MARINE, LOCOMOTIVE AND VERTICAL
Babcock & Wilcox, Ltd. Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Goldie & McCulloch Co., Galt.
Inglis Co., The John, Toronto, Ont.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
John McDougall Caledonian Iron Works, Montreal.
Waterous Engine Works Co., Brantford, Ont.

BOXES, FUSE AND METER
Johns-Pratt Co., The, Hartford, Conn.

BRASS FOUNDERS
McAvity, T., & Sons, Ltd., St. John, N.B.
D'Este Co., Julian, Boston, Mass.
Mueller Mfg. Co., H., Sarnia, Ont.

BRINE COOLERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

BRINE TANKS
Frick Co., Waynesboro, Franklin Co., Pa.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford, Ont.
York Manufacturing Co., York, Pa.

BUSHINGS
Steel Mill Packing Co., Windsor, Ont.

CABLE
Wm. C. Wilson & Co., Toronto.

CALORIMETERS
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y
Taylor Instrument Co., Rochester, N.Y.

CANS, OILY WASTE
Jas. Morrison Brass Mfg. Co., Toronto.

CAST IRON FITTINGS
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.

CASTINGS, BRASS AND IRON
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Lunkenheimer Co., Cincinnati, O.
John McDougall Caledonian Iron Works Co., Ltd., Montreal.
McAvity, T., & Sons, Ltd., St. John, N.B.
Mueller Mfg. Co., H., Sarnia, Ont.
Waterous Engine Works Co., Brantford, Ont.
Wood & Co., R. D., Philadelphia, Pa.

CELLAR DRAINERS
Morrison Brass Mfg. Co., James, Toronto, Ont.
Mueller Mfg. Co., H., Sarnia, Ont.

CEMENT HARDNER & WATERPROOFER
Beveridge Paper Co., Montreal, Que.

CEMENT, HIGH TEMPERATURE
Beveridge Paper Co., Montreal.
Gates, John W., St. James St., Montreal.
Green's Economiser, Ltd., Toronto.

CEMENT, PIPE JOINT
Wm. C. Wilson & Co., Toronto.

CEMENT MACHINERY
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Waterous Engine Works Co., Brantford, Ont.

CEMENT, INSULATING, REFRACTORY
Green's Economiser, Ltd., Toronto.

CHAIN DRIVES
Coventry Chain Co., Coventry, England.
Morse Chain Co., Ithaca, N.Y.

CHAIN WHEELS
Babbitt Steam Specialty Co., New Bedford, Mass.

CHIMNEYS, RADIAL BRICK
Green's Economiser, Ltd., Toronto, Ont.

CHIMNEYS, STEEL
Babcock & Wilcox, Ltd. Montreal
MacKinnon, Holmes & Co., Sherbrooke, Que.

CHUTES, COAL
Can. Allis-Chalmers, Ltd., Toronto, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.

CLEANERS, BOILER TUBE
Babcock & Wilcox, Ltd., Montreal.
Beveridge Paper Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto.
Cole Ltd., Geo. W., Toronto.
Darling Brothers, Ltd., Montreal, Que.
Garlock Packing Co., Hamilton, Ont.
Green's Economiser, Ltd., Toronto.
Liberty Mfg. Co., Pittsburgh, Pa.
Laurie & Lamb, Montreal, Que.
Pierce & Co., Wm. B., Buffalo, N.Y.
Pilley Packing & Flue Brush Mfg. Co., St. Louis, Mo.
Roto Co., Hartford, Conn.

CLOCKS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.

CLOSETS
Mueller Mfg. Co., H., Sarnia, Ont.

CLUTCHES
Waterous Engine Works Co., Brantford, Ont.

COAL
Dom. Coal Co., Montreal

COAL AND ASH CONVEYORS
Babcock & Wilcox, Ltd. Montreal.
Jeffrey Manufacturing Co., Montreal.
Waterous Engine Works Co., Brantford, Ont.

COAL HANDLING MACHINERY
Babcock & Wilcox, Ltd. Montreal.
Green's Economiser, Ltd., Toronto, Ont.
Jeffrey Manufacturing Co., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford, Ont.

COAL HOLE COVERS
Can. Allis-Chalmers, Ltd., Toronto, Ont.

COILS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

COLD STORAGE INSULATION
Armstrong Cork & Insulation Co., Montreal, Que.
Beveridge Paper Co., Ltd., Montreal, Que.

COMMUTATOR TRUING DEVICES
Jordan Bros., Inc., New York, N.Y.

CONDENSERS
Alberger Heater Co., Buffalo, N.Y.
American Steam Pump Co., Battle Creek, Mich.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Allis-Chambers, Ltd., Toronto, Ont.
Darling Bros., Ltd., Montreal, Que.
Goldie & McCulloch Co., Galt.
Laurie & Lamb, Montreal.
John McDougall Caledonian Iron Wks., Montreal.
Waterous Engine Works Co., Brantford.

CONDENSERS, AMMONIA AND STEAM
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

CONSULTING ENGINEERS
Walter J. Francis, Montreal.
Lamb & Lamb, Montreal.

COLD STORAGE DOORS AND WINDOWS
Jamison Cold Storage Door Co., Hagerstown, Md.

COMPRESSORS, AIR
American Steam Pump Co., Battle Creek, Mich.
Can. Allis-Chambers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.

Darling Bros., Ltd., Montreal, Que.
Inglis Co., The John, Toronto, Ont.
Laurie & Lamb, Montreal.
MacKinnon Steel Co., Sherbrooke, Que.
Smart-Turner Machine Co., Ltd., Hamilton.
Taylor Instrument Co., Rochester, N.Y.

COMPRESSORS, GAS
Can. Allis-Chalmers, Ltd., Toronto, Ont.

CONDUITS
Can. H. W. Johns-Manville Co., Toronto, Ont.

CONDENSATION RECEIVER
Cole, Ltd., Geo. W., Toronto.
Davis Regulator Co, G. M., Chicago.

CONDENSER AND SMOKESTACK PAINTS
Beveridge Paper Co., Montreal, Que.

CONNECTIONS, FLANGED
Jefferson Union Co., Lexington, Mass.
Dart Union Co., Ltd., Toronto, Ont.

CONTRACTORS' STRUCTURAL STEEL
Canadian Fairbanks-Morse Co., Ltd., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.

CONVEYOR MACHINERY
Babcock & Wilcox, Ltd. Montreal.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Jeffrey Manufacturing Co., Montreal.
Waterous Engine Works Co., Brantford.

COOLER DOORS
Jamison Cold Storage Door Co., Hagerstown, Md.

CORK INSULATION
Armstrong Cork & Insulation Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.

COTTON HOSE
Garlock Packing Co., Hamilton, Ont.

COUNTERS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

COUNTERSHAFTS
Can. Bond Hanger & Coupling Co., Alexandria, Ont.

COUPLINGS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Beveridge Paper Co., Montreal, Que.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Brothers, Ltd., Montreal, Que.
Jeffrey Manufacturing Co., Montreal.
McAvity & Sons, T., St. John, N.B.

COUPLINGS, BOILER, FLANGED PIPE, JOINT PIPE, UNION, STEAM PIPE
Jefferson Union Co., Lexington, Mass.
Dart Union Co., Ltd., Toronto, Ont.

COUPLINGS, SHAFT
Can. Bond Hanger & Coupling Co., Alexandria, Ont.

CRANES, ALL KINDS
Babcock & Wilcox, Ltd. Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

CRANES, ELECTRIC
Babcock & Wilcox, Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

CRANES, HAND POWER
Babcock & Wilcox, Ltd., Montreal.
Boving Hydraulic & Eng., Co., Ltd., Lindsay, Ont.
Frick Co., Waynesboro, Franklin Co., Pa.
Smart-Turner Machine Co., Ltd., Hamilton.

CRANES, OVERHEAD TRAVELLING
Babcock & Wilcox, Ltd., Montreal.
Boving Hydraulic & Eng., Co., Ltd., Lindsay, Ont.
Smart-Turner Machine Co., Ltd., Hamilton.

CRANES, POST JIB
Babcock & Wilcox, Ltd., Montreal.

CRANES, SWING JIB
Babcock & Wilcox, Ltd., Montreal.

CRANES, WALL
Babcock & Wilcox, Ltd., Montreal.

CRANK AND CROSSHEAD PIN OILERS
Lunkenheimer Co., Cincinnati, O.

CRIMPS, LEATHER
Graton & Knight Mfg. Co., Montreal.

CRUSHING MACHINERY
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Jeffrey Mfg. Co., Columbus, Ohio.

CYLINDER OIL
E. H. Kellogg & Co., New York.

DAMPER REGULATORS
Babcock & Wilcox, Ltd., Montreal.
Darling Bros., Ltd., Montreal, Que.
G. M. Davis Regulator Co., Chicago.
D'Este Co., Julian, Boston, Mass.
[illegible] Pittsburgh, Pa.
Mason Regulator Co., Boston, Mass.
Jas. Morrison Brass Mfg. Co., Toronto.

DISCS, FIBRE
Beveridge Paper Co., Ltd., Montreal, Que.
Johns-Pratt Co., The, Hartford, Conn.

DISCS, LEATHER
Graton & Knight Mfg. Co., Montreal.

DISTILLING APPARATUS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

DOORS, COLD STORAGE AND FREEZER
Jamison Cold Storage Door Co., Hagerstown, Md.

DOUBLE PIPE CONDENSERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

DRAFT APPARATUS SYSTEMS, MECHANICAL
Green's Economiser, Ltd., Toronto

DRYING MACHINERY
Canadian Fairbanks-Morse Co., Ltd., Montreal.

DYNAMOS
Canadian Fairbanks-Morse Co., Ltd., Montreal.

ECONOMIZERS
Babcock & Wilcox, Ltd., Montreal.
Green's Economiser, Ltd., Toronto.

EJECTORS
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.
Smart-Turner Machine Co., Ltd., Hamilton.

ELECTRICAL ACCESSORIES AND MACHINERY
Can. H. W. Johns-Manville Co., Toronto, Ont.
Beveridge Paper Co., Ltd., Montreal, Que.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Economy Fuse & Mfg. Co., Montreal, Que.
MacGovern & Co., Inc., New York.

ELECTRICAL SUPPLIES
Can. General Electric Co., Toronto, Ont.
Can. H. W. Johns-Manville Co., Toronto, Ont.

ELEVATORS
Beveridge Paper Co., Montreal, Que.
Darling Brothers, Ltd., Montreal, Que.
MacKinnon, Holmes & Co., Sherbrooke, Ont.
John MacDougall Caledonian Iron Works, Montreal.

ELEVATING MACHINERY
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Beveridge Paper Co., Montreal, Que.
Darling Brothers, Ltd., Montreal, Que.
Goldie & McCulloch Co., Galt.
Hamilton Mfg. Co., Wm., Peterboro, Ont.
Jeffrey Mfg. Co., Montreal.
Waterous Engine Works Co., Brantford.

ENAMELWARE
H. Mueller Mfg. Co., Sarnia, Ont.

ENGINEERS' SUPPLIES
Beveridge Paper Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Ltd., Montreal, Que.
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.
Jas. Morrison Brass Mfg. Co., Toronto.

ENGINES, AUPTOMATIC AND DROP VALVE
Frick Co., Waynesboro, Franklin Co., Pa.
Waterous Engine Works Co., Brantford.

ENGINES, CORLISS AND ROCKING VALVE
Frick Co., Waynesboro, Franklin Co., Pa.
Goldie & McCulloch Co., Galt.
Green's Economiser, Ltd., Toronto.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Waterous Engine Works Co., Brantford.

ENGINES, DIESEL
Can. Allis-Chalmers, Ltd., Toronto, Ont.

ENGINES, GAS AND GASOLINE
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Laurie & Lamb, Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

ENGINES, STEAM
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Can. Sirocco Co., Windsor, Ont.
Goldie & McCulloch Co., Galt.
Hamilton Mfg. Co., Wm., Peterboro, Ont.
Inglis Co., The John, Toronto, Ont.
Laurie & Lamb, Montreal.
John MacDougall Caledonian Iron Works, Montreal.
Waterous Engine Works Co., Brantford.

ENGINES, HOISTING, LOGGING, CABLE-WAY
Can. Allis-Chalmers, Ltd., Toronto, Ont.

ENGINES, MARINE
Canadian Fairbanks-Morse Co., Ltd., Montreal.
The John MacDougall Caledonian Iron Works Co., Ltd., Montreal.

ENGINES, SAW MILL
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Laurie & Lamb, Montreal.
Waterous Engine Works Co., Brantford.

ENGINES, SINGLE COMPOUND AND TRIPLE EXPANSION
Canadian Griscom-Russell Co., Ltd., Montreal.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
John MacDougall Caledonian Iron Works Co., Ltd., Montreal.
Kerr Engine Co., Walkerville.
Waterous Engine Works Co., Brantford.

ENGINES, VERTICAL
Laurie & Lamb, Montreal.

ENGINEERING BOOKS
MacLean Publishing Co., Toronto.

EXHAUSTERS
Green's Economiser, Ltd., Toronto.

EXHAUST HEADS
Darling Bros., Ltd., Montreal, Que.
Direct Separator Co., Syracuse, N.Y.
Jas. Morrison Brass Mfg. Co., Toronto.
Franklin Williams Co., New York.
Watson & McDaniel Co., Philadelphia.

EXPANSION JOINTS
Alberger Heater Co., Buffalo, N.Y.
Direct Separator Co., Syracuse, N.Y.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.

FANS, VENTILATING
Coppus Engr. & Equip. Co., Worcester, Mass
Green's Economiser, Ltd., Toronto.
Sturtevant Co. of Canada, B. F., Galt, Ont.

FEED WATER HEATERS
Alberger Heater Co., Buffalo, N.Y.
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Ltd., Montreal, Que.
Elliott Co., Pittsburgh, Pa.
The John MacDougall Caledonian Iron Works Co., Ltd., Montreal.
Waterous Engine Works Co., Brantford.

FEED WATER PURIFIERS
Stewart Heater Co., Buffalo, N.Y.

FEED WATER REGULATORS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Chaplin, Fulton Mfg. Co., Pittsburgh, Pa.
Beveridge Paper Co., Montreal, Que.
Darling Brothers, Ltd., Montreal, Que.
Elliott Co., Pittsburgh, Pt.
Green's Economizer, Ltd., Toronto.
Laurie & Lamb, Montreal.

FIBRE, VULCANIZED
Beveridge Paper Co., Montreal, Que.

FILTERS
Bowser & Co., Inc., S. F., Toronto, Ont.
The John MacDougall Caledonian Iron Works Co., Ltd., Montreal.
Laurie & Lamb, Montreal.

FILTERS, WATER
Darling Bros., Ltd., Montreal, Que.
Frick Co., Waynesboro, Franklin Co., Pa.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Scaife & Sons, Wm. B., Pittsburgh , Pa.
York Mfg. Co., York, Pa.

FIREBRICK—JOINTLESS
Beveridge Paper Co., Montreal, Que.

FIRE BRICK, PLASTIC
Gates, John W., St. James St., Montreal.

FIREPROOF COLD STORAE DOORS AND WINDOWS
Jamison Cold Storage Door Co., Hagerstown, Md.

FITTINGS, AIR, AUTOMOBILE, GAS, HYDRAULIC, PIPE, PIPE FLANGED, SCREWED PIPE, STEAM
Jefferson Union Co., Lexington, Mass.
Dart Union Co., Ltd., Toronto, Ont.
H. Mueller Mfg. Co., Sarnia, Ont.

FLANGED STEAM FITTINGS
Direct Separator Co., Syracuse, N.Y.
McAvity, T., & Sons, Ltd., St. John, N.B.

FLANGES
Dart Union Co., Ltd., Toronto, Ont.
Jefferson Union Co., Lexington, Mass.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.

FLOORING COMPOSITION
Armstrong Cork & Insulation Co., Montreal Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.

FLUE CLEANERS
Babcock & Wilcox, Montreal.
Green's Economiser, Ltd., Toronto, Ont.
Liberty Mfg. Co., Pittsburg, Pa.
Pilley Packing and Flue Brush Mfg. Co., St. Louis, Mo.
William B. Pierce Co., Buffalo, N.Y.
Roto Co., Hartford, Conn.
Wm. C. Wilson & Co., Toronto.

FLUE GAS ANALYSIS INSTRUMENTS
Green's Economiser, Ltd., Toronto, Ont.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Uehling Instrument Co., New York.
Penberthy Injector Co., Windsor, Ont.

FLUES, GAS AND SMOKE
Green's Economiser, Ltd., Toronto.

FLUMES, STEEL
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.

FREEZER DOORS
Jamison Cold Storage Door Co., Hagerstown, Md.

FRICTION LEATHERS
Graton & Knight Mfg. Co., Montreal.

FUEL AND OIL PUMPS AND MEASURING SYSTEMS
Imperial Oil, Ltd., Toronto.

FURNACES, BOILER
Gates, J. W., Montreal, P.Q.
Green's Economiser, Ltd., Toronto.

FURNACES, SMOKELESS
Babcock & Wilcox, Montreal.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Detroit, Mich.

FURNACE GRATE BARS
Beveridge Paper Co., Montreal, Que.

FUSES
Can. H. W. Johns-Manville Co., Toronto, Ont.
Economy Fuse & Mfg. Co. of Canada, Montreal.
Johns-Pratt Co., The, Hartford, Conn.

GAS ANALYSIS INSTRUMENTS, ETC.
Green's Economiser, Ltd., Toronto, Ont.
Penberthy Injector Co., Windsor, Ont.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Uehling Instrument Co., New York, N.Y.

GASKETS, RUBBER, ASBESTOS
Can. H. W. Johns-Manville Co., Toronto, Ont.
Durabla Mfg. Co., New York, N.Y.
Frick Co., Waynesboro, Franklin Co., Pa.
Garlock Packing Co., Hamilton, Ont.
Johns-Pratt Co., The, Hartford, Conn.
Sarco Co., Inc., New York, N.Y.
Thomson-Gordon, Ltd., Hamilton, Ont.

GASKETS, LEAD, COPPER AND LEATHER
Graton & Knight Mfg. Co., Montreal, Que.
Shell Bar Boico Supply Co., Toronto, Ont.
Sarco Co., Inc., New York, N.Y.
Wm. C. Wilson & Co., Toronto, Ont.

ELECTRICAL SAFETY AND ECONOMY

ECONOMY
Renewable
FUSES

Cut Annual Fuse Maintenance Cost 80%

Economy "Drop Out" Renewal Links are responsible for this saving.

A "Drop Out" Renewal Link restores a blown Economy Fuse to its original efficiency.

A sustained arc is impossible.

It's the work of a moment for even a novice to replace the link and renew the fuse.

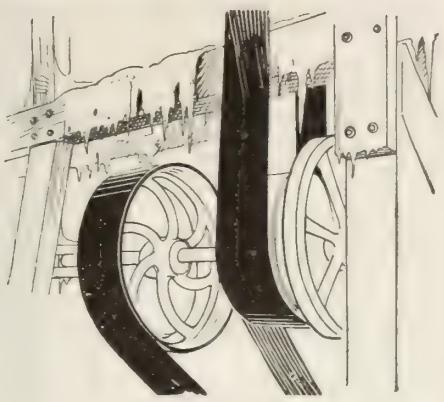
First in its field—first in efficiency.

Order from your dealer.

Write for Catalogue 24.

Economy Fuse & Mfg. Co.
of Canada, Ltd.
Unity Bldg. - Montreal

Manufacturers in Canada of S.& C.High Potential Fuses--to 150,000 volts.



Lanco Balata Belting
Works Well In Cold Places

This belt can in fact be used under any atmospheric conditions except those of heat.

This is a high-priced belt and you expect it to give long service. It does.

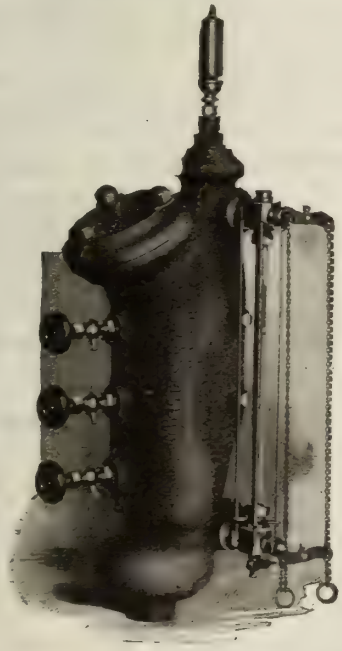
For work in wet or cold places you can buy cheaper belts that will do the work as well for a time, but would you not rather have a belt that would last longer even if you had to pay more for it?

Remember that changing belts is an expense and if you have to shut down your plant to make the change—and you sometimes do—the cost of the shut-down may be many times the cost of a Lanco Balata Belt.

We solicit the business of firms engaged in Mining, Stone Quarrying, etc.

Federal Engineering Co., Limited
172 John Street, Toronto

Water Must Be Kept At Its Proper Level—
Or Your Boiler Efficiency Drops



Exterior

When the water in your boilers rises above or falls below its proper level—it not only affects boiler efficiency, but **becomes dangerous**—you should know it instantly.

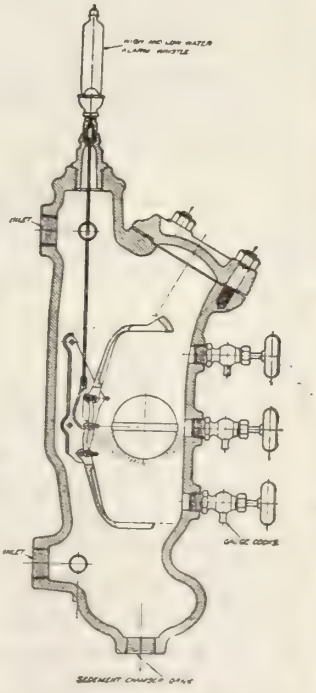
If you are depending upon a gauge glass you are taking risks. Rid yourself of all worry and care of boiler explosion in your steam plant by installing

THE ANDERSON
Safety Water Column

The "Anderson" sounds the high and low water alarm whistle plainly and unfailingly. With it you know whether the water is RIGHT or not.

The construction of the "Anderson" ensures you a big, reliable service. Nothing can go wrong.

The Anderson Safety Water Column is equally adapted for an old or new boiler—any make, size or description. Our illustrated catalog is worth sending for. Write now.



Cross Section

The V. D. Anderson Company
1935 West 96th St., - Cleveland, Ohio

GAS PRODUCER PLANTS
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Laurie & Lamb, Montreal.

GASOLINE
Imperial Oil, Ltd., Toronto.

GAUGE COCKS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Garlock Packing Co., Hamilton, Ont.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.
W. J. Wall, Montreal.

GAUGE GLASSES
Wm. C. Wilson & Co., Toronto.

GAUGES, AMMONIA, OIL, GAS, AIR
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

GAUGES, PRESSURE, VACUUM, DRAFT AND RECORDING, AND MICROMETER
Babcock & Wilcox, Montreal.
Green's Economiser, Ltd., Toronto.
Lunkenheimer Co., Cincinnati, O.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.

GAUGES, WATER
Babcock & Wilcox, Montreal.
Jenkins Bros., Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
Morton & Pearce, Toronto.
McAvity, T., & Sons, Ltd., St. John, N.B.
Penberthy Injector Co., Windsor, Ont.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

GEARS, FIBRE CUT
Beveridge Paper Co., Ltd., Montreal, Que.

GEARS, CUT, WORM, MORTISE
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

GENERATORS, STEAM TURBO
Can. General Electric Co., Toronto, Ont.
Laurie & Lamb, Montreal.

GENERATORS AND CONVERTORS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. General Electric Co., Toronto, Ont.

GOVERNORS, ENGINE
Escher Wyss & Co., Montreal, Que.
McAvity, T., & Sons, Ltd., St. John, N.B.
Waterous Engine Works Co., Brantford.

GRAPHITE, BOILER
Wm. C. Wilson & Co., Toronto.

GRATES, DUMPING, ROCKING, STATIONARY
Babcock & Wilcox, Montreal.
Can. Steam Boiler Equipment Co., Toronto, Ont.
Galt Foundry Co., Galt, Ont.
Mason Regulator & Engineering Co., Montreal.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Waterous Engine Works Co., Brantford.

GREASE CUPS
Albany Lubricating Co., New York City.
Detroit Lubricator Co., Walkerville.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

GREASE AND OIL EXTRACTORS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Elliott Co., Pittsburgh, Pa.
Laurie & Lamb, Montreal.

GREASES
Albany Lubricating Co., New York City.
Can. Economic Lubricant Co., Montreal, Que.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Wm. C. Wilson & Co., Toronto.

HAND LEATHERS OR PADS
Graton & Knight Mfg. Co., Montreal.

HANGERS
Can. General Electric Co., Toronto, Ont.
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Can. S K F Co., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Goldie & McCulloch Co., Galt.
Waterous Engine Works Co., Brantford.

HEATERS
Alberger Heater Co., Buffalo, N.Y.
Babcock & Wilcox, Ltd., Montreal.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
Laurie & Lamb, Montreal.
McAvity & Sons, T., St. John, N.B.
Waterous Engine Works Co., Brantford.

HEATERS, EXHAUST STEAM
Can. Allis-Chalmers, Ltd., Toronto, Ont.

HEATERS, METERING
Can. Allis-Chalmers, Ltd., Toronto, Ont.

HOISTS, GRIP
Jordan Bros., Inc., New York, N.Y.

HOISTING AND CONVEYING MACHINERY
Babcock & Wilcox, Ltd., Montreal.
Waterous Engine Works Co., Brantford.

HOSE, METALLIC
Pennsylvania Flexible Metallic Tubing Co., Boston, Mass.

HOSE, STEAM, SUCTION AND WATER
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Garlock Packing Co., Hamilton, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

HYDRANTS
Wood & Co., R. D., Philadelphia, Pa.

HYDRAULIC ACCUMULATORS
Smart-Turner Machine Co., Ltd., Hamilton.

HYDRAULIC MACHINERY
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Frick Co., Waynesboro, Franklin Co., Pa.
Hamilton Mfg. Co., Wm., Peterboro, Ont.
John McDougall Caledonian Iron Wks., Montreal.

HYDRAULIC PRESSES
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

ICE MAKING MACHINERY
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Frick Co., Waynesboro, Franklin Co.
Linde Canadian Refrigeration Co., Montreal.
York Mfg. Co., York, Pa.

INDICATORS, ELECTRIC—ALL TYPES
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Uehling Instrument Co., New York, N.Y.

INDICATORS, STEAM AND GAS ENGINE
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Canadian Fairbanks-Morse Co., Montreal.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Green's Economiser, Ltd., Toronto.
Uehling Instrument Co., New York, N.Y.

INDICATORS—AMMONIA, HYDRAULIC
Can. Detroit Lubricator Co., Walkerville, Ont.

INDICATORS, SPEED
L. S. Starrett Co., Athol, Mass.

INJECTORS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

INSTRUMENTS, RECORDING
Green's Economiser, Ltd., Toronto.
Taylor Instrument Companies, Rochester, N.Y.

INSULATING BRICK
Armstrong Cork & Insulation Co., Montreal, Que.
Beveridge Paper Co., Ltd., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.

INSULATING COMPOUNDS
Johns-Pratt Co., The, Hartford, Conn.

INSULATORS
Beveridge Paper Co., Ltd., Montreal, Que.
Johns-Pratt Co., The, Hartford, Conn.

IRON FILLER
Can. H. W. Johns-Manville Co., Toronto, Ont.

KILNS
Green's Economiser, Ltd., Toronto.

LACE LEATHERS
Graton & Knight Mfg. Co., Montreal.
Wm. C. Wilson & Co., Toronto.
Can. H. W. Johns-Manville Co., Toronto, Ont
Can. B. K. Morton Co., Toronto, Montreal.
Crane Packing Co., Chicago, Ill.

LAMPS, ARC
Canadian Fairbanks-Morse Co., Montreal.
Can. General Electric Co., Toronto, Ont.
Can. H. W. Johns-Manville Co., Toronto, Ont.

LAMPS, ELECTRIC
Wm. C. Wilson & Co., Toronto.

LAMPS, INCANDESCENT
Canadian Fairbanks-Morse Co., Montreal.
Can. General Electric Co., Toronto, Ont.
Can. H. W. Johns-Manville Co., Toronto, Ont
Can. Laco-Philips Co., Ltd., Toronto, Ont.

LAMPS, NITRO
Can. Laco-Philips Co., Ltd., Toronto, Ont.

LAMPS, TUNGSTEN AND NITRO
Can. General Electric Co., Toronto, Ont.
Can. Laco-Philips Co., Ltd., Toronto, Ont.

LEATHER STRAPPING
Graton & Knight Mfg. Co., Montreal.

LININGS, FIRE BRICK, STEEL STACK
Green's Economiser, Ltd., Toronto.

LUBRICANTS
Albany Lubricating Co., New York City.
Canadian Economic Lubricant Co., Montreal.

LUBRICATORS CYLINDER CUTTING COMPOUNDS
Albany Lubricating Co., New York City.
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

LUBRICATORS, FORCE FEED
Can. Detroit Lubricator Co., Walkerville, Ont.
Darling Bros., Montreal.
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

LUBRICATORS, PLAIN
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

MACHINERY INSULATION
Armstrong Cork & Insulation Co., Montreal, Que.
Beveridge Paper Co., Ltd., Montreal, Que.

MECHANICAL STOKERS
Babcock & Wilcox, Ltd., Montreal.
Green's Economiser, Ltd., Toronto.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Dertoit, Mich.

METERS, ELECTRIC
Can. H. W. Johns-Manville Co., Toronto, Ont.

METERS, STEAM
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Green's Economiser, Ltd., Toronto.

METERS, WATER
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Green's Economiser, Ltd., Toronto, Ont.
McAvity & Sons, T., St. John, N.B.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.

MIXING VALVES
Mueller Mfg. Co., H., Sarnia, Ont.

MILL AND MINING MACHINERY
Canadian Fairbanks-Morse Co., Montreal.
Engineering and Machine Works of Canada, Ltd. St. Catharines, Ont.
Goldie & McCulloch Co., Galt.
Waterous Engine Works Co., Brantford.

METER TESTERS
Mueller Mfg. Co., H., Sarnia, Ont.

MOTORS
Canadian Fairbanks-Morse Co., Montreal.
Can. General Electric Co., Toronto, Ont.
Green's Economiser, Ltd., Toronto.

OAKUM
Wm. C. Wilson & Co., Toronto.

OFFICE RAILINGS
Jas. Morrison Brass Mfg. Co., Toronto.

OIL CUPS
Albany Lubricating Co., New York City.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

OILER, COMPOUND FEEDERS
Lunkenheimer Co., Cincinnati, O.

OILERS, GAUGE
Lunkenheimer Co., Cincinnati, O.

OILERS, MULTIPLE
Can. Detroit Lubricator Co., Walkerville, Ont.
Lunkenheimer Co., Cincinnati, O.

OIL FILTERS AND CIRCULATING SYSTEMS
Bowser & Co., Inc., S. F., Toronto, Ont.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
Jas. Morrison Brass Mfg. Co., Toronto.

OIL SEPARATORS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
Direct Separator Co., Syracuse, N.Y.
Elliott Co., Pittsburgh, Pa.
Leitch Co., Arthur S., Toronto, Ont.
Liberty Mfg. Co., Pittsburgh.
Jas. Morrison Brass Mfg. Co., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.

OILS, QUENCHING
Imperial Oil, Ltd., Toronto.

OILING SYSTEMS
Albany Lubricating Co., New York City.
Bowser & Co., Inc., S. F., Toronto, Ont.
Lunkenheimer Co., Cincinnati, O.

OILS, CYLINDER
Imperial Oil, Ltd., Toronto.

OILS, LUBRICATING
Albany Lubricating Co., New York City.
Can. Economic Lubricant Co., Montreal, Que.
Kellogg & Co., E. H., New York, N.Y.
Wm. C. Wilson & Co., Toronto.

OILS, ENGINE
Imperial Oil, Ltd., Toronto.

PACKING, ASBESTOS
Johns-Pratt Co., The, Hartford, Conn.

PACKING ENGINE
Garlock Packing Co., Hamilton, Ont.
Johns-Pratt Co., The, Hartford, Conn.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING FIBRE
Beveridge Paper Co., Ltd., Montreal, Que.
Can. B. K. Morton Co., Montreal, Que.
Johns-Pratt Co., The, Hartford, Conn.
Wm. C. Wilson & Co., Toronto.

PACKING, HYDRAULIC
Can. H. W. Johns-Manville Co., Toronto, Ont.
Crane Packing Co., Chicago, Ill.
Durabla Manufacturing Co., New York.
Garlock Packing Co., Hamilton, Ont.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

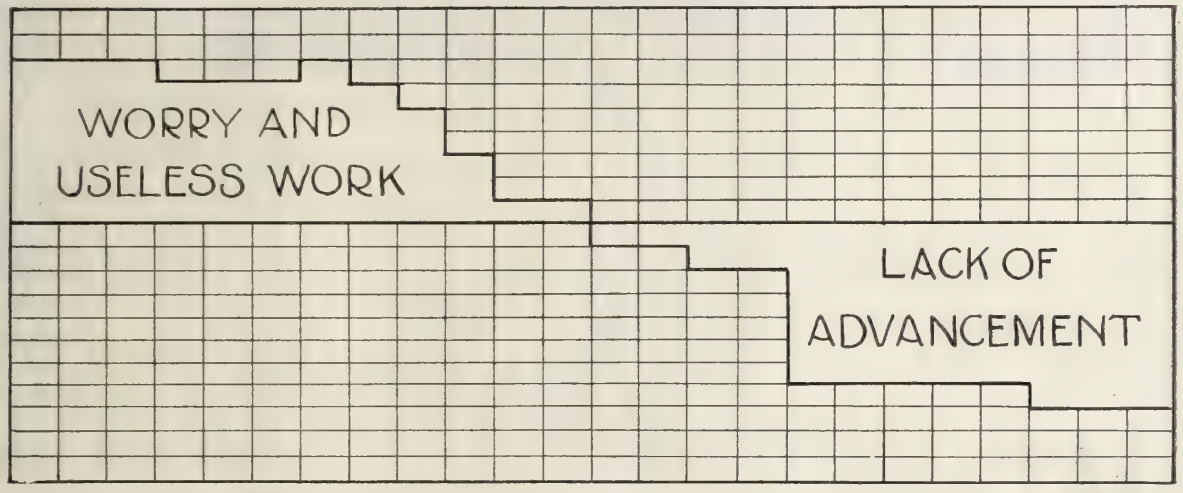
PACKING, METALLIC
Can. H. W. Johns-Manville Co., Toronto, Ont.
Crane Packing Co., Chicago, Ill.
Greene, Tweed & Co., New York.
Holmes Metallic Packing Co., Wilkesbarre, Pa
Steel Mill Packing Co., Windsor, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, ROD
Can. H. W. Johns-Manville Co., Toronto, Ont.
Crane Packing Co., Chicago, Ill.
Garlock Packing Co., Hamilton, Ont.
Steel Mill Packing Co., Windsor, Ont.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, SHEET
Can. H. W. Johns-Manville Co., Toronto, Ont
Durabla Manufacturing Co., New York.
Garlock Packing Co., Hamilton, Ont.
Jenkins Bros., Ltd., Montreal.
Johns-Pratt Co., The, Hartford, Conn.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, AMMONIA, STEAM AND WATER
Can. H. W. Johns-Manville Co., Toronto, Ont.
Crane Packing Co., Chicago, Ill.
Garlock Packing Co., Hamilton, Ont.
Greene, Tweed & Co., New York.
Johns-Pratt Co., The, Hartford, Conn.
Steel Mill Packing Co., Windsor, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

Let the C.A.S.E. Smooth Out Your Load Curve



Remove The Peaks of Worry And Unproductive Labor And Build Up The Valleys By Working For Your Advancement

A man who is thoroughly grounded in the practice of his profession, who is free from personal worry and trouble, overcomes the many difficulties besetting the path of the operating engineer with little labor and in a manner ensuring his advancement.

The successful man owes his success to a wise appreciation of the advantages and mutual help offered by association with those in the same field of endeavor. To join an association having for its objectives the welfare of the engineer in things mental and material, his advancement in knowledge and skill, his protection by provision for sickness and distress is to take advantage of an opportunity indispensable to all who hope to better themselves.

If you are interested in such an organization and live where less than fifteen engineers are located, send for a copy of our constitution and application blanks for admission to nearest branch lodge. If there are more than fifteen engineers in your community, get together and send for particulars regarding formation of a branch lodge.

J. H. HALE, General Secretary,

Canadian Association of Stationary Engineers

230 Caroline Street Hamilton, Ont.

PACKING, LEATHER
Garlock Packing Co., Hamilton, Ont.
Graton & Knight Mfg. Co., Montreal.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING PISTON
Crane Packing Co., Chicago, Ill.

PACKING, VALVE STEM
Crane Packing Co., Chicago, Ill.
Johns-Pratt Co., The, Hartford, Conn.

PAINTS
Wm. C. Wilson & Co., Toronto.

PAPER, INSULATING, ETC.
Beveridge Paper Co., Montreal, Que.

PENSTOCKS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.

PILLOW BLOCKS
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Waterous Engine Works Co., Brantford.

PIPE COILS
[illegible], Pa.
York Mfg. Co., York, Pa.

PIPE COVERINGS, STEAM, BRINE, AMMONIA AND ICE WATER
Armstrong Cork & Insulation Co., Montreal, Que.

PIPE, CAST IRON
Wood & Co., R. D., Philadelphia, Pa.

PIPE STEEL
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

PIPE VISES AND CUTTERS
Armstrong Mfg. Co., Bridgeport, Conn.

PIPE, GAS
Can. Allis-Chalmers, Ltd., Toronto, Ont.

PIPES, WATER
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

PIPING AND FITTINGS
Frick Co., Waynesboro, Franklin Co., Pa.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
York Mfg. Co., York, Pa.

PIPING, STEAM
Babcock & Wilcox, Ltd., Montreal.

PLATE WORK
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd. St. Catharines, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

PLUG COCKS
Homestead Valve Mfg. Co., Pittsburgh, Pa.

PLUMBING SUPPLIES
Mueller Mfg. Co., H., Sarnia, Ont.
Wm. C. Wilson & Co., Toronto.

POWER PUMPS
American Steam Pump Co., Battle Creek, Mich.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
Waterous Engine Works Co., Brantford.
Garlock Packing Co., Hamilton, Ont.
Laurie & Lamb, Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.

POWER, TRANSMISSION MACHINERY
American Pulley Co., Philadelphia, Pa.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Goldie & McCulloch Co., Galt.
Jeffrey Manufacturing Co., Montreal.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
MacGovern & Co., New York.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Morse Chain Co., Ithaca, N.Y.
Waterous Engine Works Co., Brantford.

PRESSES
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont

PRESSURE, BLOWERS, CENTRIFUGAL
Can. Sirocco Co., Windsor, Ont.

PULLEYS
American Pulley Co., Philadelphia, Pa.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Jeffrey Manufacturing Co., Montreal.
Waterous Engine Works Co., Brantford

PULP MILL MACHINERY
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Hamilton Co., Wm., Peterboro, Ont.
Jeffrey Manufacturing Co., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

PUMPING MACHINERY
American Steam Pump Co., Battle Creek, Mich.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Beveridge Paper Co., Montreal, Que.
Fairbanks, Morse & Co., Montreal
Laurie & Lamb, Montreal
McAvity & Sons, T., St. John, N.B.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
Waterous Engine Works Co., Brantford.

PUMPING MACHINERY, ELECTRICAL
Beveridge Paper Co., Montreal, Que.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Darling Brothers, Ltd., Montreal, Que.
Jeffrey Manufacturing Co., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

PUMPS, AIR
American Steam Pump Co., Battle Creek, Mich
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Montreal.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co. Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

PUMPS, ACID
Beveridge Paper Co., Montreal, Que.
Darling Brothers, Ltd., Montreal, Que.

PUMPS, CONTRACTORS'
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Beveridge Paper Co., Montreal, Que.
Darling Brothers, Ltd., Montreal, Que.
McAvity & Sons, T., St. John, N.B.
Smart-Turner Machine Co., Hamilton, Ont.

PUMPS, ELECTRICAL
American Steam Pump Co., Battle Creek, Mich
Beveridge Paper Co., Montreal, Que.
Darling Brothers, Ltd., Montreal, Que.

PUMPS, ELECTRICAL
Bawden Pump Co, Toronto.

PUMPS, FEED WATER
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Beveridge Paper Co., Montreal, Que.
Darling Brothers, Ltd., Montreal, Que.

PUMP GOVERNORS AND REGULATORS
Darling Bros., Montreal.
G. M. Davis Regulator Co., Chicago.
D'Este Co., Julian, Boston, Mass.
Elliott Co., Pittsburgh, Pa.
Mason Regulator Co., Boston, Mass.
Smart-Turner Machine Co., Hamilton, Ont.
Watson & McDaniel Co., Philadelphia.

PUMP STRAINERS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Darling Bros., Ltd., Montreal.
Liberty Mfg. Co., Pittsburgh, Pa.
Smart-Turner Machine Co., Hamilton, Ont.

PUMPS, HAND AND POWER
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Darling Bros., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.

PUMPS, CENTRIFUGAL
American Steam Pump Co., Battle Creek, Mich.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Darling Bros., Montreal
Hamilton Co., Wm., Peterboro, Ont.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Waterous Engine Works Co., Brantford.

PUMPS, DUPLEX
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Beveridge Paper Co., Montreal, Que.
Darling Brothers, Ltd., Montreal, Que.

PUMPS, GEARED, COMPOUND
American Steam Pump Co., Battle Creek, Mich
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Montreal.
Inglis Co., The John, Toronto, Ont.
The John McDougall Caledonian Iron Works Co. Ltd., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.

PUMPS, HYDRAULIC, PRESSURE
American Steam Pump Co., Battle Creek, Mich.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Darling Bros., Montreal.
Inglis Co., The John, Toronto, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.

PUMP LEATHERS
Beveridge Paper Co., Ltd., Montreal, Que.
Graton & Knight Mfg. Co., Montreal.

PUMPS, OIL
American Steam Pump Co., Battle Creek, Mich.
Bowser & Co., Inc., S. F., Toronto, Ont.
Can. Detroit Lubricator Co., Walkerville, Ont.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Smart-Turner Machine Co., Hamilton, Ont.

PUMPS, STEAM TURBO
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Darling Bros., Montreal.
Escher Wyss & Co., Montreal, Que.

PUMP TANK, RECEIVER
American Steam Pump Co., Battle Creek, Mich.
Beveridge Paper Co., Montreal, Que.
Darling Brothers, Ltd., Montreal, Que.
Smart-Turner Machine Co., Hamilton, Ont.

PUMPS, STEAM
American Steam Pump Co., Battle Creek, Mich.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
Inglis Co., The John, Toronto, Ont.
Laurie & Lamb, Montreal.
Leitch Co., Arthur S., Toronto, Ont.
McAvity & Sons, T., St. John, N.B.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.

PUMPS, TRIPLEX
Smart-Turner Machine Co., Hamilton, Ont.

PUMPS, VACUUM
American Steam Pump Co., Battle Creek, Mich.
Beveridge Paper Co., Montreal, Que.
Darling Brothers, Ltd., Montreal, Que.
Laurie & Lamb, Montreal.
Leitch Co., Arthur S., Toronto, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.

PYROMETERS
Green's Economiser, Ltd., Toronto.
Jas. Morrison Brass Mfg. Co., Toronto.
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.

RADIATOR TRAPS
Beveridge Paper Co., Montreal, Que.
Darling Brothers, Ltd., Montreal, Que.
Sarco Co., Inc., New York, N.Y.

RADIATOR AIR VENTS
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

RAGS
Wm. C. Wilson & Co., Toronto.

REBOILERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

RECEIVERS, AIR
Can. Allis-Chalmers, Ltd., Toronto, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.

RECORDING INSTRUMENTS
Can. H. W. Johns-Manville Co., Toronto, Ont.
Green's Economiser, Ltd., Toronto.
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.

REFRIGERATOR DOORS, WINDOWS, ETC.
Jamison Cold Storage Door Co., Hagerstown, Md.

REFRIGERATING MACHINERY
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Griscom-Russell Co., Ltd., Montreal.
Frick Co., Waynesboro, Franklin Co., Pa.
Linde Canadian Refrigeration Co., Montreal.
Vilter Mfg. Co., Milwaukee, Wis.
York Mfg. Co., York, Pa.

REFUSE DESTRUCTOR
Canadian Griscom-Russell Co., Ltd., Montreal.
Laurie & Lamb, Montreal.

REGULATORS, PRESSURE
Chaplin-Fulton Mfg. Co., Pittsburgh, Pa.
D'Este Co., Julian, Boston, Mass.
Jas. Morrison Brass Mfg. Co., Toronto.
Taylor Instrument Co., Rochester, N.Y.

REGULATORS, TEMPERATURE
Sarco Co., Inc., New York, N.Y.
Taylor Instrument Co., Rochester, N.Y.

RETORTS
MacKinnon Steel Co., Sherbrooke, Que.

REVOVLING DOORS FOR HARDENING ROOMS
Jamison Cold Storage Door Co., Hagerstown, Md.

ROOFING
Wm. C. Wilson & Co., Toronto.

ROOFINGS—RUBBER, PLASTIC, LIQUID
Beveridge Paper Co., Montreal, Que.

ROPE
Wm. C. Wilson & Co., Toronto.

ROPE PRESERVATIVE
Cling Surface Co., Buffalo.

ROTARY CONVERTERS
Canadian Fairbanks-Morse Co., Montreal.

RUBBER HOSE
Can. H. W. Johns-Manville Co., Toronto, Ont.
Garlock Packing Co., Hamilton, Ont.
Liberty Mfg. Co., Pittsburg, Pa.
Thomson-Gordon, Ltd., Hamilton, Ont.

SAFES
Canadian Fairbanks-Morse Co., Montreal.
Goldie & McCulloch Co., Galt.

SCALE REMOVERS
Babcock & Wilcox, Ltd., Montreal.
Beveridge Paper Co., Ltd., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Green's Economiser, Ltd., Toronto, Ont.
Roto Co., Hartford, Conn.
William B. Pierce Co., Buffalo, N.Y.
Snowdon, C. C., Calgary, Alta.

SEAM PROTECTORS, GIRTH
National Boiler Protector Co. of Canada, Montreal, Que.

SHAFTING
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Waterous Engine Works Co., Brantford.

SHAKING AND DUMPING GRATES
Babcock & Wilcox, Ltd., Montreal.
Galt Foundry Co., Galt, Ont.
Waterous Engine Works Co., Brantford.

SMELTER LININGS
Beveridge Paper Co., Montreal, Que.

SMOKE BOXES, STACKS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Green's Economiser, Ltd., Toronto.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

SMOOTH-ON
Wm. C. Wilson & Co., Toronto.

SPECIAL MACHINERY
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Waterous Engine Works Co., Brantford.

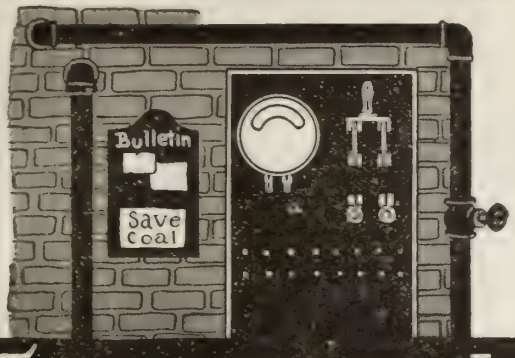
SPEED INDICATORS
Schaeffer & Budenburg Mfg. Co., Brooklyn, N.Y.
L. S. Starrett Co., Athol, Mass.

SPLICE PROTECTORS
Jordan Bros., Inc., New York, N.Y.

SPROCKET CHAIN ATTACHMENTS
Waterous Engine Works Co., Brantford.

SPROCKET RIMS
Babbitt Steam Specialty Co., New Bedford, Mass.

SPUR WHEELS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Montreal.



Tycos Temperature Instruments

Industrial Thermometers (angle and straight stem)
Capillary Recording Thermometers
Self-Contained Recording Thermometers
Capillary Index (or Dial) Thermometers
Thermoelectric Pyrometers
Recording Thermoelectric Pyrometers
Fery Radiation Pyrometers
Temperature Controlling Devices—Time Controls
Coal Oil Testing Instruments
Capillary Electric Contact Temperature Controls
Laboratory Engraved Stem Thermometers
Hygrometers (wet and dry bulb) Indicating and Recording
Outdoor and Household Thermometers
Thermographs
Medical and General Use Thermometers
Hydrometers, M. C. Vacuum Gauges, Aneroid Barometers
Aviation Altimeters, Barographs, etc., etc.

That manufacturer expecting much through the installation of indicating, recording and controlling Temperature Instruments will realize in full such expectations and derive profit—if he specifies *Tycos* products.

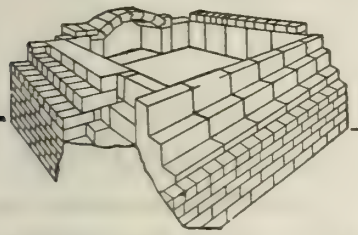
We shall be glad to give detailed description of any of our temperature instruments

Taylor Instrument Companies

ROCHESTER, N.Y.

There's a *Tycos* and *Taylor* Thermometer for Every Purpose

201 Royal Bank Building, Toronto, Ont.



Gates Boiler Furnace

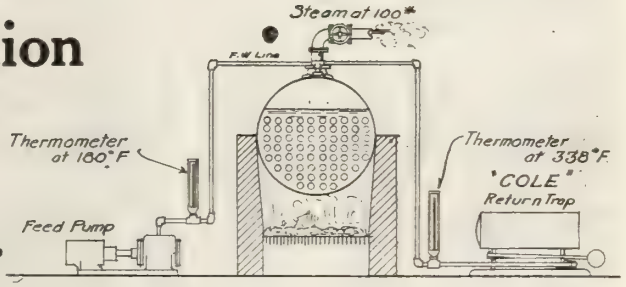
Patented 1916

Will last three times as long as ordinary good grade Fire Brick. These blocks are inter-locking, and made so that any handy man or fireman can renew them without disturbing any of the other brick work.

WRITE FOR PARTICULARS.

John W. Gates 2 St. James St., MONTREAL, QUE.

A Question for the Steam Engineer



Under these conditions—of alternative feed apparatus—how many lbs. of steam per lb. of coal would you expect?

GEO. W. COLE, Ltd. **2002 Dundas St. W.** **TORONTO**

ECONOMY!

In the Steam Plant

A remarkable number of dollars can be saved by having condensation returned to the boilers as pure **Hot** steam. This is what the "Morehead System" will do, automatically and completely—thus saving many dollars' worth of fuel in the course of a year.

The "Morehead System" does more. It effects economy in operation, gives freedom from all steam pump troubles, and maintains an equally-controlled uniform temperature throughout your plant.

The "Morehead System" offers you the simplest and most profitable way to handle steam condensation.

Requires practically no attention, needs no cylinder lubrication, will not race or run away, never sticks, takes little space, requires no foundation and will handle water of any temperature.

LET US SEND YOU SOME MORE FACTS ABOUT THE "MOREHEAD SYSTEM."

CANADIAN MOREHEAD MANUFACTURING COMPANY **Woodstock, Ont.**

Hamilton Co., Wm., Peterboro, Ont.
Waterous Engine Works Co., Brantford.

STACKS, STEEL
Babcock & Wilcox, Ltd., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.

STAND PIPES, STEEL
MacKinnon, Holmes & Co., Sherbrooke, Que.

STAYBOLTS, FLEXIBLE
Can. Allis-Chalmers, Ltd., Toronto, Ont.

STEAM SEPARATORS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Darling Bros., Montreal.
Direct Separator Co., Syracuse, N.Y.
D'Este Co., Julian, Boston, Mass.
Elliott Co., Pittsburgh, Pa.
Leitch Co., Arthur S., Toronto, Ont.
Penberthy Injector Co., Windsor, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Watson & McDaniel Co., Philadelphia.

STEAM SPECIALTIES
Alberger Heater Co., Buffalo, N.Y.
Canadian Fairbanks-Morse Co., Montreal.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
D'Este Co., Julian, Boston, Mass.
Liberty Mfg. Co., Pittsburg, Pa.
Lunkenheimer Co., Cincinnati, O.
Mason Regulator & Engineering Co., Montreal.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor.
Watson & McDaniel Co., Philadelphia.

STEAM TRAPS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Anderson Co., Y. D., Cleveland, O.
Canadian Fairbanks-Morse Co., Montreal.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
Davis Regulator Co., G. M., Chicago.
D'Este Co., Julian, Boston, Mass.
Dunham Co., Ltd., C. A., Toronto, Ont.
Elliott Co., Pittsburgh, Pa.
J. T. Long, 84 Adam St., Montreal, Que.
Can. Morehead Mfg. Co., Woodstock.
Mason Regulator & Engineering Co., Montreal.
Sarco Co., Inc. New York, N.Y.
Watson & McDaniel Co., Philadelphia.

STEEL BARRELS
Smart-Turner Machine Co., Hamilton, Ont.

STEEL DRUMS
Smart-Turner Machine Co., Hamilton, Ont.

STEEL TANKS
Babcock & Wilcox, Ltd., Montreal.
MacKinnon, Steel Co., Sherbrooke, Que.
Waterous Engine Works, Brantford, Ont.

STOKERS
Babcock & Wilcox, Ltd., Montreal.
Detroit Stoker Co., Detroit, Mich.
Galt Foundry Co., Galt, Ont.
Green's Economiser, Ltd., Toronto.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Dertoit, Mich.

STRAINERS
Babcock & Wilcox, Ltd., Montreal.
Beveridge Paper Co., Montreal, Que.
Darling Brothers, Ltd., Montreal, Que.
Elliott Co., Pittsburgh, Pa.

STRUCTURAL STEEL WORK
Babcock & Wilcox, Ltd., Montreal.
MacKinnon, Holmes & Co., Ltd., Sherbrooke, Que.

SUPERHEATERS, STEAM
Babcock & Wilcox, Ltd., Montreal.
Green's Economiser, Ltd., Toronto.

SWING JOINTS
Franklin Williams Co., New York.

SWITCHBOARDS
Can. General Electric Co., Toronto, Ont.

SWITCHES AND SWITCH BOXES
Can. H. W. Johns-Manville Co., Toronto, Ont.

TACHOMETERS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Can. H. W. Johns-Manville Co., Toronto, Ont.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

TANKS, BLOW-OFF
Darling Bros., Montreal.
John McDougall Caledonian Iron Works, Montreal
Waterous Engine Works Co., Brantford.

TANKS, FREEZING, STORAGE AND WATER COOLING
Frick Co., Waynesboro, Franklin Co., Pa.

TANKS, OIL
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Bowser & Co., Inc., S. F., Toronto, Ont.
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

TANKS, WATER
Inglis Co., The John, Toronto, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

TAPPING MACHINES
Mueller Mfg. Co., H., Sarnia, Ont.

TECHNICAL BOOKS
MacLean Publishing Co., Toronto.

THERMOMETERS
Green's Economiser, Ltd., Toronto, Ont.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.

THERMOSTATS
Sarco Co., Inc., New York, N.Y.

TOOLS
Mueller Mfg. Co., H., Sarnia, Ont.

TRANSFORMERS
Can. General Electric Co., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.

TRANSMISSION MACHINERY
American Pulley Co., Philadelphia, Pa.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Goldie & McCulloch Co., Galt, Ont.
Jeffrey Manufacturing Co., Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Waterous Engine Works Co., Brantford.

TRAPS, STEAM AND WATER-LINE
Beveridge Paper Co., Montreal, Que.
Darling Brothers, Ltd., Montreal, Que.
D'Este Co., Julian, Boston, Mass.

TRUCKS, FACTORY
Beveridge Paper Co., Ltd., Montreal, Que.
Canadian Fairbanks-Morse Co., Montreal.

TUBE CLEANERS
Babcock & Wilcox, Ltd., Montreal.
Darling Brothers, Ltd., Montreal, Que.
Elliott Company, Pittsburgh, Pa.
Green's Economiser, Ltd., Toronto, Ont.
Liberty Mfg. Co., Pittsburgh, Pa.
Pelley Packing and Fine Brush Mfg. Co., St. Louis, Mo.

TURBINES, HORIZONTAL AND VERTICAL SHAFT
Barber & Sons, Charles, Meaford, Ont.

TUBE CUTTERS
Babcock & Wilcox, Ltd., Montreal.
Liberty Mfg. Co., Pittsburg, Pa.

TUBES, BOILER
Babcock & Wilcox, Ltd., Montreal.

TUBE EXPANDERS
Babcock & Wilcox, Ltd., Montreal.
Liberty Mfg. Co., Pittsburg, Pa.

TUBING, FELXIBLE METALLIC
Pennsylvania Flexible Metallic Tubing Co., Cleveland, O.

TURBINE OIL
Kellogg & Co., E. H., New York, N.Y.

TUNGSTEN LAMP (Vacuum and Gas Filled Types)
Penberthy Injector Co., Windsor, Ont.
Can. Laco-Phillips Co. of Toronto, Ont

TURBINE WATER WHEELS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.

TURBINES, STEAM
Belliss & Morcom, Birmingham, Eng.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Coppus Engr. & Equip. Co., Worcester, Mass.
Escher Wyss & Co., Montreal, Que.
Laurie & Lamb, Montreal.
John McDougall Caledonian Iron Works, Montreal.

UNIONS
Canadian Fairbanks-Morse Co., Montreal.
Dart Union Company, Toronto.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.

UNIONS, BALL JOINT, COMBINATION, FLANGED PIPE, GROUND JOINT, MALLEABLE IRON, FLANGE, PIPE, SWING
Jefferson Union Co., Lexington, Mass.
Dart Union Company, Ltd., Toronto, Ont.

VACUUM GOVERNORS
Smart-Turner Machine Co., Ltd., Hamilton.
Canadian Steam Boiler Equipment Co., Toronto.
Beveridge Paper Co., Montreal, Que.
Darling Brothers, Ltd., Montreal, Que.
G. M. Davis Regulator Co., Chicago.
Leitch Co., Arthur S., Toronto, Ont.

VACUUM REGULATING VALVES
Can. Steam Boiler Equipment Co., Toronto, Ont.
Darling Bros., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

VACUUM TRAPS
Darling Brothers, Ltd., Montreal, Que.
Can. Morehead Mfg. Co., Woodstock, Ont.
Cole, Ltd., Geo. W., Toronto.

VALVE DISCS
Wm. C. Wilson & Co., Toronto.

VALVE LEATHER
Beveridge Paper Co., Ltd., Montreal, Que.
Graton & Knight Mfg. Co., Montreal.

VALVE RESEATING MACHINES
Darling Bros., Montreal.

VALVES
Babcock & Wilcox, Ltd., Montreal.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Can. Steam Boiler Equipment Co., Toronto, Ont.
Darling Brothers, Ltd., Montreal, Que.
Frick Co., Waynesboro, Franklin Co., Pa.
Beveridge Paper Co., Montreal, Que.
G. M. Davis Regulator Co., Chicago.
D'Este Co., Julian, Boston, Mass.
Homestead Valve Mfg. Co., Pittsburg.
Jenkins Bros., Montreal.
Kerr Engine Co., Walkerville, Ont.
Liberty Mfg. Co., Pittsburg, Pa.
Lunkenheimer Co., Cincinnati, O.
Mason Regulator & Engineering Co., Montreal.
Mason Regulator Co., Boston, Mass.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor.
Pratt & Cady, Hartford, Conn.
Victoria Foundry Co., Ottawa, Ont.
Watson & McDaniel Co., Philadelphia.
Wm. C. Wilson & Co., Toronto.
Wood & Co., R. D., Philadelphia, Pa.
York Manufacturing Co., Philadelphia.

VALVES, ACID RESISTING
Homestead Valve Mfg. Co., Pittsburg.
McAvity & Sons, T., St. John, N.B.
Victoria Foundry Co., Ottawa, Ont.

VALVES, BACK PRESSURE
Can. Allis-Chalmers, Ltd., Toronto, Ont.

VALVES, BLOW-OFF
Babcock & Wilcox, Ltd., Montreal.
Canadian Fairbanks-Morse Co., Montreal.
Beveridge Paper Co., Montreal, Que.
Darling Brothers, Ltd., Montreal, Que.
Elliott Co., Pittsburg, Pa.
Homestead Valve Mfg. Co., Pittsburg.
Jenkins Bros., Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Watson & McDaniel Co., Philadelphia.
Yarnall-Waring Co., Philadelphia, Pa

VALVE CHAIN WHEEL
Babbitt Steam Specialty Co., New Bedford, Mass.

VALVES, FOOT
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Smart-Turner Machine Co., Ltd., Hamilton.

VALVES, GATE
Babcock & Wilcox, Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.

VALES, HYDRAULIC
Yarnall-Waring Co., Philadelphia, Pa

VALVES, MULTIPORT
Can. Allis-Chalmers, Ltd., Toronto, Ont.

VALVES, NON-RETURN STOP
Canadian Fairbanks-Morse Co., Montreal.

VALVES, RELIEF
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
McAvity & Sons, T., St. John, N.B.

VALVES, REDUCING
Beveridge Paper Co., Montreal, Que.
Darling Brothers, Ltd., Montreal, Que.
D'Este Co., Julian, Boston, Mass.
Leitch Co., Arthur S., Toronto, Ont.
Liberty Mfg. Co., Pittsburg, Pa.
Mason Regulator Co., Boston, Mass.
Jas. Morrison Brass Mfg. Co., Toronto.
Mueller Mfg. Co., H., Sarnia, Ont.
Watson & McDaniel Co., Philadelphia.

VALVES, RADIATOR
Jenkins Bros., Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.

VALVES, POP
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.

VALVES, PUMP
Beveridge Paper Co., Ltd., Montreal, Que.
Canadian Fairbanks-Morse Co., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

VALVES, SAFETY THROTTLE
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Detroit Lubricator Co., Walkerville, Ont.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.

WATER COLUMNS, GAGES
Darling Brothers, Ltd., Montreal, Que.

WATER SCAIFE AND WE-FU-GO
PURIFICATION SYSTEMS
SOFTENING & FILTRATION
FOR BOILER FEED AND ALL INDUSTRIAL USES
WM. B. SCAIFE & SONS CO. PITTSBURGH, PA.

Don't buy that New Electrical Apparatus Just Yet

WE can supply you with high-grade apparatus that has been slightly used and discarded through no fault of its own, at an **immense saving in cost.** For instance, in many cases we take over entire plants simply because of changed conditions such as increased capacity, change of system, etc.

EVERYTHING IS OVERHAULED AND REFINISHED BY US AND **GUARANTEED** AS GOOD AS NEW, BOTH ELECTRICALLY AND MECHANICALLY.

Our catalogs of offerings should be in the hands of every power plant superintendent each time they are gotten out, and it will be worth while for anyone interested in this class of power plant equipment to be on our mailing list to receive all offerings.

Nearly all of the principal power, lighting and street railway plants in the United States are our customers.

WRITE FOR OUR LATEST CATALOG of **Power House Equipment, Street Cars, Motors, Hoists, Compressors, etc.**

MACGOVERN & COMPANY, Inc.

Canadian Office: 285 Beaver Hall Hill, Montreal

The Wrench of 25% Greater Efficiency

TRIMO PIPE WRENCH

Two new features have been recently added to the Trimo Pipe Wrench, namely Nut-Guards, in all sizes, and unbreakable steel frames, in leading sizes.

The Nut-Guards prevent the accidental rotation of the nut while in use.

These improvements add 25% to the usefulness of the tool.

The Trimo Pipe Wrench is made with wood handles in 4 sizes, 6-in., 8-in., 10-in., 14-in. and in steel handles in all sizes, 6-in. to 48-in. inclusive.

All Trimo Pipe Wrench parts are interchangeable.

The inserted jaw in the handle can be readily replaced when worn, thus adding to the life of the tool.

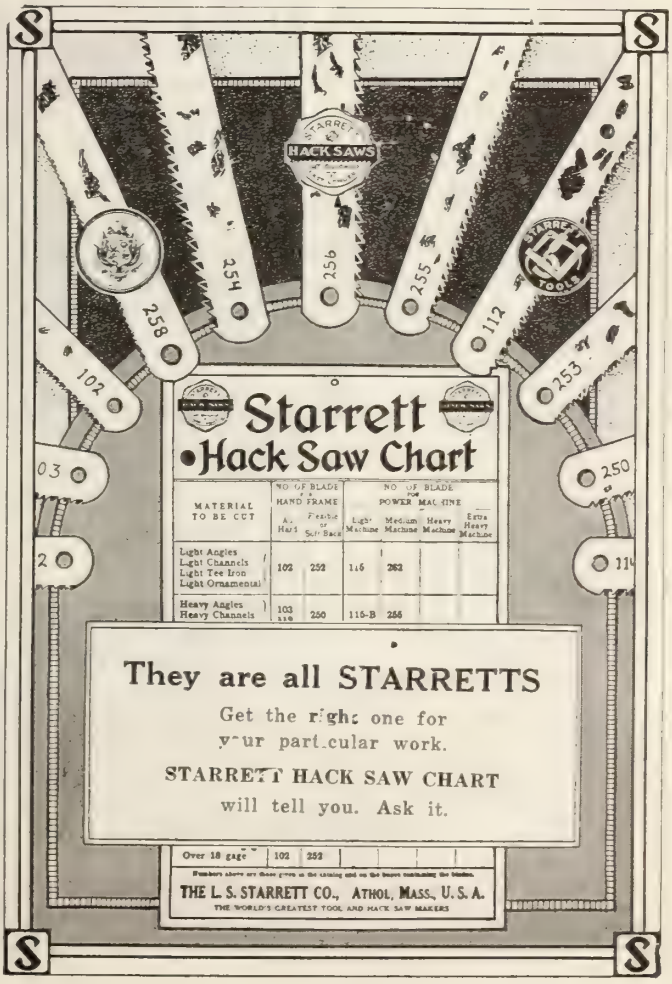
Nut with Nut-Guards

Inquiries from Importers and Dealers Solicited. Send for Catalogue No. 55.

TRIMONT MANUFACTURING CO.

Cable Address: Triwrench
Code: Western Union

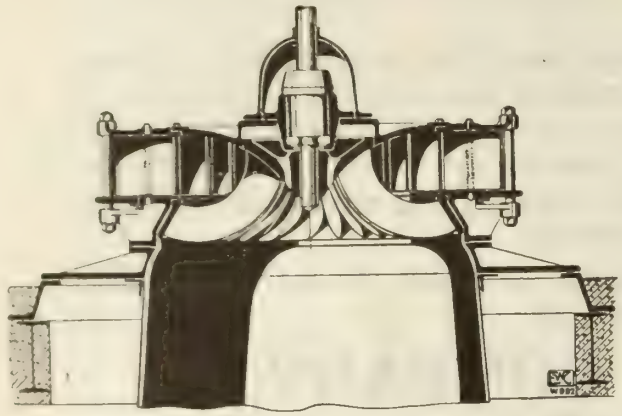
Roxbury (Boston) Mass., U.S.A



Escher Wyss & Co., S.A. ZURICH (Switzerland)

Montreal Office: 112 Coristine Building

Water Turbines



Governors

Pipelines

Turbopumps

ADVERTISING INDEX

A

Albany Lubricating Co. 77
Alberger Heater Co. 62
American Steam Gauge & Valve Mfg. Co. 58
American Steam Pump Co. ... 66
Anderson Co., V. D. 89
Armstrong Cork & Insulation Co. 11

B

Babbitt Steam Specialty Co.... 5
Babcock & Wilcox 81
Betson Plastic Fire Brick Co.. 54
Beveridge Paper Co. 85
Boiler Inspection Dept. 85
Boving Hydraulic & Eng. Co... 84
Bowser, S. F., & Co. 71
Bernitz Method Co. 49

C

Can. Allis-Chalmers Co. 55
Can. Assoc. Stationary Engrs. 91
Can. Detroit Lubricator Co. ... 5
Can. Economic Lubricant Co.. 66
Can. Fairbanks-Morse Co. 57
Can. H. W. Johns-Manville Co. 74
Can. Laco-Philips Co., Ltd. ... 77
Can. Morehead Mfg. Co. 93
Can. S K F Co. 63
Can. Steam Boiler Equipment Co. 4
Chaplin-Fulton Mfg. Co. 73
Classified Ads 54
Cling-Surface Co. 80
Cole, Ltd., Geo. W. 93
Coppus Engr. & Equip. Co. .. 9
Coventry Chain Co. 80
Crane Packing Co. 78

D

Darling Bros. 8
Dart Union Co. 58
Davis Regulator Co. 73
D'Este Co., Julian 70
Defender Automatic Regulator Co. 56
Direct Separator Co. 58
Dominion Belting Co. 82
Dominion Coal Co. 84
Dunham & Co., C. A. 73
Durabla Mfg. Co. 60

E

Economy Fuse & Mfg. Co. of Canada 89
Elliott Co. 47
Engineering & Mach. Works of Canada, Ltd. 2
Escher Wyss & Co. 96

F

Federal Engineering Co. 89
Financial Post of Canada 72
Francis & Co., Walter J. 50
Frick Co. 11

G

Galt Foundry Co. ..... —
Garlock Packing Co. 79
Garth Co. 84
Gates, John W. 93
Goldie & McCulloch Co. 16
Graton & Knight Mfg. Co. .. 59
Greene, Tweed & Co. 61
Green's Economizer, Ltd. 54

H

Holmes Metallic Packing Co.. 84
Homestead Valve Mfg. Co. ... 70
Hoyt Metal Co. 4

I

Imperial Oil Co. 3
Inglis Co., John...Inside back cover

J

Jamison Cold Storage Door Co. 12
Jefferson Union Co. 65
Jeffrey Mfg. Co. 75
Jenkins Bros. 69
Johns-Pratt Co., The 78
Jones Underfeed Stoker Co. ... 5
Jordan Bros., Inc. 6

K

Kellogg & Co., E. H. 50
Kerr Engine Co. 70

L

Ladd Co., The Geo. T. 85
Laurie & Lamb 13
Leitch Co., The Arthur S. 6
Liberty Mfg. Co. 47
Linde Canadian Refrigeration Works Co. 10
Long & Co., J. T. 51
Lunkenheimer Co. 68

M

MacGovern & Co. 95
MacKinnon Steel Co. 50
MacLean's Magazine 64
Magnolia Metal Co. 82
Mason Regulator Co. 6
Mason Regulator & Engr. Co. . 7
McAvity & Sons, T. 68
McDougall Caledonian Iron Works Co. 14
McGhie, W. C. 84
McLaren Ltd., D. K. 81
MacKinnon Steel Co. 55
Metlskin Co., Inc. 58
Morrison Brass Mfg. Co., Jas. Outside back cover
Morse Chain Co. 83
Mueller Mfg. Co. 67
Murphy Iron Works 8

N

National Boiler Seam Protector Co. 84

P

Pennsylvania Flexible Metallic Tubing Co. 62
Pierce Mfg. Co., Wm. B. ..... Inside front cover
Pilley Packing & Flue Brush Mfg. Co. 85
Power Plant Equipment Co. .. 86
Pratt & Cady Co., Inc. 60

R

Roto Co. 56

S

Sarco Co., Inc. 52
Scaife & Sons Co., Wm. B. 94
Schaffer & Budenberg Mfg. Co. 6
Shell-Bar, Boico Supply, Ltd. .. 2
Smart-Turner Mach. Co. 85
Snowdon, C. C. 76
Starrett, L. S., Co. 95
Steel Mill Packing Co. 56

T

Taylor Instrument Co. 93
Thomson-Gordon, Ltd. 77
Trimont Manufacturing Co. ... 95

U

Uehling Instrument Co. ..... Front cover

V

Vilter Mfg. Co. 10

W

Wall, W. J. 52
Waterous Engine Works Co. .. 1
Williams & Co., J. H. 56
Williams Co., Franklin 62
Wood & Co., R. D. 51

Y

Yarnall-Waring Co. 78
York Mfg. Co. 12

INGLIS BOILERS

Inglis quality has not been attained in a day or a month or a year or two. It represents the fruit of over half a century in meeting the requirements of boiler users.

Inglis boilers are Canadian standard in materials, workmanship and efficiency. They ensure a lifetime service with a minimum of repairs.

We build boilers of all kinds for any service. We are also sole Canadian manufacturers of the Erie City Water Tube Boilers. Absolute satisfaction guaranteed.

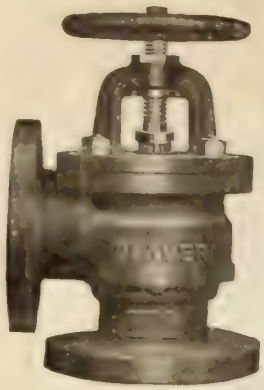
Write us for prices and specifications.

The John Inglis Company

LIMITED

ENGINEERS AND BOILERMAKERS

14 Strachan Avenue **Toronto, Canada**



"BEAVER" Valve. Iron Body. Bronze Mounted.
Working Pressure. 250 lbs. per sq. in.

J.M.T. REDUCING VALVE
Iron Body. Bronze Mounted.

J.M.T. IMPROVED INJECTOR

TRADE MARK J.M.T. REGISTERED A GUARANTEE OF QUALITY

Morrison's

Steam Goods and Specialties

Some of Our Lines

Stop Valves
Check Valves
Gate Valves
Safety Valves
Relief Valves
Reducing Valves
Steam Traps
Injectors
Ejectors
Inspirators
Jet Pumps
Steam Gauges
Vacuum Gauges
Ammonia Gauges
General Boiler Mountings
Gauge Board Outfits
Lubricators
Pipe Fittings
Steam Whistles
Engine Indicators
Pipes, Tools, etc.

NO materials are better than those which enter into their construction.

Everything that is best in material and workmanship goes into Morrison's Steam Goods and Specialties—that's why they are absolutely reliable and give good service day in and day out for years and years.

Morrison's Steam Goods and Specialties are approved by the Provincial Boiler Inspection Departments.

Do not hesitate to write us for full information on any lines or line in which you are interested.

The James Morrison Brass Mfg. Co., Ltd.
93-97 ADELAIDE ST. W., TORONTO

POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power; and to the operation of Refrigerating Machinery.

Published by The MacLean Publishing Company, Limited, 143-153 University Ave., Toronto

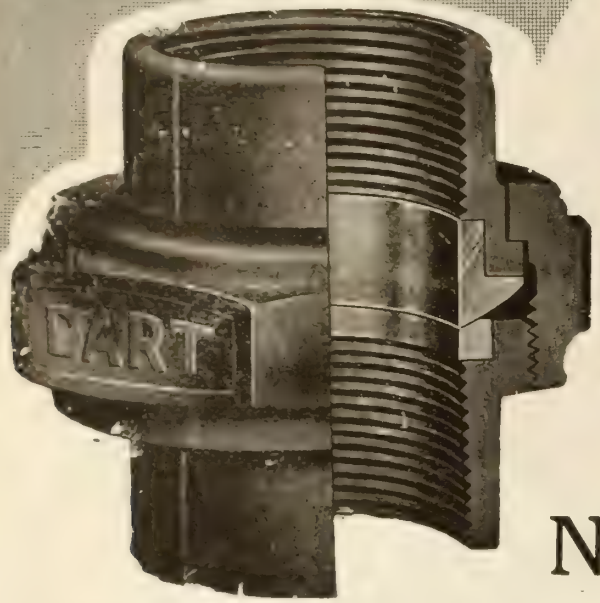
MONTREAL: Southam Bldg. LONDON, ENG.: 88 Fleet St., E.C. WINNIPEG: 1207 Union Trust Bldg

Vol XI—No. 12 Publication Office, Toronto—December, 1918 Published Monthly $1.00 per Year.

TRADE
JENKINS
MARK
Jenkins Bros
Jenkins Bros.' Valves record 54 years of success throughout the World. They are used in office buildings, institutions, colleges, schools, and factories representing every line of industry endeavor.
Jenkins Bros.' Valve success is built on a good foundation: GUARANTEED SUPERIOR QUALITY.
If you will put a Jenkins Bros.' Valve on the worst place you can find where you cannot keep other valves tight and if it is not perfectly tight, or does not hold steam, oils, acids, water or other fluids, longer than any other valve YOU MAY RETURN IT AND YOUR MONEY WILL BE REFUNDED.
Every genuine Jenkins Bros.' Valve bears the Diamond Trade Mark. It's a seal of guaranteed service.
JENKINS BROS., LIMITED
103 St. Remi Street, - Montreal, Canada
European Branch
6 Great Queen St., Kingsway, London, W.C. 2, England
Agencies in All the Principal Countries of the World

"DART" UNIONS

No Deterioration Here



That Joint Will NEVER Loosen Up

THE DART UNION IS THE KEY TO A PERMANENTLY TIGHT JOINT.

A leaky pipe connection is a thing of the past wherever it is used.

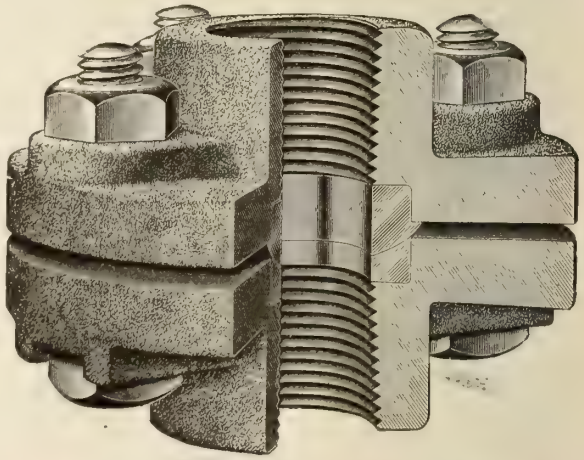
Dart Union Pipe Couplings stay tight because of the Bronze to Bronze face and seat which cannot rust or corrode, and the extra heavy iron parts which will stand unusual strains without any signs of stretching or pulling apart.

DART UNIONS SAVE TIME IN MAKING CONNECTIONS. The Ball-shaped Joint enables you to connect pipes quickly and without bother whether they are in or out of alignment.

NO UPKEEP COST. NO REPLACEMENT COST. NO LOSS FROM LEAKS.

DART TRADE MARK

ORDER FROM YOUR JOBBER and be sure this trade mark is on the kind you get—it's your guarantee.

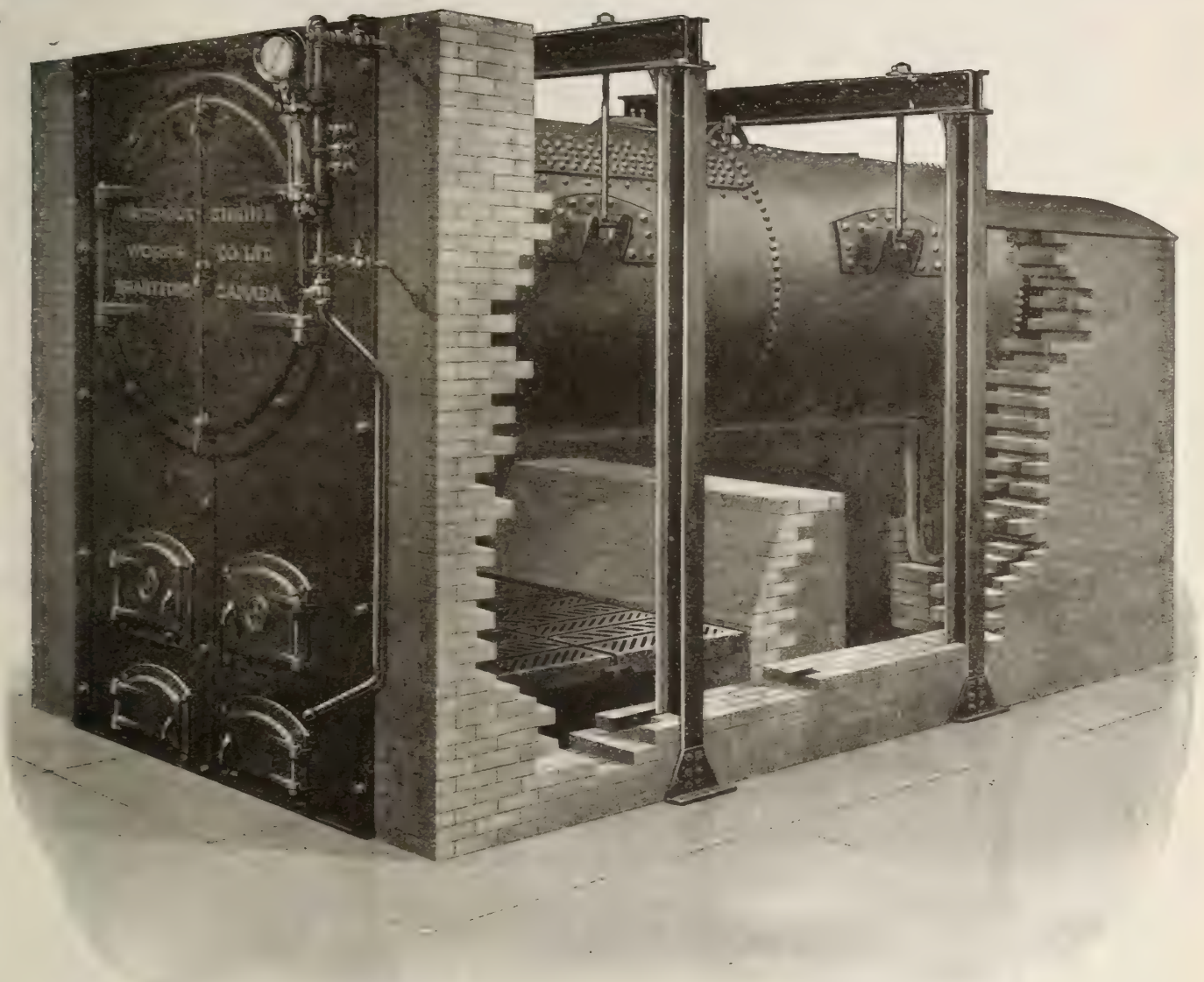


FLANGE UNION

Manufactured and Guaranteed by
DART UNION COMPANY, Limited
TORONTO, CANADA

DART UNION PIPE COUPLINGS STAY TIGHT

POWER PLANTS



Waterous

BRANTFORD, ONTARIO, CANADA

If any advertisement interests you, tear it out now and place with letters to be answered.

BOILERS IN STOCK

SUBJECT TO PRIOR SALE

2—72″ x 18′ H.R.T. Boilers, 125 lbs., W.P., Ontario Code.
2—54″ x 14′ H.R.T. " " " " "

VERTICAL TYPE

1—30 H.P., Ontario Code
1—25 H.P., " "
2—20 H.P., " "

LOCOMOTIVE TYPE

1—50 H.P., Standard Inspection
2—30 H.P., " "
1—20 H.P., " "

1—9″ x 12″ Double Cylinder Jenckes Cableway Hoist, complete with carriage, cable, sheaves, etc.
1—Open Top Tank, 10′ long x 2′ deep x 3′ wide, ¼″ plate.
1—Concrete Bucket, 24″ x 24″ x 30″ deep, with open bottom.

We manufacture Marine, Horizontal Tubular, Vertical Tubular and Locomotive Type Boilers, also Smoke Stacks, Breechings, Tanks, Penstocks and CASTINGS up to 15 tons.

Send us your inquiries.

Engineering & Machine Works of Canada, Limited

Formerly
St. Catharines Works of
The Jenckes Machine Co., Ltd.

Head Office and Works
St. Catharines, Ont.

Eastern Sales Office:
Hall Machinery Company
Sherbrooke, Quebec

A Barrel of Boico Saves Tons of Coal

BOICO is the One Sure and Safe Cleanser of Boilers

Quickly Removes and Positively Prevents Any Further Formation of Scale in Any Boiler

Think of the price you are paying for coal now! Every ton wasted runs into a lot of money. BOICO will save you this wasted expense by ridding your boilers of the cause of this waste—boiler scale. BOICO cleans the boilers thoroughly of the worst scale formation. While it's saving fuel it saves oil and packing, too.

Contains nothing that will prove injurious to the boilers or their accessories. Never causes priming or foaming.

When you use BOICO you get the results you are after. You should at least test it.

WRITE FOR FREE TRIAL.

Anti-Clinker Shell Bar Grates

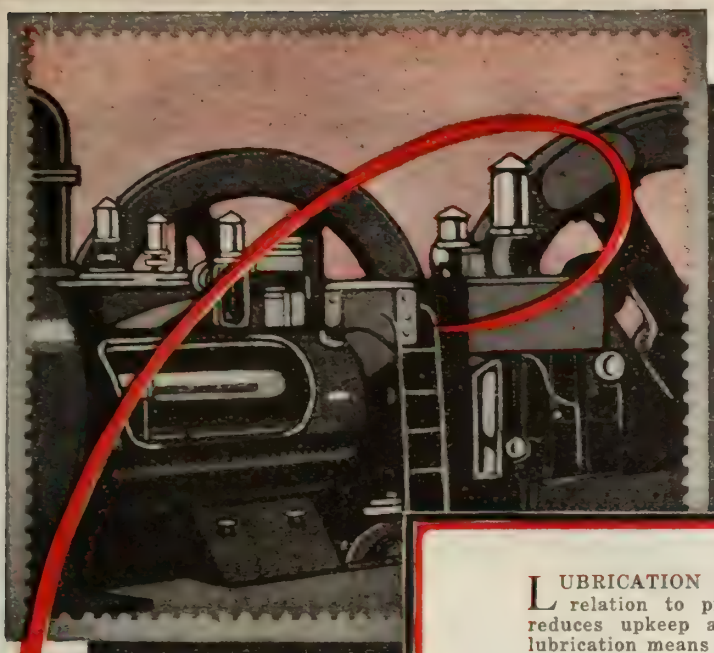
Give You More Heat With Less Coal

The scientific draft principle of Anti-Clinker Shell Bar Grates give as much as 25 per cent. more heat to fuel gases. There's no waste. There's no clinker formations, warping or twisting and the grates are easily cleaned. When you adopt Anti-Clinker Shell Bar Grates you save time, fuel, labor and money.

Copper Asbestos Boiler Gaskets

Made of copper, with pure asbestos cord-filled corrugations. They stop leaks in pipe lines; never blow out and never stick. Try them.

Shell-Bar } Boico Supply, Limited
376 Dufferin St., Toronto, Canada



A DIRECT CONNECTION

LUBRICATION always has a direct and important relation to production costs. Proper lubrication reduces upkeep as well as operation costs. Proper lubrication means a greater output, less repair bills and more years of service from power plants and other machinery.

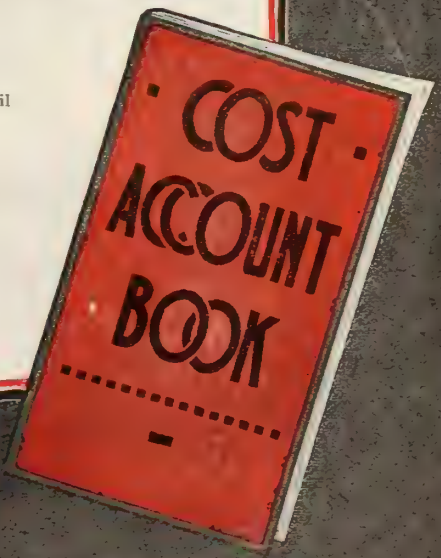
Correct lubrication requires not only high quality lubricants but *carefully selected lubricants.* To properly lubricate your plant you must use the right lubricant for each specific purpose. Do not let poor lubricants or improper lubrication destroy expensive machines before their time. Imperial lubricants are always cheaper in the long run. There is indeed a direct connection between lubrication and your cost account book.

Our Lubrication Engineers will gladly advise you on anything relating to lubrication. Write us at 56 Church St., Toronto. All enquiries will receive prompt attention.

Imperial Lubricants

For Manufacturing, Mining and Milling

Imperial Atlantic Red Engine Oil
Imperial Bayonne Engine Oil
Imperial Standard Gas Engine Oil
Imperial Kearsarge Engine Oil
Imperial Renown Engine and Dynamo Oil
Imperial Solar Red Engine Oil
Imperial Junior Red Engine Oil
Imperial Eldorado Engine Oil
Imperial Capitol Cylinder Oil
Imperial Beaver Cylinder Oil
Imperial Cylinder Oil
Imperial Shield Cylinder Oil
Imperial Ebony Cylinder Oil
Imperial Acme Cylinder Oil
Imperial Disc Cylinder Oil
Imperial Dominion Cylinder Oil



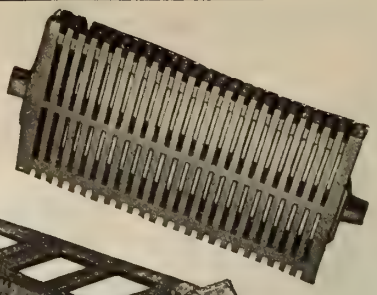
IMPERIAL OIL LIMITED

Power Heat Light Lubrication

Branches in all cities

If any advertisement interests you, tear it out now and place with letters to be answered.

Cyclone Grates



are your best insurance against fuel waste. Their 60% Air Space and 90% Underdraught prevent the formation of clinkers. Their new jarring, shaking movement sifts the ashes through—but not one lump of good coal. You can use economically the highest grade hard coal, the lowest grade soft coal, even screenings, with these Cyclone Shaking and Dumping Grates. And if you want proof, just ask us for the names of users.

30-DAY Free Trial Offer

This offer fully protects you. We make it because we are confident you will be well pleased with our Cyclone Grates once you have given them a trial.
Ask for particulars to-day.

The Canadian Steam Boiler Equipment Co., Ltd.

Sole Makers for Canada

20 McGee Street **Phone G. 3660** **Toronto, Ontario**

AGENTS:
ST. JOHN, N.B.: F. W. Blizard, 329 Charlotte St. MONTREAL: Mason Regulator Co., Ltd., St. James St. HAMILTON: Robt. Fitzsimmons, 8 Grove St. WINNIPEG, Vulcan Iron Works.

The Kaiser Wasted His Power—and Went Down to *DEFEAT*

Allied pressure together with friction between militarism and the people finally ended in speedy collapse of autocracy.

Reduce the Friction in Your Machinery *it Eats Power*

Make sure that friction is greatly reduced in your plant by using

Hoyt Babbitt Metals

and you save power which in turn saves fuel.

Hoyt Metals are giving super-service all over the world. Would our annual sales total over $5,000,000 if Frost King and other Hoyt Babbitts were not far and away superior.

Try Frost King—our general purpose Babbitt. We've put 40 years' Babbitt-making experience into compounding it.

Try Nickel Genuine—is as perfect as an alloy can be made for use in gas and gasoline engines, all classes of marine engines and automobile engines.

Frost King and our specific purpose Babbitts are described in the Hoyt Catalog. Also how these super-service Babbitts will lighten the Babbitt expense in your plant is told. Write for copy.

HOYT METAL CO., TORONTO

NEW YORK, N.Y. LONDON, ENG. ST. LOUIS, MO.

THE OLD FASHIONED WAY

--he's a good fireman; he gets up steam all right--BUT--

the cost of firing is at least 15% more than it needs to be

What is wanted here is a modern stocking equipment—the

JONES UNDERFEED STOKER

The "Jones" equipment automatically maintains a uniform steam pressure; it responds instantly to load fluctuations and will make 85 tons of coal go as far as 100 tons would go with the man with shovel.

No Losses Through Grates—
There are None

Simplicity is another of its cardinal virtues. No parts move in contact with fire. Works with very little attention and **saves labor.** Does away with a lot of fire worry. **Burns less coal and cheaper coal.** You get a steady steam pressure, regardless of load.

WOULD YOU LIKE TO GET IN TOUCH WITH SOME USERS OF THIS STOKER? WRITE US.

Jones Underfeed Stoker Co.
Limited
37-41 Britain St. Toronto, Ont.

THE JONES MODERN WAY

Babbitt
—Adjustable—
SPROCKET RIM
with chain guide

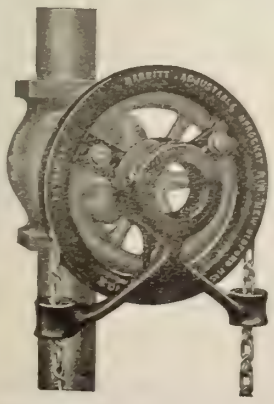
Simplifies piping arrangements, reduces danger and expense, makes overhead or out-of-the-way valves easy to operate from long distance.

The "Babbitt" can be quickly attached, five minutes and a wrench will do the job. To operate—simply pull a chain —that's all.

Every valve should have a Babbitt. It's the **only** safe way to open or close a valve.

Write for our Catalog

Babbitt Steam Specialty Co.
New Bedford, Mass.



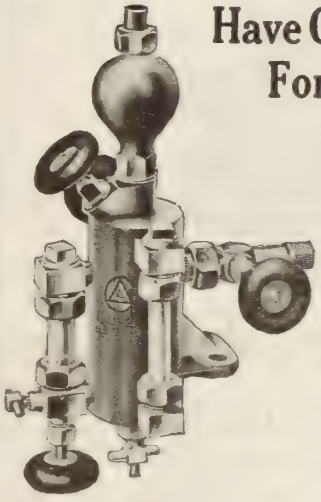
Manufactured in Canada, under Canadian Patents, exclusively by the Engineering Specialties Co., Limited, 1080 King St. West, Toronto, Ont.

Jenkins Bros.
300 W. Lake Street
CHICAGO
Western Distributors

93-25

Detroit Lubricators

Have Given Satisfaction For Forty Years.



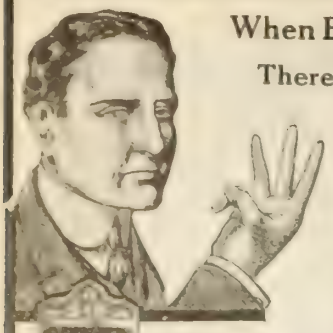
Built in a sufficient variety of styles to lubricate properly every type of steam engine, pump, gas engine, air compressor, etc.

Send to-day for catalog L 1. The information on lubricating devices contained in it will be valuable to you.

THEIR efficiency holds over half the world's trade.

Makers of Stewart Carburetors.

CANADIAN DETROIT LUBRICATOR COMPANY, LTD.
WALKERVILLE, ONT.



When Buying Thermometers

There's Just Three Things to Remember—

First, you must have accuracy and sensitiveness—

Second, durability is absolutely essential—

Third, the thermometer must be suitably constructed for the intended application.

Accuracy, sensitiveness and durability are absolutely guaranteed in

"Crescent" Thermometers

And with nearly seventy years of experience to our credit, we are qualified to properly interpret your needs.

Our Catalog P.H. 200 illustrates and describes "Crescent" Thermometers for every application. Also test thermometers, glass thermometers, etc.

Get a copy of Catalog P.H.-200 to-day.

The Schaeffer & Budenberg Mfg. Co.

Canadian Agents:

Brooklyn, New York

Chicago
Pittsburg
St. Louis
Philadelphia
Los Angeles

Milton and Prentiss, Toronto.

Power Plant thermometers for all temperatures not exceeding 1000° F

Also—"Columbia" Recording Gauges and Thermometers, Gauges, Gauge Testers, Tachometers, Steam Calorimeters, Counters, etc.

MASON

Reducing Valves

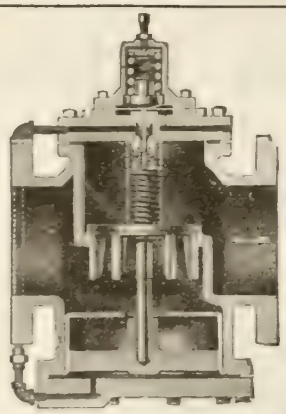
Pump Regulator
Balanced Valves
Damper Regulators

If you order a Mason you will get absolute satisfaction. This we guarantee you. You simply cannot make a mistake.
Dependable regulation under every possible condition.

Our complete catalog tells you WHY. Let us mail you a copy.

Mason Regulator Company
BOSTON, MASS.

TORONTO REPRESENTATIVES:
The Arthur S. Leitch Co.,
506 Kent Bldg., Toronto.



Kieley & Mueller Specialties

Regulating Valves
Back Pressure Valves
Pump Governors
Separators
Traps

FOR EVERY SERVICE

SALES ENGINEERS

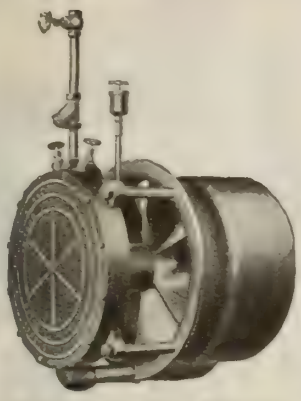
THE ARTHUR S. LEITCH CO.
TORONTO

Having Commutator Troubles?

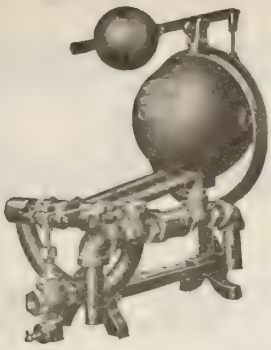
The Jordan Commutator Truing Device will true your commutators without a shut-down.

Jordan Bros., Inc.
82 Beekman St. New York City, N.Y.

Canadian Representative :
CANADA SALES CO., 183 Church Street, Toronto, Canada



Coppus Turbine-Driven Blower



New Bundy Return Trap

Mason No. 55 Style Pump Pressure Regulator

What Does "Mason" Service Mean to YOU?

1. Quality
2. Reliability
3. Results

Every Engineer appreciates the value of the **confidence** this three-fold Service assures.
"MASON'S" specialties are accepted everywhere as the Standard, representing the latest test-tried and proven Designs.
A long list of permanent customers prove this fact.

A REAL SERVICE FOR YOU

Our Salesmen are practical engineers. They know the practical application of our lines to actual conditions and SELL FROM KNOWLEDGE, not from catalog.

Power Plant Specialties

"Mason" Reducing Valves (Genuine)
"Mason" Pump Governors
"Mason" Pressure Controllers
Bundy Steam Traps for every service
Coppus Turbine-driven Blowers
Sims Hot Water Generators
Sims Storage Heaters
Sims Open Feed Water Heaters
Bundy Oil Separators
Ashton Gauges and Safety Valves
Everlasting Blow-off Valves
Babbitt Sprocket Rims
Stratton Steam Separators
Reilly Multi-coil Feed Water Heaters
Reilly Evaporators and Distillers
Reilly Multi-screen Feed Water Filters

The Mason Regulator & Engineering Co., Ltd.

Successors to H. L. PEILER & COMPANY

Toronto Representative:
The Arthur S. Leitch Co., 506 Kent Bldg.

Montreal Office & Factory: 135 Dagenais St.

Full Information always gladly and quickly Furnished. Use "MASON" Service

REGISTERED

COPPUS

U. S. PAT OFFICE

TURBO BLOWERS

Burn Cheapest Coal Mined

and increases steaming capacity to 50 to 100% of Normal Rating of Boilers without doing slightest injury to Boilers

Coal is the biggest expense of your power plant. With **Coppus Turbo Blowers** you make steam with the cheapest kind of coal—with fuel that even looks like black dirt—and at the same time increases your boiler capacity 50 to 100 per cent. In a nutshell here is what **Coppus Turbo Blowers** mean—a saving in:

—losses from incomplete combustion;
—losses from choked grates and frequent attempts at cleaning;
—losses from extra work and worry in the vain attempt to properly work fires with only one element of combustion—coal—under control.

Further, **Coppus Turbo Blowers** give, by their instantly adjusted control of draft, a
—quick pick-up power on peak loads;
—sustained over-power for loads beyond the ordinary capacity of the plant;
—and the money-saving, capacity to burn anything in the form of coal with which the power plant man may have to contend in these days of great fuel scarcity.

You should investigate Coppus Turbo Blowers without delay. Ask for catalog and further information.

Coppus Engineering and Equipment Co.

341 Park Ave., Worcester, Mass.

Agents for Montreal—Mason Regulator & Engineering Co.
Agents for Winnipeg—Parkhill & Hanson, 905 Confederation Building.

Murphy AUTOMATIC Furnace

IN 1919 WHAT?

The wise business man is now preparing to increase his power needs to meet industrial conditions during 1919.

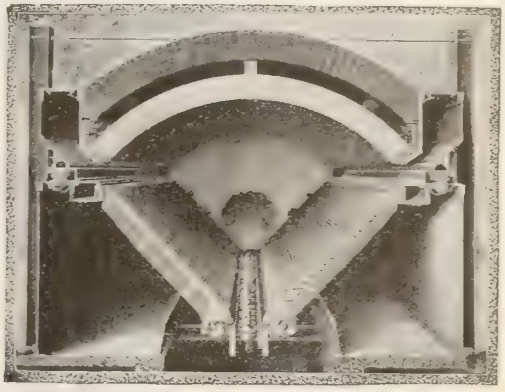
Industrial plants are at the dawn of a brighter day---anticipate your power needs now! and remember MURPHY AUTOMATIC FURNACES will give you that additional power---do it with less coal---smokelessly---efficiently---and with fewer men.

Get ready for the reconstruction period. Send for copy of Murphy catalog today!

MURPHY IRON WORKS

DETROIT, MICH. BUFFALO, N.Y.

MURPHY AUTOMATIC FURNACES



The Webster Vacuum System of Heating

can be likened unto the Matterhorn. It has an individuality all its own. From its pinnacle of fame it commands everything in sight.

The Webster System cannot be anything but a good system because of its simplicity and excellence of operation.

It is a **Vacuum System,** which means, crudely, that steam leaving the boiler is sucked through the radiation, no matter where placed, and made to perform its functions to the last ounce.

But the real beauty of the thing is this: Your heating, or a large part of it, can be taken care of by the use of **Exhaust Steam from your Boiler. Think of it,** steam that you would otherwise waste can be developed into heating units by the use of the **Webster Vacuum System of Heating.**

Sole Agents for Canada

DARLING BROTHERS, LIMITED

Engineers and Founders

120 PRINCE STREET - MONTREAL

VANCOUVER CALGARY WINNIPEG TORONTO HALIFAX

The Only Manufacturers *of* Refrigerating Machinery
***In* CANADA**

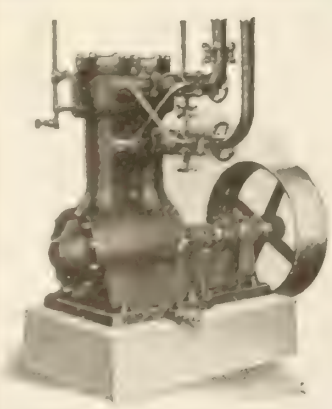
Quality not Quantity is our Standard

LINDE

Let your FIRST COST be your LAST

— ESTABLISHED 1896 —

The LINDE CANADIAN REFRIGERATION CO., Limited
37 St. Peter St., Montreal, P.Q.
TORONTO WINNIPEG VANCOUVER



Ice-making and Refrigerating Machinery

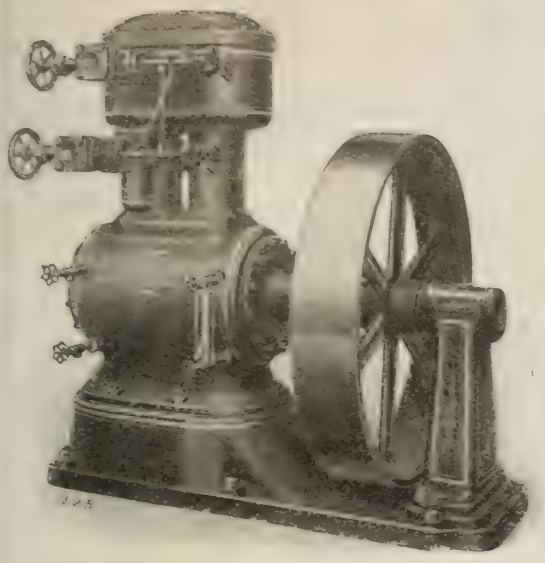
Built in any capacity that you desire. HORIZONTAL OR VERTICAL
Our SMALL MACHINES have the same "regularity of Operation," "Reliability" and "Efficiency" as our large ones.
AMMONIA FITTINGS, CONDENSERS, BRINE COOLERS, ETC.

Our Machines are in daily operation in Canada
CORLISS and POPPET VALVE ENGINES

The Vilter Manufacturing Company
242 Beecher St. - - - Milwaukee, Wisconsin

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

FRICK Machines "Carry On"



It is a fact that FRICK Machines have been "Carrying On" for more than thirty years, meeting all attacks and conditions encountered in every day operation, especially during the busy season, when overloads and extra duty are of common occurrence.

"We are practically running our cold storage plant just as you installed it eighteen years ago; we added a twelve ton fish sharp freezer some dozen years ago, and added four rooms for fruit from time to time, and the machinery installed keeps all running in good shape. Our cost for maintenance and repairs during all these years has been very small, and the machinery looks good for another eighteen years."

(Name on request).

36 YEARS OF SUCCESSFUL REFRIGERATING ENGINEERING EXPERIENCE

Ask for a copy of our list of users covering 48 pages of satisfied customers—also your copy of "Ice and Frost."

Frick Company

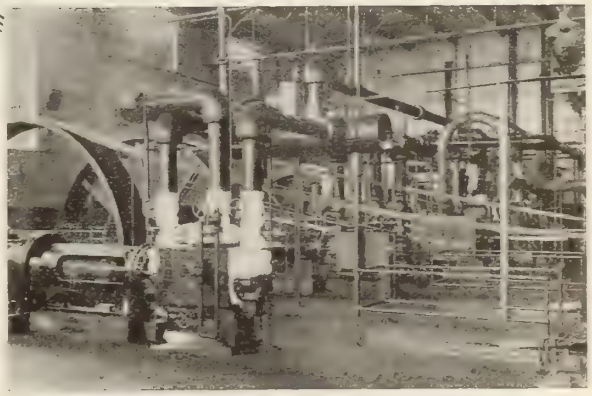
WAYNESBORO, PA., U.S.A.
ICE MACHINERY SUPERIOR SINCE 1882
BRANCHES IN ALL PRINCIPAL CITIES

There is a FRICK Machine for every refrigerating purpose—all types; Vertical — Horizontal — Absorption.

"The Best We Ever Had"

That's a pretty strong statement, but it indicates in no uncertain way just what the Harris Abattoir Co., West Toronto, Ont., think of Nonpareil Cork Covering. On June 7, 1918, Mr. H. D. Tefft, Superintendent, wrote:

"Referring to the Nonpareil Cork Covering you applied on the brine and ammonia lines throughout our plant. You will remember that this cork covering was put on about a year and a half ago, and we are pleased to say it has given the best satisfaction of any refrigerating pipe insulation we ever had."



Nonpareil Cork Covering on ammonia lines in the plant of the Harris Abattoir Co., Ltd., West Toronto, Ont.

Mr. Tefft is in a position to make comparisons, too, because the Nonpareil Cork **replaced** fibrous coverings that did not prove satisfactory.

There are good reasons why Nonpareil Cork Covering stands up under hard service. It is made solely of pure cork, which is cellular, not fibrous, in structure. Hence it does not suck in moisture by capillary attraction. If properly applied and given a reasonable amount of attention, Nonpareil Cork will save in ordinary cases enough refrigeration to pay for its cost in twelve months and will keep on saving refrigeration for years after that.

Armstrong Cork & Insulation Co. 504 McGill Building Montreal, Quebec, Canada

Nonpareil Cork Covering

For Cold Pipes and Tanks

If any advertisement interests you tear it out now and place with letters to be answered.

AN ESSENTIAL

Is Mechanical Refrigeration essential in my Business? You may have asked yourself this question many times. Or if you are at present the owner of a Refrigerating Plant you have doubtless struggled with the problem of improvements and additions. These are natural questions and should not be passed over lightly.

A function of the York Organization is to help you over the top in matters of this kind, with information—data—advice. If a prospective customer is well and truly advised and acts accordingly, he is sure to install a plant that will be a credit to the Industry, and even though we do not make the sale, we benefit indirectly.

Information from our Engineering Department, data from our Sales Engineers, and even advice from a Financial viewpoint, we are prepared to offer you as a part of the York Selling Plan, without cost or obligation on your part. Others have taken advantage of this offer to their lasting benefit. We do not believe you can afford to pass it by.

Think it over and write us if you are interested.

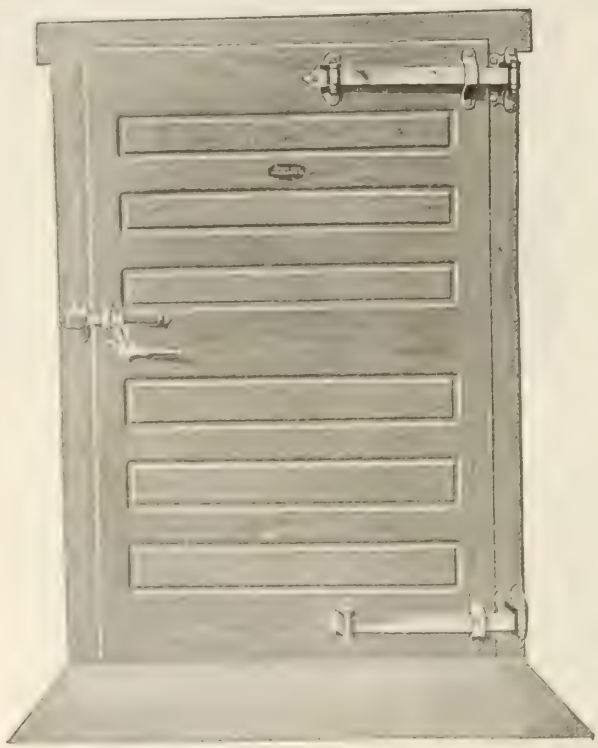
YORK MANUFACTURING COMPANY

(Ice-Making and Refrigerating Machinery Exclusively)

YORK, PA.

Canadian Ice Machine Company

WINNIPEG	TORONTO	MONTREAL	CALGARY
85 Lombard St.	82 Chestnut St.	626 Coristine Bldg.	605 Second St.



In the LARGEST and MOST MODERN PLANT in the WORLD, building Insulated DOORS and allied products exclusively, we are building what we KNOW to be THE BEST INVESTMENT FOR THE USER and the universally recognized WORLD'S STANDARD DOORS. In verification:—

THE HARRIS ABATTOIR CO., Ltd., Canada.

"Our Coolers and Freezers are mostly equipped with your doors. In fact we adopted it as *Standard throughout our plant,* as we find *them substantially made* and the *insulation perfect.* We also find the *Hardware stands up better than on any other door* we have seen or tried."

LOUISVILLE SOAP CO., Louisville, Ky.

"Coolers at one of our plants are *equipped with your doors, which have given us such satisfaction we wish to improve the doors at our old plant.* We would not be warranted in throwing out the doors but would like the type hardware you supply."

THE WASHINGTON MARKET, Washington, D.C.

"The *doors supplied by you,* in use at both plants, *have been in every way satisfactory,* and we think the *Jamison door is the best on the market.*"

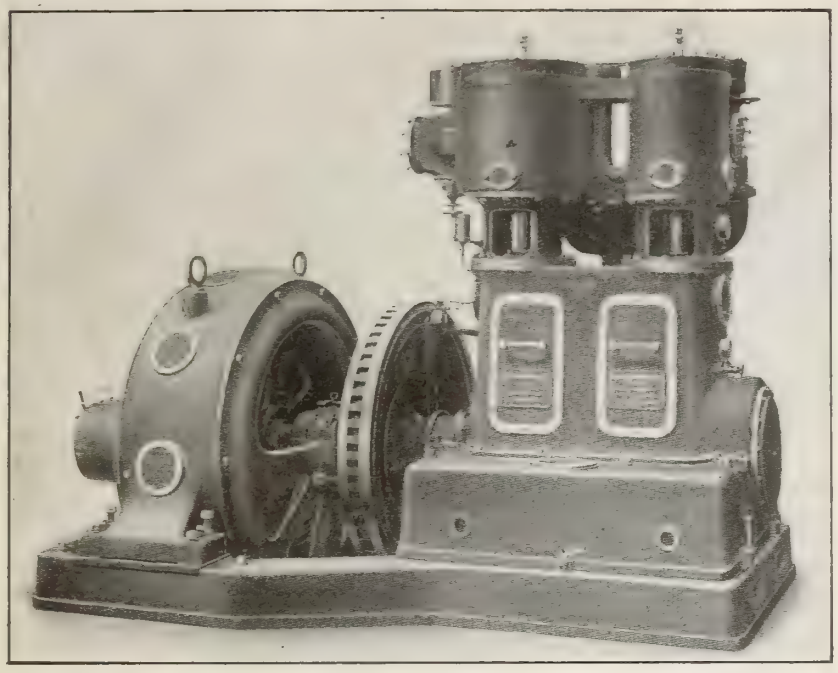
Read 'em again men—analyze them! Acquaint yourself fully with our method of construction through latest catalog No. 8.

Jamison Cold Storage Door Company

Formerly Jones Cold Door Co.

HAGERSTOWN, M.D., U.S.A.

BELLISS & MORCOM, LTD.
Engines and Air Compressors



Belliss & Morcom Motor-Driven Air Compressor.

Belliss Steam Engines, Steam Turbines, Diesel Engines,
Air Compressors, Condensing Plants

Heenan Refuse Destructors, Air Coolers, Water Coolers,
Oil Coolers, Dynamometers

Paterson Water Softening Plants and Filters

Centrifugal Pumps

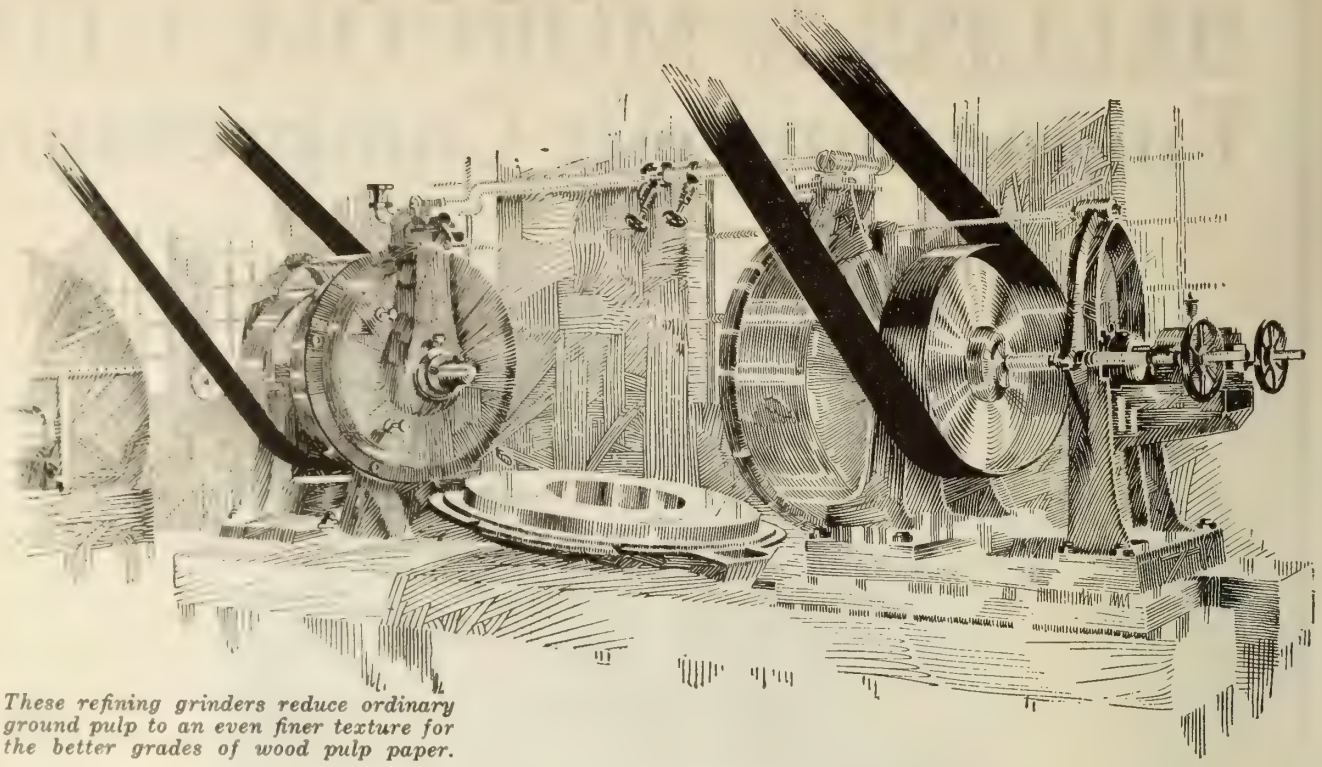
We can make good delivery for War Service.

LAURIE & LAMB

Engineers

211 Board of Trade Bldg. - - MONTREAL

If any advertisement interests you, tear it out now and place with letters to be answered.



These refining grinders reduce ordinary ground pulp to an even finer texture for the better grades of wood pulp paper.

Making One Belt Do the Work of Three

IN a big Ontario paper mill this refining grinder drive had been a glutton for belts.

Ten months from 8-ply belts was considered exceptional service.

The superintendent was finally induced to try Goodyear "Extra Power." We prescribed 7-ply to replace the former 8-ply belt, giving a lower initial cost.

Now, after two and a half years, the superintendent writes of continuous, twenty-four hour a day service for all that time.

Just three times the service previously known. Less than one-third the cost.

Further saving — "Extra Power" gave *continuous* service. Only *one* stop to apply *one* belt in two and a half years.

This problem of belting costs is too vital to be decided off-hand. Belt life and belt performance must be balanced against belt price.

Thousands of executives who buy belts on facts, who keep belt costs, are turning to "Extra Power." It is the dominant factor in the belt field to-day.

It will be worth *your* while to talk with a man trained in belt problems by Goodyear. It places you under no obligation. Just 'phone, wire, or write any branch.

The Goodyear Tire & Rubber Co. of Canada, Limited

Branches—Halifax, St. John, Montreal, Ottawa, Toronto, Hamilton, London, Winnipeg, Regina, Calgary, Edmonton, Vancouver, Victoria.

GOODYEAR

MADE IN CANADA

EXTRA POWER BELTING

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

Greeting

GRATITUDE to our dead and living heroes tempers the merriment of hearts and gives deeper meaning to expressions of good will this Xmas.

TO OUR READERS
TO OUR ADVERTISERS

We extend sincere best wishes for this season and the New Year.

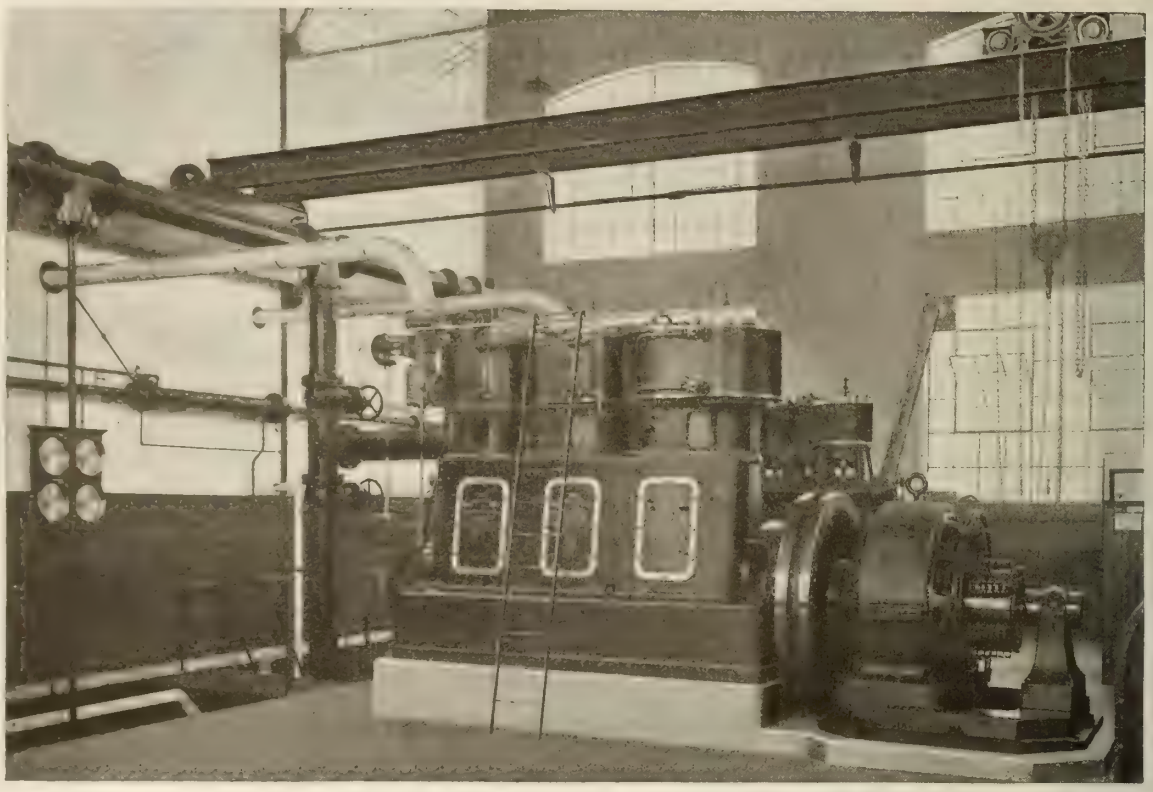
We thank you one and all for your steadily increasing interest and patronage, and throughout the year 1919 we shall endeavor to show our appreciation by giving you a service even more helpful.

THE PUBLISHERS OF

POWER HOUSE

POWER EQUIPMENT

Built to Meet Your Own Requirements



A corner in the Engine Room of our New Power Plant recently erected at our Main South Works. Equipped with G. & McC. Co. Three-Cylinder Compound and Two-Cylinder Compound Vertical Forced Lubrication Steam Engines.

G. & McC. CO. ENGINES and BOILERS

will provide your plant with

A Continuous and Economical Service

WE BUILD

Horizontal and Vertical Steam Engines; Steam Turbines; Return Tubular and Water Tube Boilers; Heaters; Tanks; Pumps and Condensers; Transmission Machinery; Safes, Vaults and Vault Doors.

The advice of our Engineering Experts, our Catalogues, Specifications, Photographs, etc., will be cheerfully supplied to interested parties.

The GOLDIE & McCULLOCH CO., Limited

Head Office and Works: GALT, Ontario, Canada

TORONTO OFFICE:	WESTERN BRANCH:	QUEBEC AGENTS:	BRITISH COLUMBIA AGENTS:
Suite 1101-2.	248 McDermott Ave.,	Ross & Greig, 412 St. James St.	Robt. Hamilton & Co.,
Traders Bank Bldg.	Winnipeg, Man.	Montreal, Que.	Vancouver, B.C.

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

POWER HOUSE

Engineer's Life Not Always a Bed of Roses

The First Instalment of This Article Appeared in the August Issue—The Present Article Deals With the Reconstruction of the Plant and the Present Layout

By S. BALMFIRTH

THE original plan of doing the work was to use a locomotive type boiler, or boilers, set them up on skids, and run temporary mains to the existing steam lines. This plan, unfortunately, was considered impracticable, first on account of the heavy load on the bunker roof, which forms the yard, and secondly on account of it being almost impossible to erect a temporary stack high enough to carry the smoke from the hospital windows.

So the writer was in the unhappy position of the contractor, after the church vestry had decided:

First—To build a new church.

Second—To use the material from the old church to build the new one.

Third. — To use whilst the new one the old church was being built.

Prior to the beginning of this alteration the writer had had the pump-room wall removed below the engine room floor and the wall above carried on steel beams and columns. Whilst this cooled off the pump room, it heated the boiler room, so a large air shaft was put in over the pipe, tunnel and carried out above the power house roof. This carried away quite a lot of heat and improved the conditions somewhat. Removing the wall also gave more room, which was sadly needed, and especially so when the first boiler was removed.

PRESENT BOILER ROOM FROM FIRING FLOOR LEVEL

Work was begun the last week in June, 1916. The first thing to be done was to get more room to work in. Accordingly the old heating main, consisting of 16 in. by 14 in. pipe and fittings, was torn out. This heating main was shown in the old plans.

The building contractor had begun work on the excavation for the new fire room. The plans shown were adhered to fairly closely, about the only change being that the steam main was made into a ring main.

Small temporary lines were run to take care of the high pressure services so as to allow of the old valves and other fittings being used again, and also to give room for the men to work in handling the boilers. These alterations had to be done at night or on Sundays so as to interfere as little as possible with the routine of the hospital.

To take the place of a 6 in. live steam main for laundry, pasteurizing department, cooking, and sterilizing services, two 2 in. lines were run, and in the winter of 1916 the whole of the hospital service, lighting and heating included, was handled on the 4 in. auxiliary main.

By this time there was considerably more head room in front of the boilers, the floor of the boiler room had been cut up and the new foundation for the single boiler built, and the firemen were walking around the boiler room and pumps on planks.

There was considerable seepage into the new fire room, which was five feet below the level of the old one, so it was found necessary to keep one pump continually pumping out the excavation into the sewer, which was about fifteen feet above.

The east wall had been removed below grade line, and the portion above grade carried on steel beams and columns. This had been done in the usual manner by needling the wall, carrying one end of the needles on the boiler wall and the other end on heavy timbers. The removal of this east wall had also taken in with it the tunnel connecting the boiler room and coal bunker. The removal of this wall disclosed the fact that the breeching had no end wall but was built up to the building wall. It was not discovered until the reduced draft and consequent lowering steam pressure turned out the whole engine room crew to find the cause. So the bricklayers had to hurry and build a dry wall in the end of the flue and plaster it over, after which there was no more trouble from that source.

This made it necessary to devise some means of getting coal to the boilers, so 2 in. by 4 in. scantling was lag-screwed to the wall of the building above ground

level, and brackets of 2 in. by 4 in. scantling built on to the scantling. A trough of 2 in. by 10 in. plank was laid on the brackets, and the bottom of it covered with 16-gauge iron. A single chain carrying 2 x 9 flights dragging along the bottom of the trough was driven by a ¾ h.p. motor that happened to be around the job. The flights discharged the coal into a sheet iron concrete chute which the contractor obligingly loaned. It was necessary to use two countershafts to get the reduction of speed. The rig was rough and ready, the motor and countershaft were perched on a platform fastened to the side of the building in the same manner as the trough. The writer never heard of a flight conveyor being a new thing, but judging by the adverse prophecies of the contractor and others, it must have been so in the locality. Anyway, in spite of the calamity howlers it delivered the coal where it was wanted, the trolley beam and bucket having been left in front of the boilers.

Once in a while some fireman would let the bucket run off the end of the beam and down into the hole by way of breaking the monotony, but on the whole there were very few accidents, less even than might be anticipated in a job of this description.

One of the first shut-downs, which were almost invariably made at night, was to cut out the Cochrane heater preparatory to moving the same. It must be remembered that this heater was permanently connected to the exhaust main in such a manner as to form part of it, so before it could be moved the exhaust main had to be blanked off.

By breaking the exhaust pipe of the 25 kw. set, and running a temporary exhaust pipe out through the office window, lights were kept on the building.

Unfortunately, whilst there was quite a let the bucket run off the end of the the plant there was not a muffler or exhaust head, so the exhaust was open and unconfined, and made its presence felt. The engine runs at 600 r.p.m. and was carrying 50 per cent. overload, and at night the noise could be heard quite distinctly. Some of the neighbors objected quite strenuously, but then one cannot please everybody.

So the steam connections to the heater were broken and the two ends of the exhaust pipe blanked.

If the plans of the old lay-out are referred to it will be seen that the outboard exhaust runs along the east side of the boiler room. In the new lay-out the exhaust pipe runs along the west side of the room. Really, the old 9-inch low-pressure heating main to the main building forms part of the exhaust line, so one of the next steps was to connect the exhaust line to the 9 in. low-pressure line.

The weather was getting cool, so live steam was used to heat the buildings whilst the exhaust line was open.

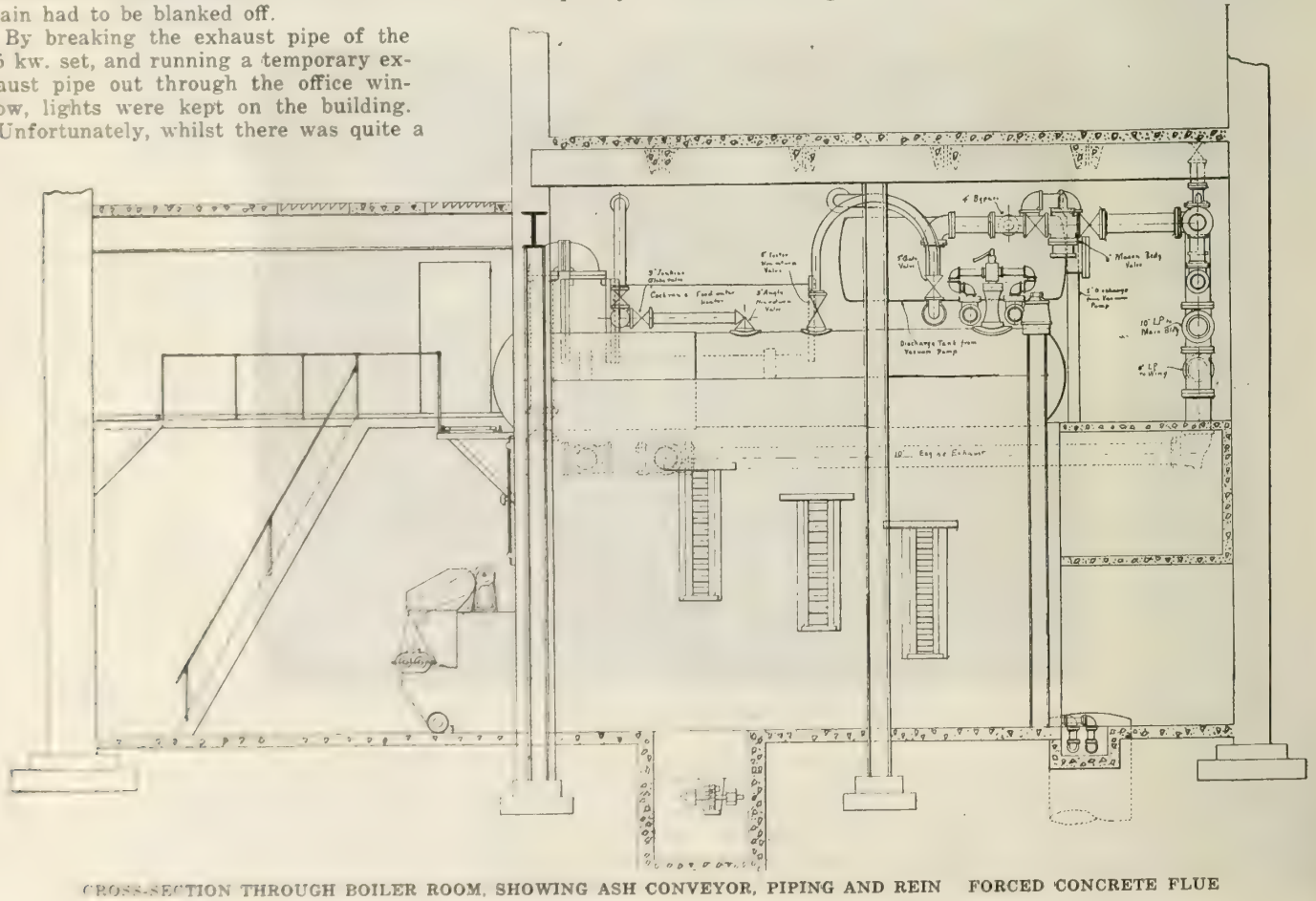
The same small set was run for lights, and the exhaust main pulled out where it entered the pump room, and by having the new pipe joined together as far as possible in the daytime, it was possible to get the connections made in one night. Outlets were left off for the exhaust from the pump and also for the Cochrane heater and the west wing and domestic hot water generators. In connection with this low-pressure main, the oil extractor comes before the heater, not after it.

The temporary steam lines being in place, No. 3 boiler was dismantled. In order to cut this boiler out it was necessary to close down the whole plant for a short time, because, as shown in the first portion of this article, there was only one valve on each boiler, and even had there been more it would not have helped in this case as the main had to be cut, so accordingly the auxiliary was shut off and the boiler No. 2 shut down, and the main header flanked at the 10 in. tee. This also cut off the 8 in. engine main, so that the auxiliary became the only main.

When it came to removing the 5 in. gooseneck band from the top of the boilers this was found to be impossible as there was not sufficient room to get it down (as a matter of fact these pipes were installed first, originally, and the floor above them laid in afterwards) so the pipes had to be sawn in two; 5 in. extra heavy steel, 2 ft. 9 in. headroom, temperature 150° in the shade—some job.

The stoker on this boiler was dismantled and taken outdoors and the brickwork pulled down and the rubbish cleared away ready for moving round. It had been the original intention to move the whole boiler intact without cutting, but tackle heavy enough could not be obtained and the room available was insufficient even if tackle could have been found.

The front and back nipples and circulating tubes were burned off and the nests of tubes lowered to the ground. These had to be carried forward and their whole length turned and laid on the new foundation. However, as there was

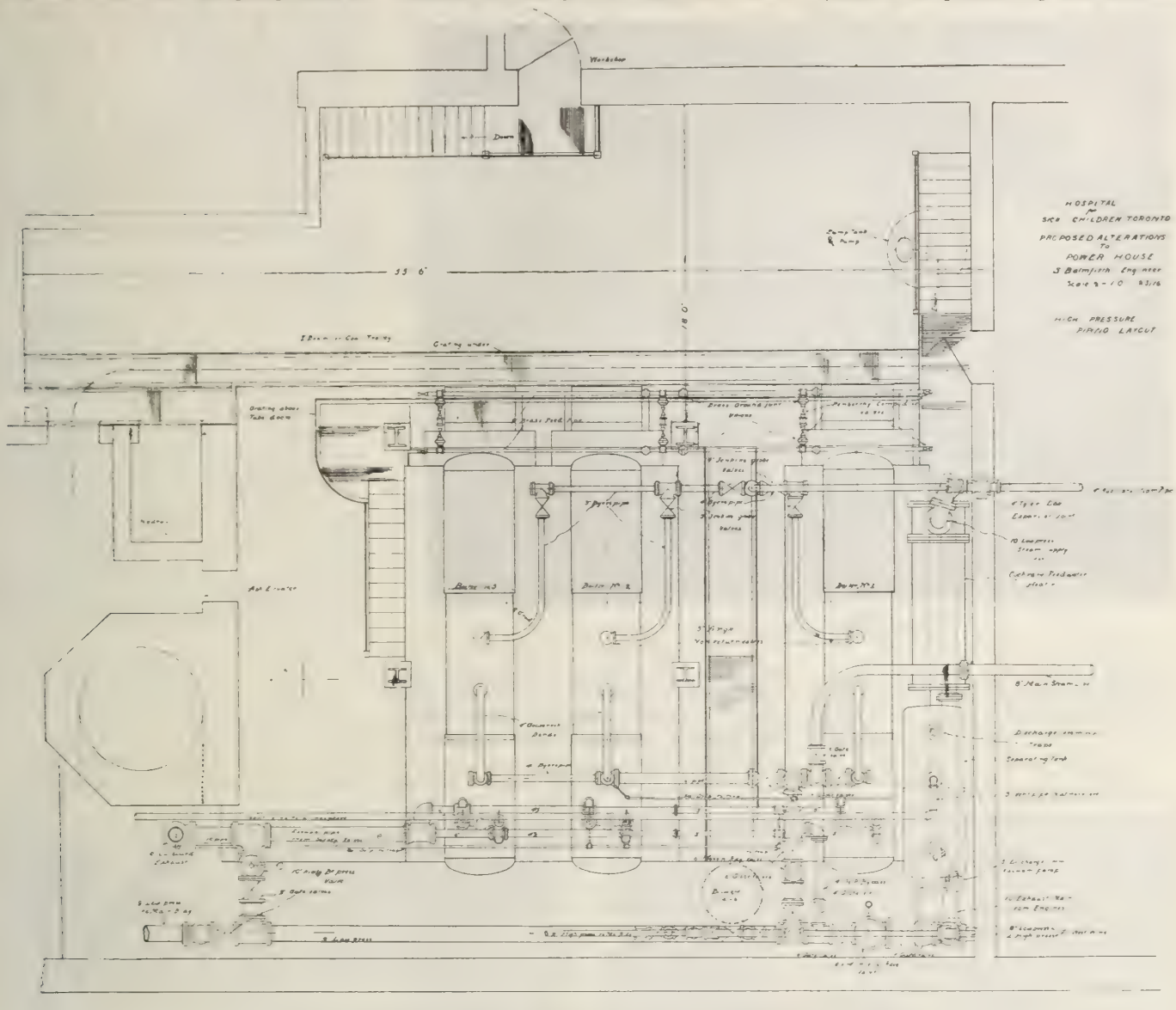


CROSS-SECTION THROUGH BOILER ROOM, SHOWING ASH CONVEYOR, PIPING AND REIN FORCED CONCRETE FLUE

only about fifteen feet of room in front of the boilers, and tubes about nineteen feet long over all, it was necessary to carry them right into the pump room in order to get sufficient room to swing them.

This being done, attention was paid to the steam drum. However, since the separating tank and feed water heater were to be above the boilers in the new layout, these were hoisted up to the ceiling and left hung on straps attached to the I beams.

Everything being clear, the moving gang started on the boiler drum. If there was not sufficient room for the tubes, there was even less for the drum, which was 24 feet long and 4 ft. diameter. The back end was lowered to the floor and front end left in the air, the only way in which it was possible to get it turned round on account of the lack of space, so it was held at an angle of about 45°, the front close up to the ceiling and the back dragging on the ground. There was still considerable piping close to the ceiling, and with the tank and heater in position there was not much more than two or three inches clearance past the stoker of boiler No. 2. When the boiler was about halfway round, the contractor quit the job, or rather his men did—just walked off the job at noon and never came back again—so there was nothing else left to do but to tackle the job ourselves. Accordingly, the day after Christmas day we started in. There were about five men on the job, two men on the boiler drum hauling on the tackle, one man at the back end with a crow bar easing it along, another steadying the drum, and the writer directly underneath the drum. Everything was going nicely, the back end of the boiler was being coaxed around into position, and had possibly ten feet more to go, when without an instant's warning there was a crack and a crash, and the drum was down amongst the crowd. It was the first time in his experience that the writer worked under a swinging load, and it is most likely to be the last. It came very near being the last, anyway. However, he moved very swiftly and stayed not on the order of his going, although that would not have done much good had not the drum fallen on the hopper of the stoker, which threw it over on to the new low-pressure main and against the engine room wall. The material damage was a broken stoker frame (which was patched up and the stoker kept running for another six weeks), flange on 10 in. low-pressure main and 4 in. L on pump suction line broken.



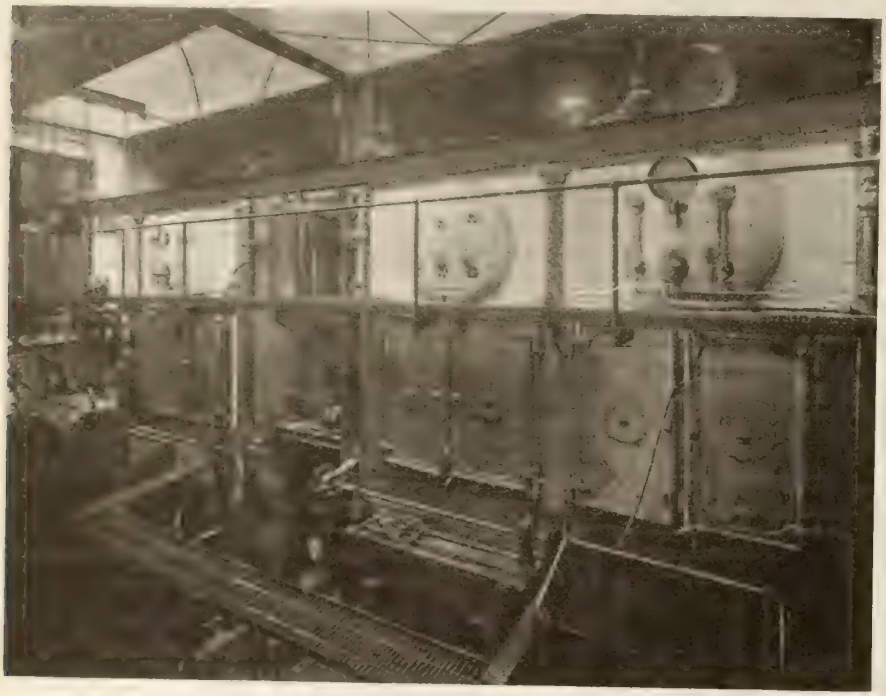
PLAN OF NEW BOILER ROOM, HOSPITAL FOR SICK CHILDREN, TORONTO

Amongst the men, the damage amounted to various bruises and abrasions, and the writer got a very hot shower bath as he passed under the same suction pipe. Moral: Put not your trust in another man's tackle.

However, as none of the men had lost his nerve the drum was picked off the steam main, the stoker got running, and the suction pipe repaired. Next morning the job was done. The back circulation tubes of the boilers were cut up and annealed and used for nipples.

Now began the hard times around the plant. As already mentioned, the floor was up and the firemen were walking around on scaffold planks. No. 2 boiler was stoker fired, but the No. 1 stoker on No. 1 had been removed and the front wall bricked up. The east side wall had been opened and two doorways built in and a lower half front braced up to the

side wall. Herring-bone grates were fitted and the boiler put in service. Since the floor on the east side was five feet lower than the floor at the front, a wooden platform was built the whole length of the boiler and about 9 feet wide, narrow enough, surely, for a firing floor, but as wide as was permissible.



BOILER ROOM FROM GALLERY LEVEL

It was not long before it was seen that No. 2 stoker was badly damaged from its collision with No. 3 drum; to relieve it as much as possible, No. 1 was put on forced draft.

The writer picked up a 40 in. fan and 5 h.p. motor. The motor was half buried with coal all the time, but we managed to get steam enough, which was the main consideration just at that time. Also we were able to burn anything that was black, which was another great help that winter, as soft slack was at a premium. That plant was certainly a smoke factory that winter. One idea developed to reduce the smoke was: The suction pipe to the pipe which ran to outdoors was broken and a Y let in; a branch was run to the end of the breeching so that a mixture of cold air and flue gases could be obtained. This mixture supplied under the grates resulted in a great diminution in black smoke. The amount of flue gases drawn in was regulated by a damper in the Y. On the whole the idea worked very well, and that boiler was in commission all winter.

As the work of bricking up the new No. 1 boiler proceded it was discovered that the stoker of No. 2 boiler would project into the brickwork of No. 1, so before the bricklayers had got much work done the stoker on No. 2 had to be dismantled and grates put under the boiler instead. So one week-end this had to be done, Saturday afternoon and night, Sunday and Sunday night the work went on. On Monday morning the new grates were in and the boiler under steam. No. 1 had to carry the whole load during that time. Very fortunately for us the weather was mild that week-end.

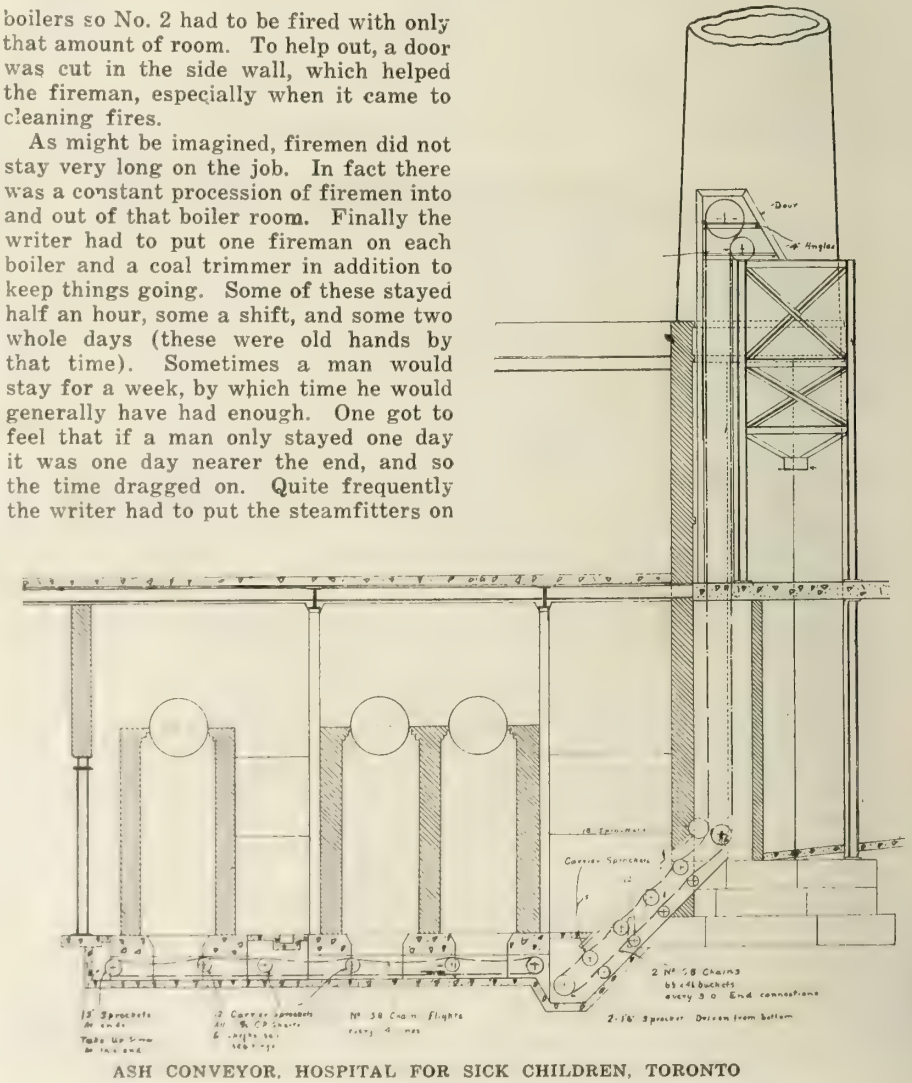
The new No. 1 boiler wall came about 4 ft. from the front wall of the other boilers so No. 2 had to be fired with only that amount of room. To help out, a door was cut in the side wall, which helped the fireman, especially when it came to cleaning fires.

As might be imagined, firemen did not stay very long on the job. In fact there was a constant procession of firemen into and out of that boiler room. Finally the writer had to put one fireman on each boiler and a coal trimmer in addition to keep things going. Some of these stayed half an hour, some a shift, and some two whole days (these were old hands by that time). Sometimes a man would stay for a week, by which time he would generally have had enough. One got to feel that if a man only stayed one day it was one day nearer the end, and so the time dragged on. Quite frequently the writer had to put the steamfitters on the boiler fires, which of course raised the cost of the job, besides holding it back considerably.

Whilst the old No. 3 boiler, now the new No. 1, was being rebuilt, which, by the way, was done by a local boiler maker (the makers being too busy to spare an erector) the ground under the old breeching was excavated and the north wall of the building underpinned. This underpinning helped considerably to boost the price of the job.

Where the No. 3 boiler had been was also dug out and the west wall underpinned and preparations made for building a new breeching. This is made of concrete, in the proportions 1-2-3, using cinders instead of gravel or broken stone. The inside measurements of the breeching are 6 ft. 3 in. wide by 5 ft. high, giving an area of over 31 sq. ft. as against 18 sq. ft. area of the old breeching. This was to allow for the increased length and a right angle bend.

The bottom of the breeching was carried on 7 in. I beams built into the building wall and into the boiler walls on the other end. The bottom was further reinforced with ¾ in. square twisted steel. The side walls of the breeching are 6 in. concrete with ¾ in. reinforcing. The top is 5 in. concrete, also reinforced. The concrete had to be run at two operations. The bottom forms were built and the



ASH CONVEYOR, HOSPITAL FOR SICK CHILDREN, TORONTO

concrete bottom 7 in. thick was run all in one piece. The sides and top forms were built up and the whole then run together, the men working day and night to make it one solid run without a break. Spaces were left in the walls of the breeching for No. 2 and No. 3 boilers, these spaces being built up with dry brick and then plastered over. The whole weight of the breeching was carried on a framing until the boilers were built up to it. which was a matter of three or four months.

In order to get as much of the breeching as possible in one piece and still keep the old one in service, the old one was cut off with a dry wall close to No. 2 boiler damper and the concrete run up to and joining the old breeching wall, which was of brick.

A manhole was left on the top of the new breeching for removing forms and rubbish. As soon as the building of the new breeching commenced the side door on No. 2 boiler was shut off, which made things increasingly difficult, especially round this No. 2 boiler, so that the boiler on forced draft was called upon to furnish most of the steam.

By the time the breeching was built the brickwork on the new No. 1 boiler was begun. If the place was cramped before, it was crowded out now, what with six or eight bricklayers and their boards for three different kinds of mortar (lime and cement, mortar, fireclay, and the special cement for Nonpareil brick),two or three laborers, two firemen and a trimmer, to say nothing of steamfitters, there was scarcely room to move. The drawings show a scant two feet of room between boiler and the engine room between the boiler and the engine room wall, and there was not more than four feet of room on the north side, and in this four feet coal had to be wheeled through and No. 2 boiler fired.

The lower six courses of brick were red or grey stock brick laid in cement mortar, according to the boilermaker's specifications, which were followed throughout, with the exception of using Armstrong Nonpareil insulating brick instead of one thickness of red brick. The bricks from the old setting were used as far as possible.

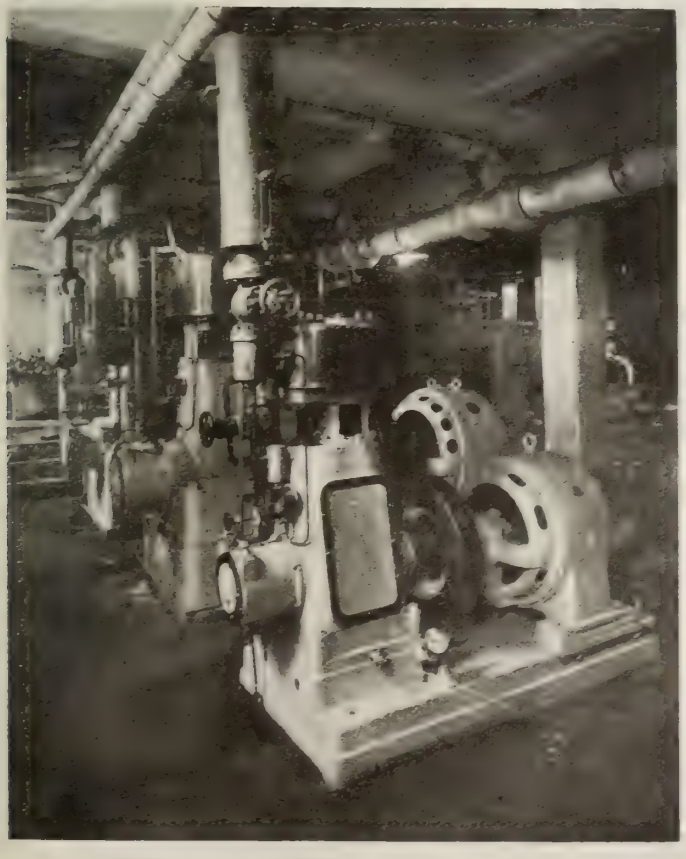
The boiler has 18 in. side walls and 14 in. back wall. The firebrick lining in the firebox is 9 in. thick laid in fireclay dipped, and the brick is laid, 1 course headers to three courses stretchers.

The lining in the first pass is 4½ in. thick, laid in a similar manner to the firebox. The firebrick is bonded into the red brick with firebrick headers, and the Nonpareil brick into the red brick, with red brick headers. Apart from the firebox, the boiler brickwork is laid 1 course headers to 4 courses stretchers. The use of Nonpareil brick has been justified by the low temperatures obtained on the brickwork of the boilers. With the boilers under full load and a firebox temperature of about 2,300° to 2,500° Fahr., judging by the color of the fire, one can bear to place one's hand on the brickwork and a thermometer shows a temperature of 150° Fahr. when placed on the brickwork for ten minutes.

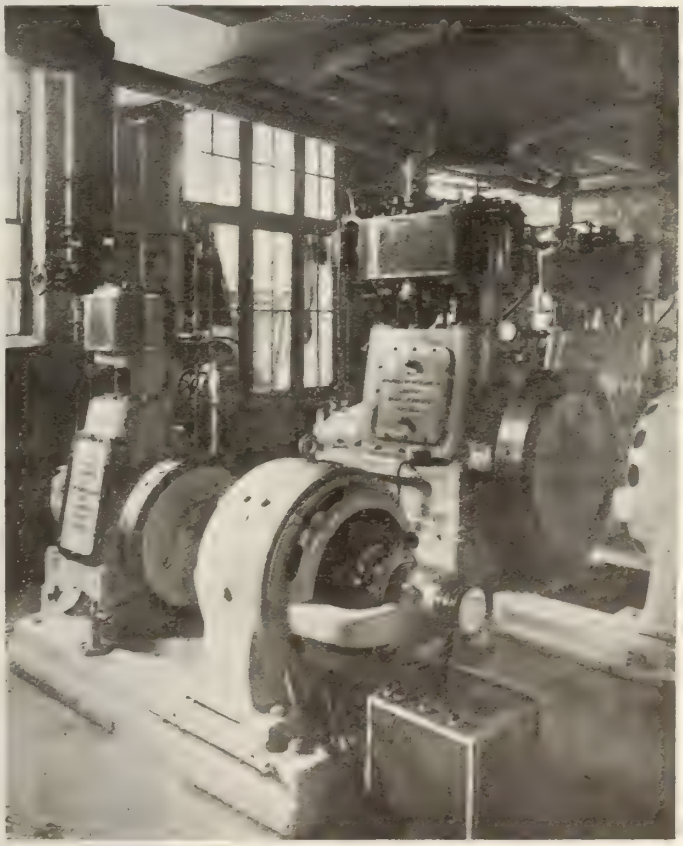
As soon as the brickwork was safe to work on, the boiler was connected up for service. A 3 in. Davis non-return valve was placed on the front safety valve nozzle and a temporary line was connected to the high-pressure services. The back safety valve nozzle was blanked with a valve as this outlet was intended for use as the new main steam outlet. One side of the permanent feed main was placed in position as quickly as possible and the boiler filled and the brickwork dried out. One set of the herringbone grates were placed under this boiler temporarily and a slow fire lighted, after the new breeching had been cleaned and the dry wall knocked out.

By using the temporary gates about a week's time was saved as the stoker was rebuilt as the boiler was drying. Just at this time there was nowhere to place the motor to drive the stoker so the motor was placed on the gallery which runs around the boiler room and clamped down to the grating. A counter-shaft was hung under the grating and the stoker was running in about two hours after the work of placing the motor was started. There was some difficulty encountered after starting up this boiler. The local boilermaker, in spite of repeated instructions, managed to get in the baffle brick without fireclay, and the bricklayers left room below the baffle on the first pass to allow any nicely-heated gases a short straight cut to the stack, so that the Venturi meter only registered about 3,000 lbs. per hour. So the first Sunday that boiler had to be shut down again and the baffles made good. Neither boilermaker nor bricklayer are very likely to make that same mistake again.

Continued on page 359



ENGINE ROOM, HOSPITAL FOR SICK CHILDREN



ENGINE ROOM, SHOWING 25 KW., 3 WIRE SET IN FOREGROUND

Historical Development of the Steam Turbine—II

The Second Installment of a Series Dealing With Development of the Turbine—Growth in Size of Turbo-Generator Units in Recent Years—Compounding Adopted

THE past two decades have seen a growth in the size and economy of steam turbines beyond the most optimistic expectation of twenty years ago, as is shown graphically in Figs. 4, 5 and 6. The types of machines which represent the various stages in this development are illustrated and their performances are given in the following discussion:

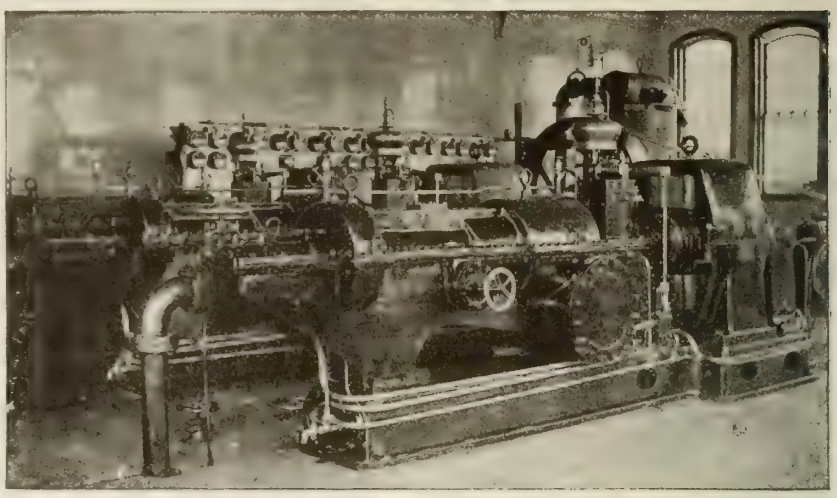


FIG. 11.—400-K.W. TURBINES INSTALLED 1899

1899

The 400 kilowatt 3,600 r.p.m. turbines, driving revolving armature, 440-volt generators shown in Fig. 11 were installed at the plant of the Westinghouse Air-brake Company. These turbines are still in service. Sixty-six machines of this size were sold.

1900

The 2,000 kilowatt turbine for the Hartford Electric Light Company shown in Fig. 12 was shipped in 1900. This turbine was of the straight Parsons single-cylinder construction and was designed to operate at 1,200 r.p.m.

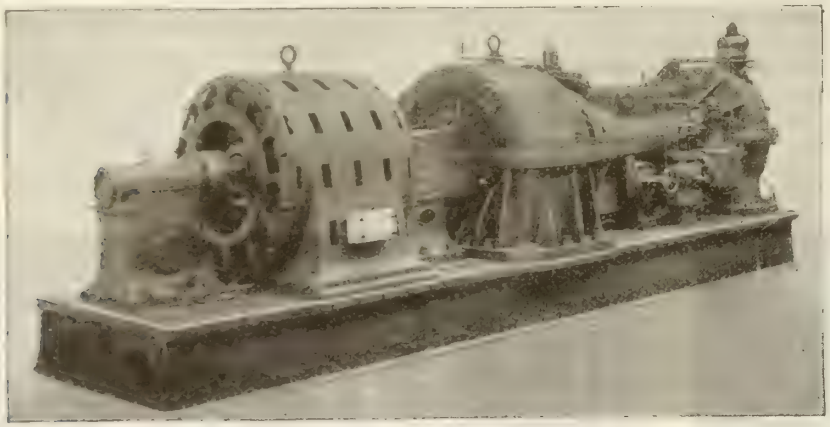


FIG. 12.—2,000 K.W. UNIT

1903

The 1,000 and 1,500 kilowatt two-cylinder machines arranged in tandem, shown in Fig 13, are of the straight Parsons design. Sixteen of these turbines were built.

1904

The single-cylinder machines of 1,000 kilowatt rating were built of straight Parsons design, the turbine as shown in Fig. 14 being operated either at 1,500 or 1,800 r.p.m. One hundred and twenty-nine of these turbines were sold in this year.

1905

Some large machines sensible of being given a normal rating of either 5,500 or 7,500 kilowatts were shipped in 1905. These were regarded at the time as of unprecedented capacity. They operated at 750 r.p.m., and were also of Parsons design, as shown in Fig. 15. Fourteen of these machines were built. Twelve of these are still in serviceable operation.

1905 to 1909

Between these years a very large number of straight re-action turbines were built of similar type to those described under 1903, varying in capacity from normal ratings of 300 kilowatts to normal ratings of 3,000 kilowatts, speeds varying from 3,600 to 1,200 r.p.m., and others at 7,500 kilowatt capacity at 750 r.p.m.

1909

Improvement in generator construction permitted increased capacities at a given speed as it was then considered undesirable to materially increase the blade speeds. A feature was developed for providing the turbine with low-

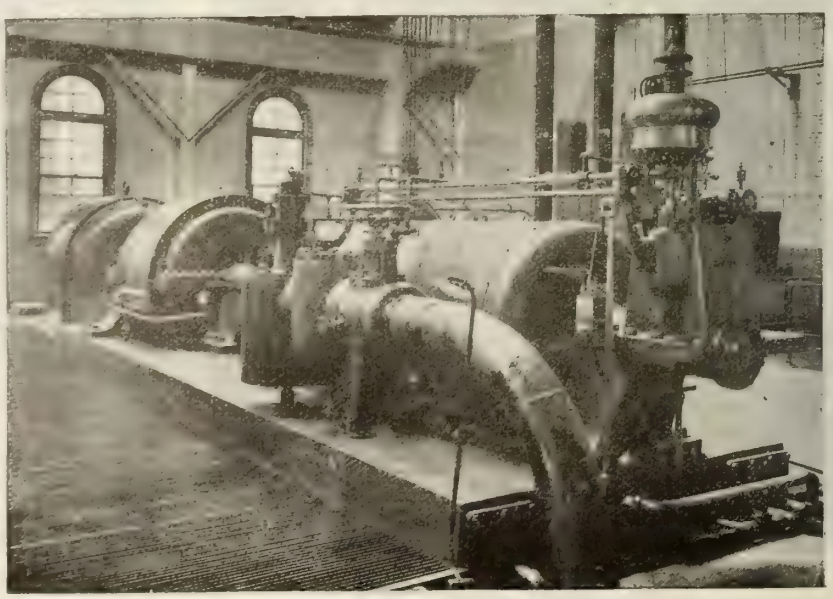


FIG. 13.—TANDEM COMOUND TURBINE

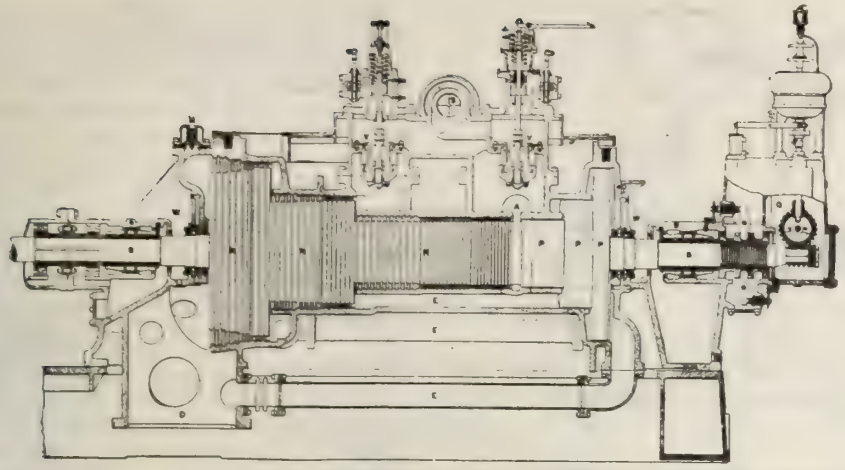


FIG. 14.—1,000 K.W. TURBINE OF PARSONS DESIGN

pressure elements of double-flow construction, thus doubling the capacity of those elements and replacing the first barrel of Parsons blading in the older design machines, whose dimensions were small and consequently subject to large leakage losses, by an impulse element, producing what is now known as a single-double flow turbine.

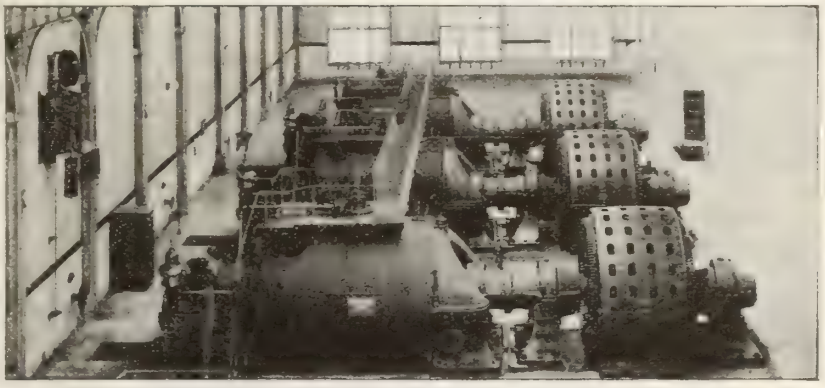


FIG. 15.—A 1905 INSTALLATION

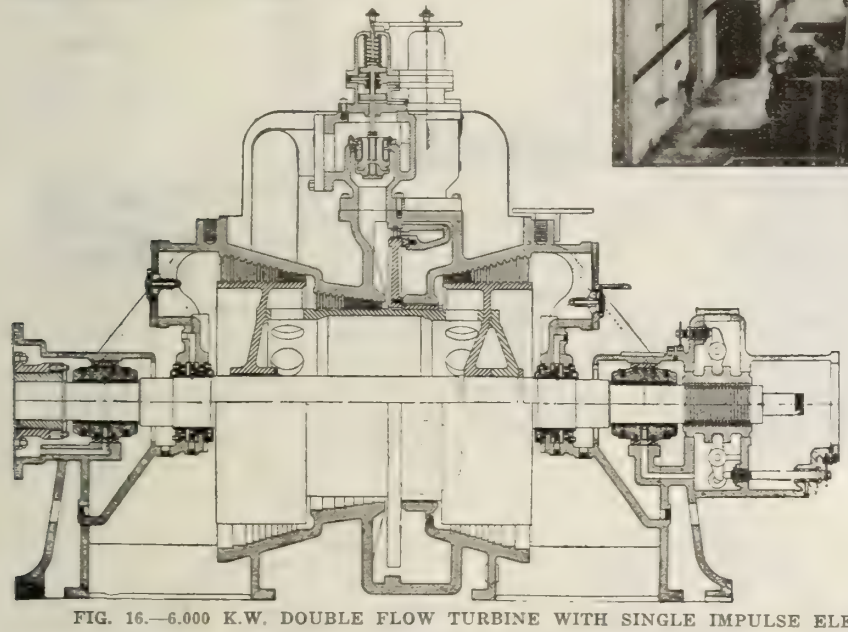


FIG. 16.—6.000 K.W. DOUBLE FLOW TURBINE WITH SINGLE IMPULSE ELEMENT

During this year there were shipped a number of 6.000 kilowatt, 1,500 r.p.m. normal rated machines as shown in Fig. 16. At the same time some 10,000 kilowatt, 750 r.p.m. machines of the same construction were built and are shown in Fig. 17. Also during this year there was shipped a 1,500 r.p.m., 10,000 kilowatt maximum rated machine to the Metropolitan Street Railway Company

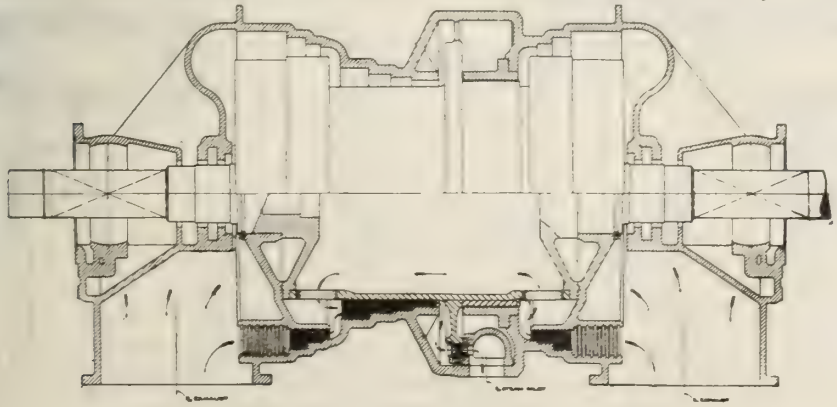


FIG. 17.—10,000 K.W. MACHINE OF SIMILAR CONSTRUCTION

of Kansas City, of single-double-flow construction. With a load of 8,551 kilowatts at 166.5 pounds, gauge steam pressure at 75.4 degrees F. superheat and a vacuum of 28.73 inches mercury, the steam consumption of this turbine was 14.50 pounds per kilowatt-hour, and its efficiency ratio was 65.0.

In the same year an epoch-making machine was shipped to the City Electric Company of San Francisco, of 10,000 kilowatt normal rated capacity, 15,000 kilowatt maximum, at 1,800 r.p.m. This machine, as shown in Fig. 18, was of double-flow construction, except that the impulse element only was single-flow, all of the re-action blading being double-flow.

1910

A 2,000 kilowatt normal rated, 3,000 kilowatt maximum machine was developed of precisely similar design to the 10,000 kilowatt turbine, except that it was arranged to operate at 3,600 r.p.m. In the absence of authentic tests its performance at 2,000 kilowatts is stated to be 15.4 pounds per kilowatt-hour, giving an efficiency ratio of 63.5, with 175 pounds gauge steam pressure, 100 degrees F. superheat and 28.0 inches mercury vacuum.

1911

Some bleeded turbines as shown in Fig. 21 were developed of 750 to 1,500 kilowatt capacity for industrial plants where heating was required for some industrial process, also for small communities which required exhaust steam in the winter time for district heating, the turbine operating completely condensing in the summer. These turbines automatically maintain the desired pressure in the heating system, and that which is not required for heating purposes passes through the low-pressure turbine elements to the condenser.

1912

A 3,500 kilowatt normal rated, 4,500 kilowatt maximum, double-flow turbine as shown in Fig. 20 was shipped in this year, the impulse element only being single-flow, designed to operate at 3,600 r.p.m., in which blade speeds as high as 500 feet per second were employed. In the absence of authentic tests their performance is stated to be that shown in connection with Fig. 20. In this year

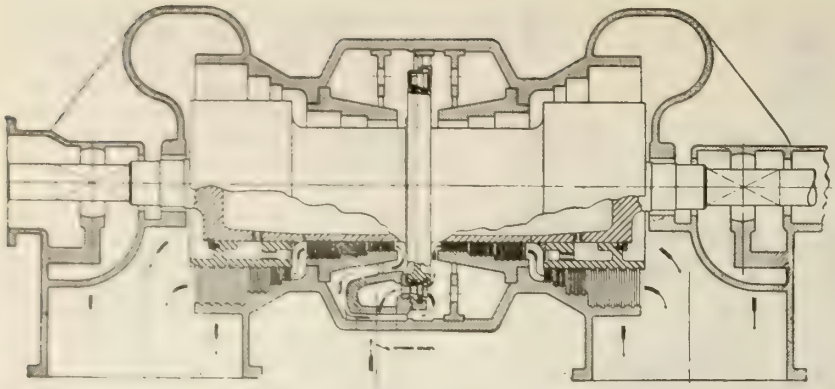


FIG. 18. 15,000 K.W. TURBINE, DOUBLE REACTION BLADING AND SINGLE IMPULSE ELEMENT

two of the largest geared direct-current units of 3,750 kilowatt capacity were shipped. These turbines, which were shown in Fig. 1, operate non-condensing against 20 pounds back pressure, the gear reduction being from 1,800 to 180 r.p.m. The operation of these gears and turbines has been of a most satisfactory character.

1913

A 20,000 kilowatt maximum rated turbine operating at 1,500 r.p.m., as shown in Fig. 23, and a 15,000 kilowatt maximum turbine operating at 1,800 r.p.m. were developed of a design similar to the 3,600 r.p.m. turbine of Fig. 20. There were a large number of these built

1914

Some important machines of 30,000 kilowatt capacity were shipped to the Interborough Rapid Transit Company of New York City, in which the principle of so-called cross-compounding was introduced; the steam expansion being divided in two separate elements, each driving a separate generator. The high and low-pressure element respectively operating at different speeds, each at the nearest synchronous speed most suitable to the steam volume involved, as shown in Fig. 19. The advantage of cross-compounding is commended for the increased reliability thereby gained.

1915

Machines of 20,000 kilowatts maximum capacity, 25-cycles, 1,500 r.p.m., as shown in Fig. 22, having higher design co-efficients than those heretofore built for machines whose expansion was complete within a single cylinder, were shipped in 1915.

1916

A 60-cycle machine of 1,800 r.p.m., of similar design to the above was developed in 1916.

1917

During the year, 30,000 kilowatt machines of single-double-flow construction were shipped, having all-re-action blading, the complete expansion being carried out within a single cylinder, as shown in Fig. 25.

Another high efficiency machine of 35,000 kilowatt capacity has been shipped to the Commonwealth Edison Company of Chicago, the steam expansion being divided in two elements like those described under 1903, the cylinders being arranged tandem fashion, and driving one generator, as shown in Fig. 24. The first of these machines has been placed in successful operation during the year.

Some 40,000 and 45,000 kilowatt, 60-cycle, cross-compound machines, similar to the Interborough Rapid Transit Company's machines, have lately been put in service. The high-pressure element operates at 1,800 r.p.m., and the low-pressure at 1,200 r.p.m. There are also under construction 60,000 kilowatt turbines for both 25 and 60-cycle service, which are a further development of the compound principle, in that the turbine element will comprise one high-pressure and two low-pressure elements, the steam passing through the latter in parallel and each driving separate generators. Means are provided that, should the circuit-breaker open on any of these elements or should the unit be put out of service by means of the emergency stop, the remaining two units will continue operating, thus providing in a measure the economy commensurate with a very large unit with the flexibility of a number of smaller units.

It is expected that the new 35,000 kilowatt, 60-cycle, 1,200 r.p.m., tandem compound turbine with direct-connected exciter, with a load of 25,000 kilowatts

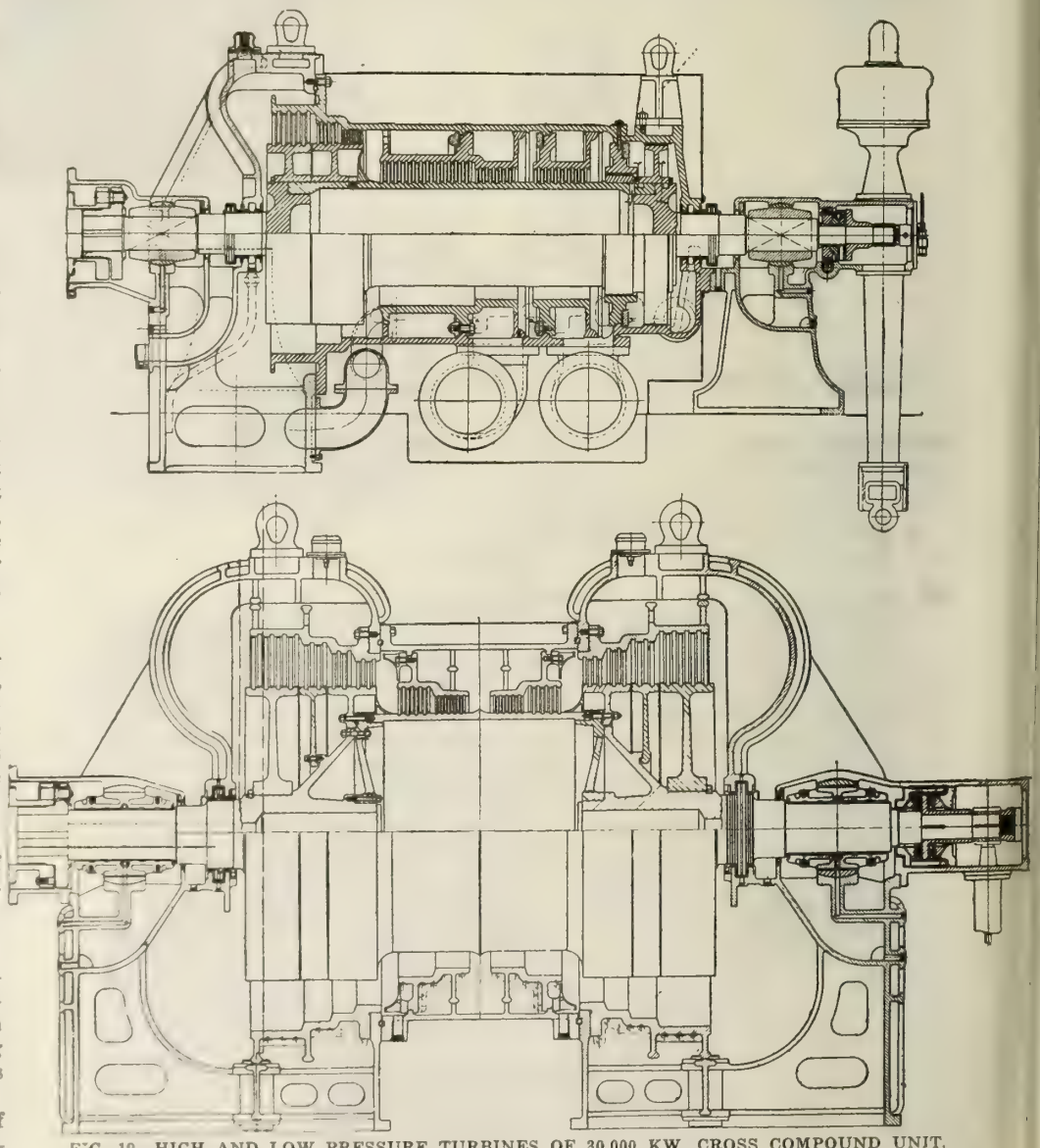


FIG. 19—HIGH AND LOW PRESSURE TURBINES OF 30,000 KW. CROSS COMPOUND UNIT.

at 85 per cent. power-factor, at 220 pounds, gauge steam pressure, 200 degrees F. superheat and a vacuum of 29 inches mercury, will have a steam consumption of 10.65 pounds per kilowatt-hour, and an efficiency ratio of 75.4.

With a load of 50,000 kilowatts at 275 pounds gauge steam pressure,, 200 degrees F. superheat and a vacuum of 28.5 inches mercury, the new 60,000 kilowatt, 60-cycle, 1,800 and 1,200 r.p.m., three-cylinder, cross-compound turbine at 85 per cent. power factor will have a steam consumption of 10.65 pounds per kilowatt-hour and an efficiency ratio of 76.2. Also the 60,000 kilowatt, 25-cycle, 1,500 r.p.m., three-cylinder, cross-compound turbine at 100 per cent. power factor with a load of 40,000 kilowatts at 205 pounds, gauge steam pressure, at 150 degrees . superheat and a vacuum of 29 inches of mercury, will give a steam consumption of 10.75 pounds per kilowatt-hour and an efficiency ratio of 77.7.

In comparing the foregoing performances, cognizance must be given to the fact that the efficiency ratio cannot be used as a direct comparison, for the same turbine will give a higher efficiency ratio with higher superheat. This emphasizes the quite remarkable performance of the earliest machine. The efficiency ratios quoted in the foregoing include generator losses. It may be proper to explain that by efficiency ratio is meant the ratio of the energy actually obtained from an engine to that which is theoretically obtained by the adjabatic expansion of steam between the specified pressure and also temperature limits.

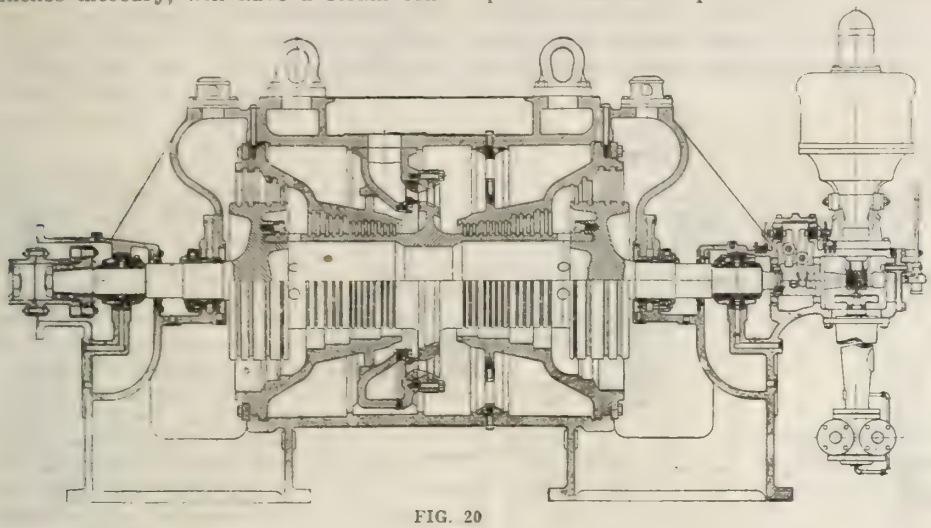


FIG. 20

It is interesting to record that owing to the changed condition of the merchant marine in the United States a large number of vessels are under construction in which geared turbines are being employed. The Westinghouse Company has built and has under contract steam turbine propelling machinery for two hundred and forty-four merchant ships with an aggregate horse-power capacity of 480,000. Four of the above have been to sea and proven eminently successful. In addition to the above the same company has built and has under contract turbine propelling machinery for fifty-six naval vessels aggregating 1,600,000 horse-power. In the case of 10,000 horse-power passenger ship trading in the Pacific, 22.8 per cent. gain in fuel consumption is experienced as compared with a sister ship having modern four cylinder three stage reciprocating engines.

Along with the improvements in turbine performances already discussed have been corresponding improvements in details which have materially increased the reliability of steam turbines. Some of these details, for example, the blading and governing systems, have in themselves gone through a process of development which will be reviewed briefly. (To be continued)

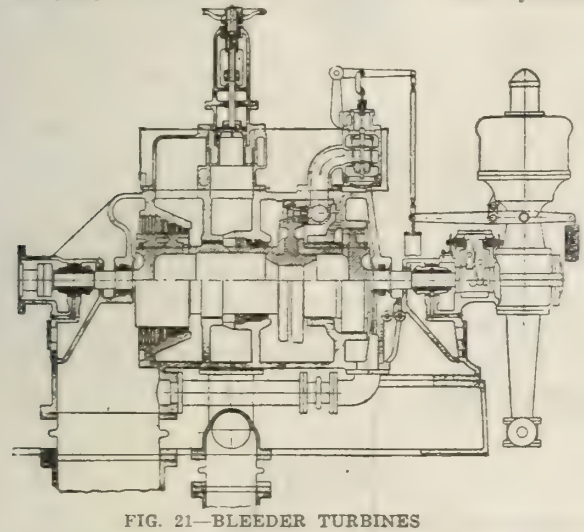


FIG. 21—BLEEDER TURBINES

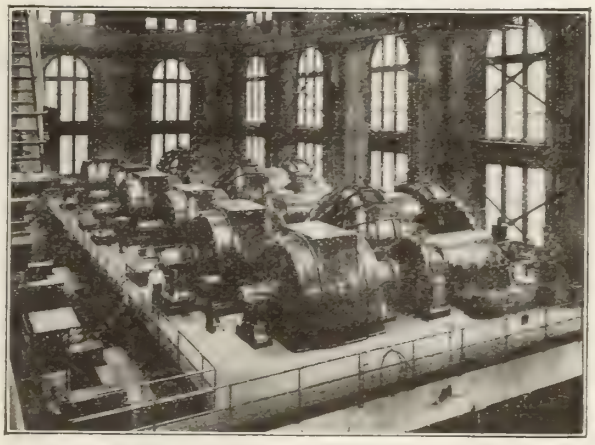


FIG. 24

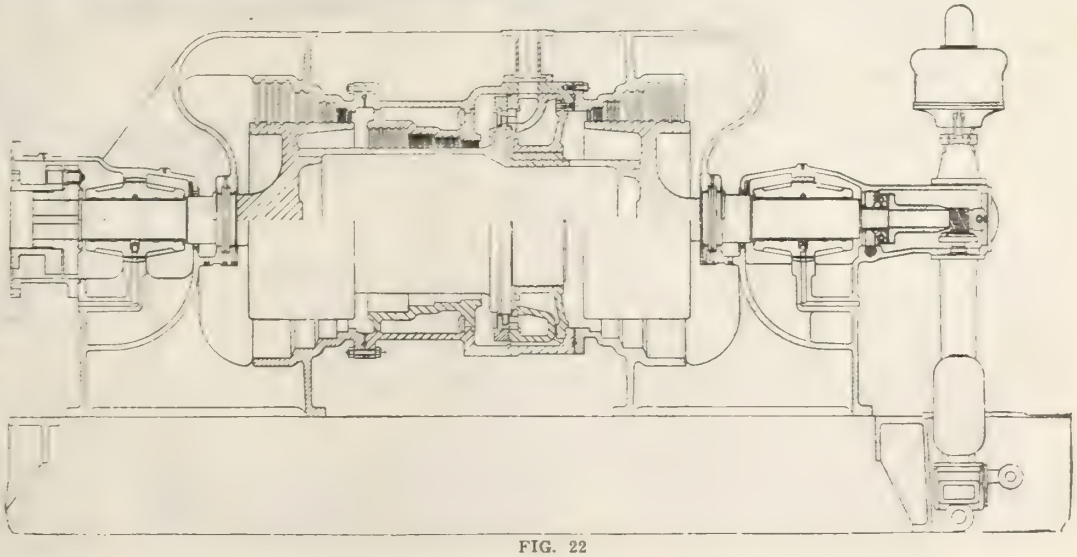


FIG. 22

LUBRICANT ECONOMY

By D. Street

One of the minor troubles in the mechanical business at the present moment, which is certain to become more acute as time advances, is that of lubrication. Oils, fats and greases, of whatever origin, do not increase and multiply. They grow scarcer and dearer. The troubles in this respect in enemy countries are their own, and it is certain that rolling stock of all kinds must be in a deplorable condition there owing to the blockade, and this matter alone is forcing the pace with regard to Rumania and Russia. Lubricants are as essential to the conduct of war and transport as food. With a shrinking tonnage available, importation must inevitably be restricted further still, and there is no natural supply of oil available in many countries. Tallow, lard, mineral oils, as well as those of vegetable origin, are all in like case. The shortage of edible fats has led to rationing these equably to the population, and practically the whole available supply of vegetable oils can be considered as withdrawn for food purposes in Great Britain.

Out of this shortage and scarcity arise several matters worth mention; the first of these exerts a natural check upon consumption; prices are rising steeply. The second matter is that relief in this particular cannot be expected; indeed, the conditions of scarcity will prevail after hostilities cease. Conservation of existing stocks therefore must be rigidly practised.

So far as possible all wastage should be avoided. In the normal shop quite half the expenditure upon lubricants is thrown away; every unit in the shop force should, as a point of honor, contrive to use as little oil as possible. For instance, the use of the oil can to drill a hole, or on any machining operation should be barred; it's up to the storekeeper to ration the supply with the strictest economy. The management should display in a conspicuous place warnings upon the matter, taking the percentage increase in cost and the need for rigid economy, of the national stocks.

Most moving mechanism can be efficiently lubricated with about half the considered normal amount. Where drip lubrication is in use a little careful investigation will show how to cut expenditure of lubrication. In deed and fact, without being parsimonious, and without grudging the needful supply, the drops per unit of time can in many instances be halved without danger of rise in temperature.

It was an experienced operating engineer who maintained from experiment that doing his own oiling round he cut oil bills 33 1-3 per cent. Bearings of common type, unprovided with drip trays, needing adjustment, and with surfaces in poor condition, require much more oil than those under the reverse conditions. To compensate and spin out the supply, and so save tonnage, every piece of greasy waste should be treated to recover the oil; a small centrifugal extractor and filter pays large dividends in a big works.

Care should be exercised over the oil can to see that this is in good shape and not leaky. One way in which the mechanical trades, and every man in association therewith, can help victory is to be sparing with the oil can. Owing to the fact that ball bearings need but one filling of grease, and this simply to exclude the grit, over a long period of time, the present high price of lubricants and the national need should instal these wherever possible.

A ball bearing will (dust excluded) run without lubricant at all, and present circumstances should make them more prominent than before. All grease and greasy material should be collected.

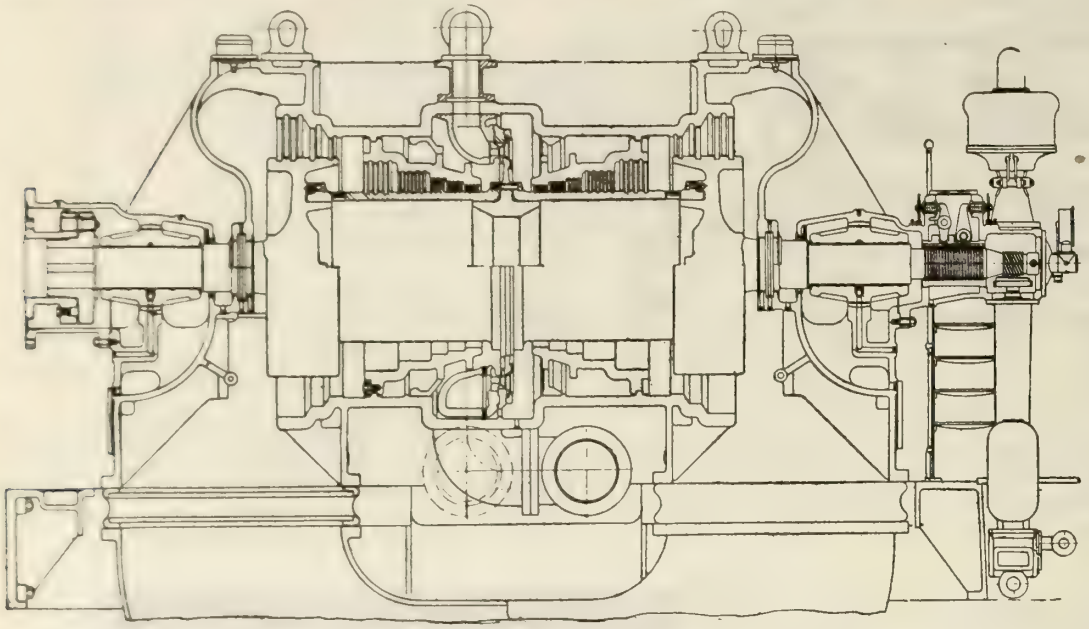


FIG. 23—20,000 KW. TURBINE, DESIGNED IN 1913

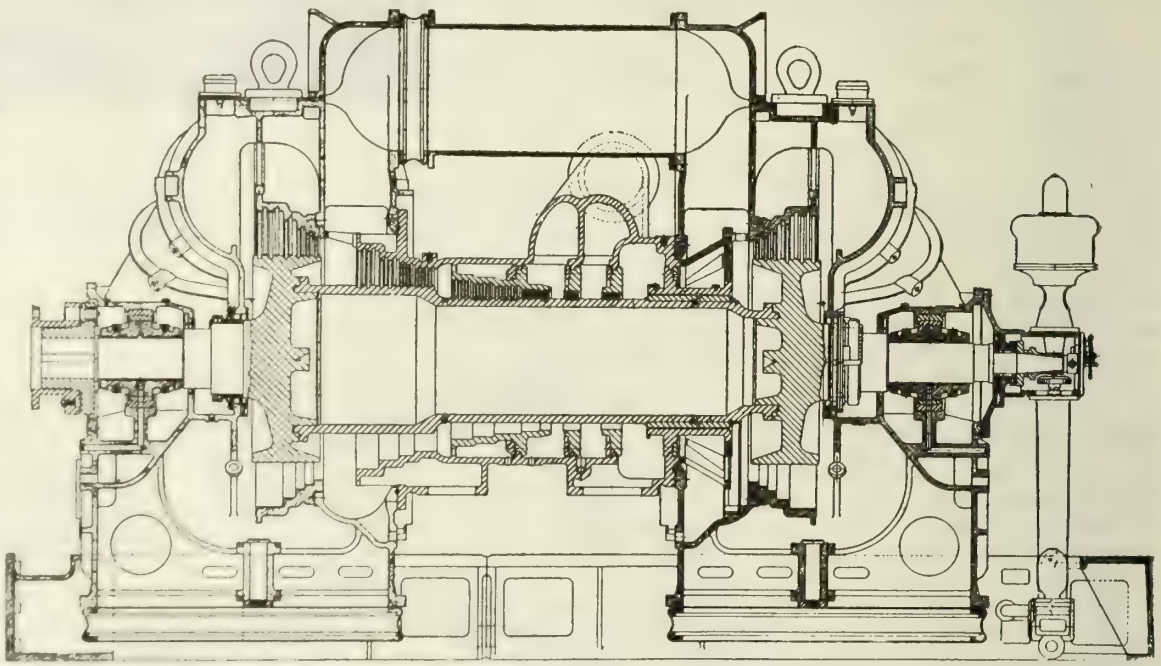


FIG. 24—TANDEM COMPOUND UNIT OF 35,000 KW. CAPACITY FOR THE COMMONWEALTH EDISON CO., CHICAGO

The Growth and History of Refrigeration

Refrigeration is All Essential in Maintaining Modern Civilization —Cities, Battleships, Armies in the Field, All Are Dependent For Their Food Supply on the Refrigerating Plant

By JAMES F. PATTON

HOW many of us realize the enormous part mechanical refrigeration plays in modern civilization? When the price of meats soar high we usually condemn the "profiteer" packers, not considering the fact that a large per cent. of our population is herded together in the large cities, and progressive communities make no provision for the old-time butcher who killed his own cattle under unsanitary conditions, nor are they likely to do so. Without the packers and their wonderful system of mechanical refrigeration we would have no meats at all.

In carrying on the work of supplying hundreds of population centers with a highly perishable product in the kinds and quantities demanded, at the time needed, and in perfect condition, one Chicago packer has developed a chain of branch supply houses, nearly 400 in number, uses over 9,000 trained employees, 400 motor trucks, and over 7,000 refrigerator cars. The foundation on which the entire business is based being mechanical refrigeration.

Our boys "Over There" are absolutely dependent on the refrigerating systems as used on cars, storage houses, and on shipboard. The battleship uses such a system to keep the ammunition in a satisfactory condition, and the temperature of the shop in which the ammunition is produced is regulated by such a system.

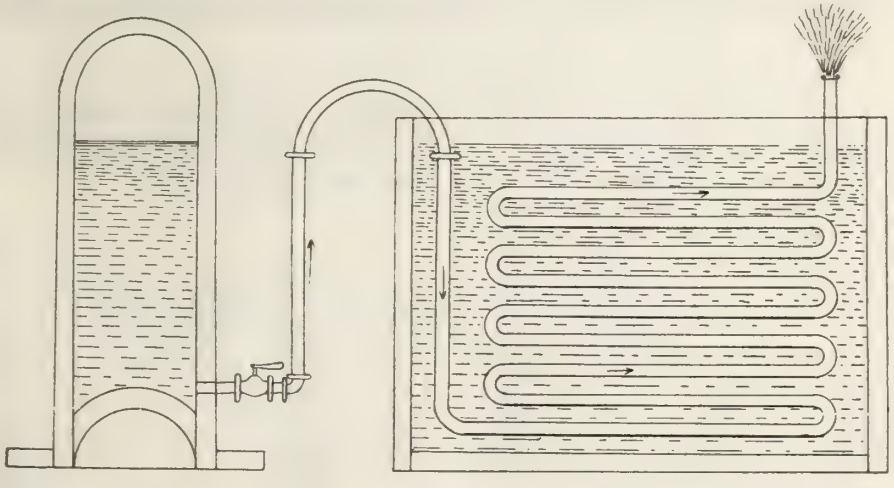


FIG. 1

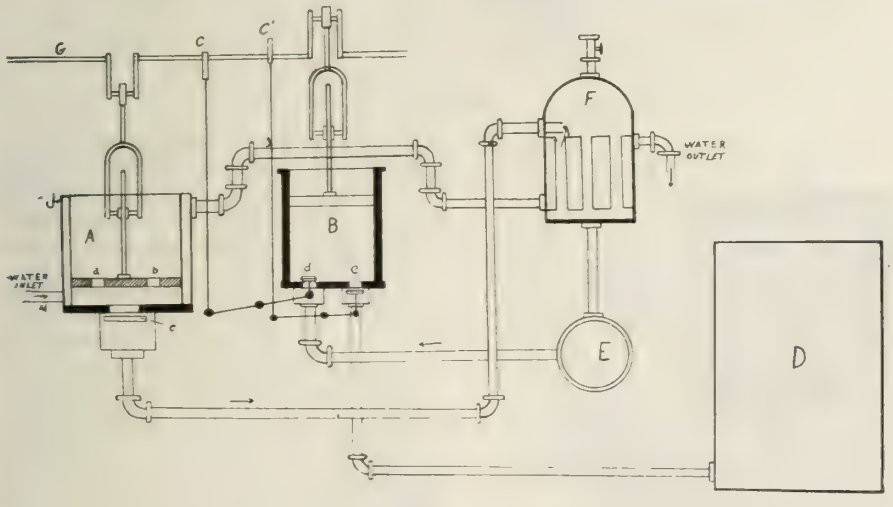


FIG. 2

Practically speaking, every modern food product to be found on the markets to-day has at some stage in its journey from producer to consumer, come under the influence of a refrigerating plant. The day is past when the producer was forced to dump his product on an overstocked market at an unsatisfactory price. Further, "seasons" do not affect the consumer because refrigerators have made it possible for us to purchase any particular delicacy we have set our hearts on at any time. The home, hospital, hotel, all are dependent upon refrigeration. The lady of means puts her furs in cold storage, while the poor woman of the slums in the great cities is thankful for artificial ice, which can be bought where natural ice is out of the question. Refrigeration also plays an important part in our amusements. We enjoy the "movies" on a hot afternoon, because the air has been artificially cooled, and even when the temperature it 102° Fahr., we can skate on smooth ice in the modern ice rink, if we desire to do so.

While the product of refrigerating machines is well known to all, and every housewife knows how much it costs to fill the lamily ice box, yet few of those who use the product know how it is produced. There is a natural state for all matter. Under the ordinary conditions, a liquid tends to remain a liquid, or a gas to remain a gas. A change in state is accompanied by change in temperature. It takes heat to melt iron, and when this iron solidifies, it gives out this heat again. Put some ether on your hand, a feeling of cold results. The ether was naturally a gas, and in its return from the liquid form to its natural state, heat is absorbed. Figure I illustrates an early type of machine known as the compression system. This is the simplest possible form, and if volatile liquids could be obtained at nominal cost, no other apparatus would be necessary, but as such is not the case, some means must be had of catching the vapor and using it again. The liquid is allowed to flow through the pipe and expand into the atmosphere. This will cool the liquid surrounding the pipes.

In 1845 Dr. Gorrie invented the cold air ice machine, shown in Fig. II. We are all familiar with the process of changing heat into work, the steam engine and gas engine are examples. The process used by Dr. Gorrie was the exact reversal of this, the change of work into heat, but in such a way as to produce cold. The underlying principle of operation is the fact that the expansion of a gas will produce cold, or rather remove heat, because heat is energy, something which exists, and cold is the absence of this, so in a strict sense we cannot produce cold, we can only remove that which exists—the heat. You can easily prove this principle. Pump an auto tire by

rapidly working a hand pump. Put your hand on the cylinder of the pump, and note that it is hot. Now open the valve

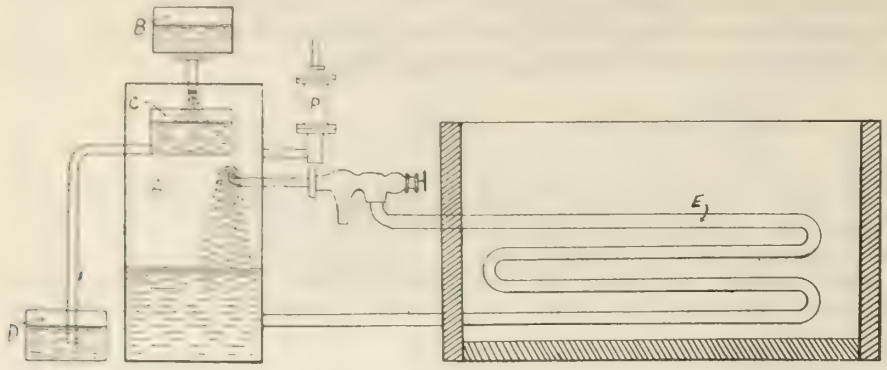


FIG. 3

in the tire and let the air out, feel it, and note that it is cold. The expansion of the compressed air has been accompanied by a decided cooling. Referring to Fig. I, we have a source of power represented by the line shaft G. This shaft furnishes power to drive the piston shown in the cylinder A. This piston has valves A-B, which close on the down stroke, and valve C, which opens on the down stroke. A downward stroke then compresses the air in the cylinder A. Valve C opens, and this air is forced through the pipe into the condenser F. The compression of the air in A generates heat, and in order to remove this the entire cylinder is water-jacketed, the water inlet being at M. This water flows through the upper pipe, through coils shown in the condenser F to the water outlet. The water serves two purposes; it helps to remove the heat generated by the compression in A and it also helps to further cool the air in F, for the air circulates between the coils. From the condenser the cooled air goes to the receiver E, from which there is a connection to the cylinder B. This is the expansion cylinder. The valves E and D are worked automatically by eccentrics, the valve D being closed during the compression stroke. The air

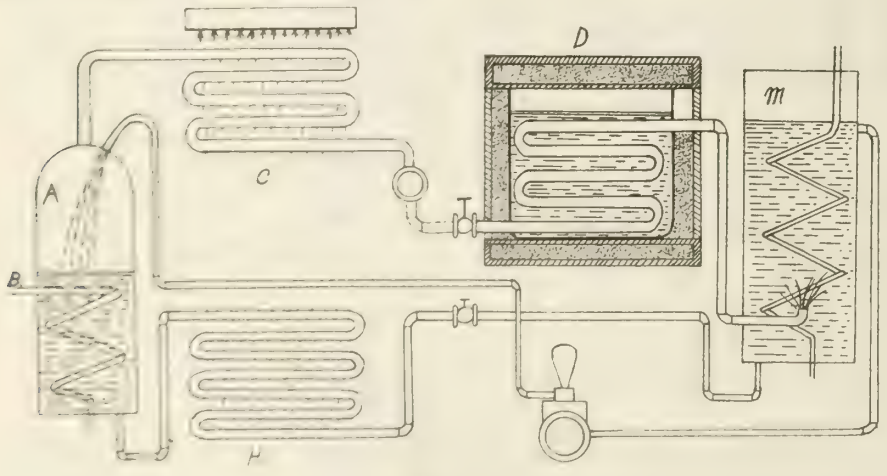


FIG. 5

in B expands, is further cooled by this expansion, and is discharged on down stroke of piston through the valve E to the refrigerator D, where it circulates in coils among the goods to be cooled, and is then returned to the machine or discharged. This type of machine has been largely used on shipboard owing to the entire absence of any obnoxious gases, but it is not efficient.

Nearly one hundred years before the cold air machine was perfected, Dr. Cullum applied the vacuum principle to ice-making. A solid substance may be changed to a liquid, or a liquid to a gas, but heat is needed to do the work. It takes heat to melt ice, and more heat to change the ice water to steam. In heating one pound of water 1 degree, 1 heat unit is used. This is the standard B.T.U. Now to change 1 pound of water at 212° to steam, 966 heat units are used. This is the reason why the sprinkling of the street on a hot day cools the atmosphere. The water evaporates, and the heat needed to cause this evaporation is taken from the air, pavement, and from the water itself.

In Fig. III an air pump P is used to produce a vacuum in tank A, which is partly full of water, which, as pressure is reduced, begins to evaporate. Vessel B contains sulphuric acid, which is permitted to spray into the smaller tank C, from which it is discharged to receiver D and repumped to reconcentrator not shown, then back to B. As this acid has an affinity for water it absorbs the water

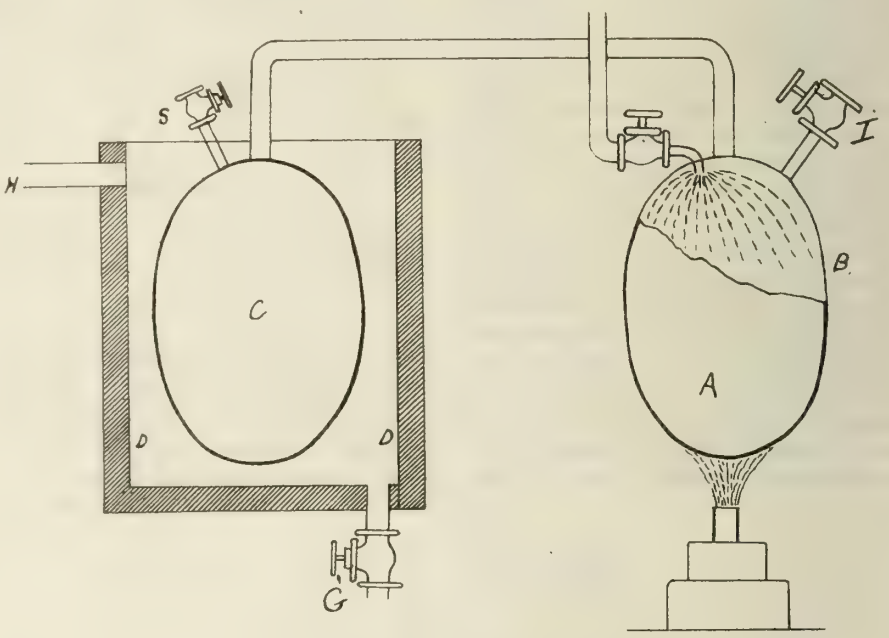


FIG. 4

vapor in chamber A. Fresh water is supplied through injector, which also assists in calculating the brine through the coils E in the refrigerator. This is an involved and costly process, not used to any extent commercially.

In Fig. IV we have two very strong iron vessels, which are connected by an iron pipe. In A we place a quantity of liquid ammonia. Under jar A we place a spirit lamp, the heat from which distills the liquid and the vapor passes to jar C. This jar is in a tank surrounded by cooling water. This water, being changed constantly and kept at a low temperature, forces the ammonia gas to condense in C. When the distillation is completed the lamp is removed, cooling water is allowed to flow over A, and the pressure is therefore reduced, which causes the liquid ammonia to vaporize and return to A, when it is reabsorbed by the water. As this ammonia evaporates it removes the heat from the liquid which surrounds B, and freezing is

accomplished. For many years following the discovery of this principle it was not used, as continuous operation could not be obtained. This was finally accomplished, however, and Fig. V shows the main parts of the modern absorption plant. Steam flows through coil B in tank A, thus raising the temperature of the ammonia solution, so that ammonia gas is driven off at a high pressure, going to the condenser C. The temperature is regulated so that it is always below the boiling point of water, consequently no water is evaporated.

Water flows over this, removing heat from the gas and condensing it. The gas passes through valve to coils in D, where the expansion of the gas removes heat from the brine or other liquid in the tank.

Liquid from the bottom of A flows through coil H, where it is cooled, to tank M, where it meets and absorbs the gas from D, the pump forcing the liquid back to A.

There are three processes in the modern plant: first, the gas must be reduced in volume by a compressor; second, the heat generated by this compression must be removed and gas reduced to a liquid; third, it must then be re-expanded so as to absorb additional heat. The can and plate systems are most used in ice making. In the former the insulated tanks contain brine, which is kept at a temperature considerably below the freezing point of water, evaporating coils being used. In this brine, galvanized iron cans are immersed. These contain the water to be frozen. In the plate system a hollow plate of boiler iron is immersed in a tank containing water to be frozen. The plate is filled with brine, which is cooled by evaporating coils. In the course of time layers of ice form on the sides of the plate.

Power Plant Management; Mechanical Stokers

Why Stokers Are Efficient—Smoke Prevention—Stokers and Laborer Types of Stokers—Chain Grate Stokers, Characteristics of—Instructions For Operation

By ROBT. JUNE

STOKER-FIRED furnaces have many advantages over hand firing, but where a stoker installation is contemplated there are many factors to be considered. It is true that the stokers if the coal to the fire automatically, but if the coal has first to be fed to the stoker hopper by hand its automatic advantage is lost. This is as true of the removal of ash from a stoker. In a general way it may be stated that a stoker installation is not advantageous except possibly for diminishing smoke, unless the automatic feature is carried to the handling of the coal and ash, as, where coal and ash handling apparatus is not installed there is no saving of labor. In large plants, however, stokers used in conjunction with modern methods of coal storage and coal and ash handling, make possible a large labor saving. In small plants the labor saving for stokers over hand-fired furnaces is negligible, and the expense of installation is no less proportionately than in large plants. Stokers are, therefore, advisable in small plants only where the saving in fuel will be large, or where the smoke question is important.

Interest on investment, repairs, depreciation and steam required for blast and stoker drive must all be considered. The up-keep cost will, in general, be higher than for hand-fired furnaces. Stokers. however, make possible the use of cheaper fuels with as high or higher economy than is obtainable under operating conditions in hand-fired furnaces with a better grade of fuel. The better efficiency obtainable with a good stoker is due to more even and continuous firing, as against the intermittent firing of the hand-fired furnaces; constant air supply, as against a variation in this supply, to meet varying furnace conditions in hand-fired furnaces and doing away, to a certain extent, with the necessity of working the fires.

Why Stokers are Efficient

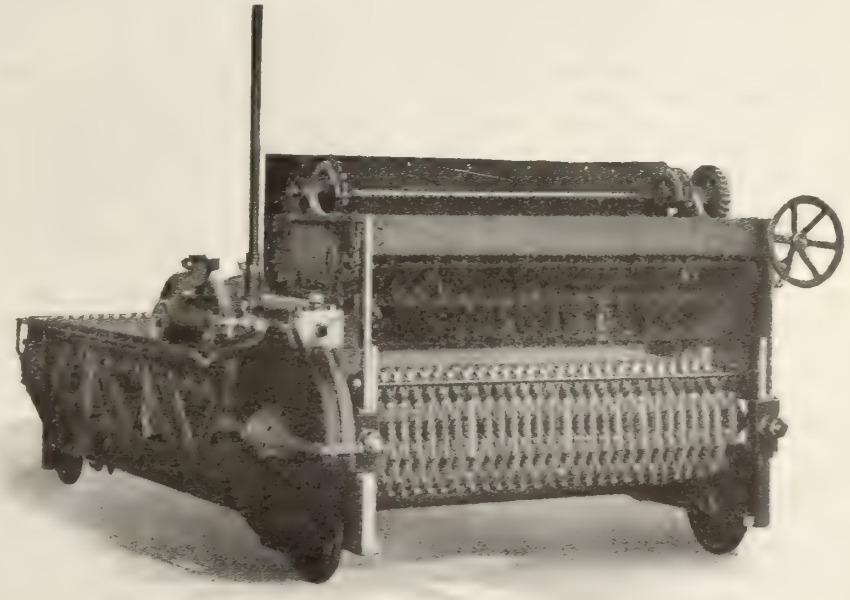
Mechanical stokers, as a class, are more effective in preventing smoke than hand-firing, for the reason that their continuous action is productive of uniform development of the volatile gases. Where stokers feed irregularly the effect is identical with hand firing, and it is necessary not only to employ an auxiliary mixing apparatus, but also to furnish at times an extra supply of air by means of fan or otherwise, to take care of the enormous volume of volatile gas evolved after a fresh charge of fuel is added. It follows that, for periods of light load, the stoker engine should be throttled down to the lowest possible speed rather than to be started and stopped intermittently.

The high efficiency of mechanical stokers is due to:

1. Uniformity of feed.
2. Proper proportion of air and combustible.
3. Absence of excessive air dilution. as when the fire doors are opened in connection with hand firing.
4. Self-cleaning grates.

There is a tendency in all stokers to cause a loss of some good fuel through siftings to the ash-pit, and suitable arrangements should be made to reclaim this.

Just as with hand firing, daily records are essential with any type of stoker if the most economical results are to be obtained. Only by frequent observation is it possible to determine the proper adjustment of air supply, depth of fire, and rate of feed. Don't leave the deter

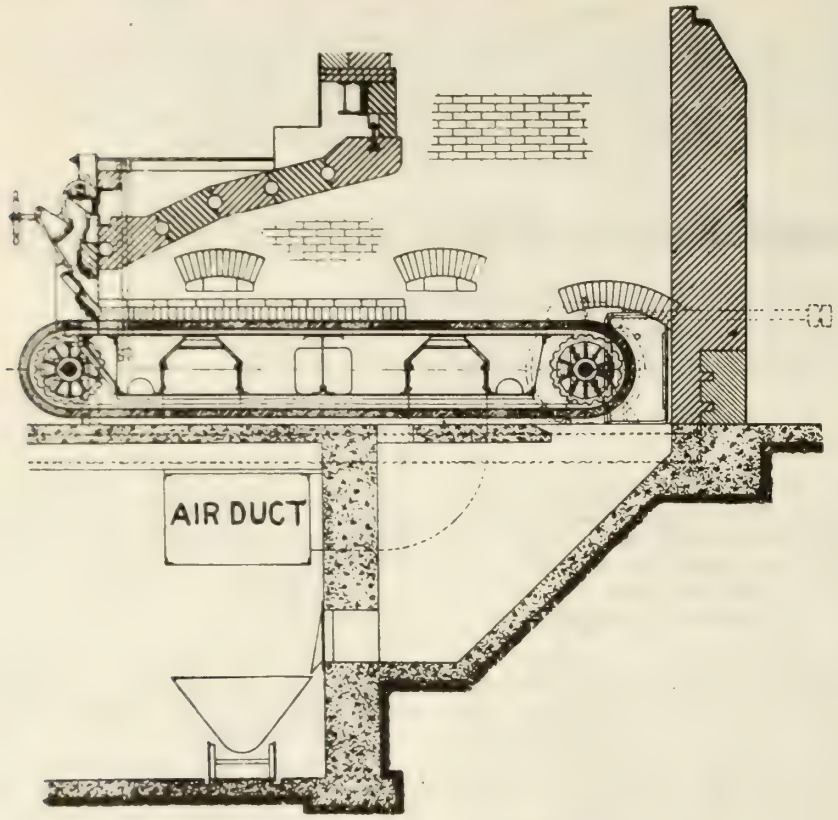


BABCOCK & WILCOX CHAIN GRATE STOKER

Editor's Note:—This is the sixth in a series of articles by Mr. June, on Power Plant Problems. Succeeding articles deal with principles of heat absorption, coal and ash handling equipment, storage of coal, abuse of steam, etc. Later articles sum up the best current practice in the business management of the power plant. The series is of timely interest and should prove of interest to our readers.

mination of these to your fireman's casual guess. The best engineer you can get—in or out of your plant—is the cheapest man to standardize your firing practice.

And once he has formulated standard practice don't think that all is done, and that you and he can go away and forget your stokers. Ten chances to one your boiler room crew is constantly shifting, and you have no guarantee that two succeeding shipments of coal will come from the same mine or that they will be of similar characteristics. Call your engineer back to check up methods and results of firing every week or two at first; later, his visits can be cut down to once a month if conditions warrant, but even with a stable, intelligent and willing boiler room crew and uniform coal, the monthly inspection should be rigidly adhered to. Stokers are often condemned by owners as inefficient and inferior to hand firing because no particular attention has been paid to them beyond keeping them supplied with coal.



COXE CHAIN GRATE STOKERS

Smoke and Stokers

The stoker is not a cure-all for the smoke evil. It is a decided alleviative in many cases, and an actual specific in many others, but to say that the installation of stokers will eliminate smoke in any and all circumstances, is to ignore evident facts.

There are any number of plants burning a wide variety of fuels in ordinary hand-fired furnaces, in extension furnaces, and on automatic stokers, that are operating under service conditions practically without smoke. We know from experience, however, that no plant will operate smokelessly under any and all conditions of service, nor is there a plant in which the degree of smokelessness does not depend upon the operating force.

When fires must be brought up quickly, operatives, in handling certain types of stokers, will use their slice bars freely to break up the green portion of the fire. In fact, when a load is suddenly thrown on a station, the steam pressure can often be maintained only in this way, and such use of the slice bar will cause smoke with the very best type of stoker. In a certain plant, using a highly volatile coal, and operating boilers equipped with ordinary hand-fired furnaces, extension hand-fired furnaces and stokers in which the boilers with the different types of furnaces were on separate stacks, a difference in smoke from the different types of furnaces was apparent at light loads, but when a heavy load was thrown on the plant all three stacks would smoke to the same extent, and it was impossible to judge which type of furnace was on one or the other of the stacks.

While it is absolutely true and should at all times be remembered that the question of smokelessness is largely one of degree, and dependent, to a much greater extent than is ordinarily appreciated, upon the handling of the fuel and the furnace by the operators, be these furnaces hand fired or automatically fired, it is a fact that the best results are obtained with a good stoker properly operated. The reason for this is that in practically all stoker installations there is, as compared with hand firing, a much longer time for combustion, the volatile gases as they are distilled being acted upon by ignition arches or other arches before they strike the heating surfaces. In many instances, too, stokers are installed with extension beyond the boiler front, which gives an added length of travel during which the gases are acted upon by the radiant heat from the ignition or supplementary arches, and here again the long travel gives time for the volatile gases to be properly consumed.

Stokers and Labor

In plants of 2,000 H.P. and over, the installation of mechanical stokers and coal conveyors effects a considerable saving in labor. With smaller plants, interest on investment, depreciation and other items of expense may make hand firing more desirable, although it should be noted that there are stoker plants of 200 H.P. which are considered a good investment by their owners.

A stoker of the self-cleaning, slow-running type, requires much less attention than a hand-fired furnace. With hand firing one fireman can effectively attend to the water, coal, and ashes of about 200 H.P., or handle coal for 500 H.P., whereas with good automatic stokers, equipped with overhead bunkers and down spouts, he can readily take care of 4,000 H.P.

Types of Stokers

There are three principal types of stokers—chain grate, overfeed and underfeed. In addition, there are several special types such as down draft and sprinkler. A clasification of the best-known American makes follows:

Chain Grates

Babcock & Wilcox; McKenzie; Lacelede-Christy; Green; Illinois; Westinghouse; Playford; Coxe.

Overfeed

Step Grates—Frontfeed: Roney; Wilkinson; Acme.

Step Grates—Sidefeed: Murphy; Detroit; Model.

Underfeed

Jones; Taylor; Westinghouse; American; Riley; Type "E".

Down Draft—Hawley.

Sprinkler—Swift; Vulcan.

Chain Grate Stokers

The standard type of chain grate is one of the most popular forms of automatic stokers for burning small sizes of high ash and free-burning bituminous coals (30 to 40 per cent. volatile matter, and 10 to 20 per cent. ash). It is also adapted to lignites and the very high ash coals of the West. With low ash coals at high rates of combustion the grate is apt to become overheated and breakage with attendant high maintenance may result.

The standard chain grate embodies a moving, endless chain of grate bars, mounted on a frame, with provision for the continuous and uniform feeding of coal into the furnace, the fuel and the grate moving together. As usually installed, the surface of the grate is horizontal, though in some designs it is given a slight incline toward the bridge wall. The operations of feeding the coal, carrying it through the progressive stages of combustion, removing the ashes

and clinkers, and maintaining a clean grate and free air supply are automatic. The driving mechanism consists of a gear train actuated by ratchet and pawls, the arms carrying the latter being given a reciprocating motion by an eccentric mounted on a line shaft. The latter may be driven by any type of engine or motor, and the speed of the grate regulated by varying the stroke of the arm carrying the pawls.

Fuel is fed into a hopper placed at the front end of the furnace and the depth of the fuel regulated by a guillotine damper. The front part of the furnace is provided with a flat or slightly inclined ignition arch, the function of which is obvious. The entire grate and driving mechanism is mounted on a permanent truck and may readily be removed from beneath the boilers. The thickness of the fire and the speed of the grate should be so regulated that when the fuel has reached the end of the grate it shall have been completely consumed and incandescent ashes only will be discharged into the pit.

With chain-grate stokers there may be leakage of air through the coal in the hoppers. In the earlier forms chain grates had an objectionable feature in that the admission of large amounts of excess air at the rear of the furnace through the grates was impossible. This objection has been largely overcome in recent models by the use of some such device as the bridge-wall water box and suitable dampers. A distinct advantage of chain grates over other types is that they can be withdrawn from the furnace for inspection or repairs without interfering in any way with the boiler setting.

Chain grate stokers in general produce less smoke than either overfeed or underfeed types, due to the fact that there are no cleaning periods necessary. Such periods occur with the latter types of stokers at intervals, depending upon the character of the fuel bed and the rate of combustion. With chain grate stokers the cleaning is continuous and automatic, and no periods occur when smoke will necessarily be produced.

This class of stoker is particularly successful in burning low grades of coal running high in ash and volatile matter, which can only be burned with difficulty on the other types.

The standard type of chain grate is not adapted to coking coals on account of the swelling and fusing action of the fuel under the ignition arch. The chain grate may be modified to burn this class of fuel by introducing inclined coking plates immediately under the front of the distillation. This agitation prevents the coal from fusing together, and by the time the fuel reaches the grate proper it no longer tends to coke.

Characteristics of Individual Chain Grate Stokers

The general characteristics of chain grate stokers have already been described. It may be of interest, however, to set down the individual characteristics of a representative number of chain grate stokers. It should be understood, of course, that the fact that a particular stoker is mentioned by name does not mean that the use of that stoker is recommended in preference to some other which is not mentioned.

Babcock and Wilcox Chain Grate Stoker

Coals best adapted for: Bituminous high volatile.

Draft: Natural or forced.

Arch construction: Parallel to grate, extending over two-thirds or more of grate surface.

Constructional features: Bridge wall fitted with water back to prevent grate bars from being burned. Construction excludes air at side of stoker. Structural channels between upper and lower layers of chain at rear of grate form a number of air baffles. Arrangement is such that a varying amount of air may be admitted to the rear of stoker to meet varying conditions of combustion. Any leakage of air at rear, prevented by bridge-wall water box, connected to circulation of boiler.

Operational features: With normal uniform load the type of ignition arch and setting insures smokeless combustion, but careful manipulation is necessary with rapidly fluctuating loads to prevent the formation of smoke.

Illinois Chain-Grate Stoker

Coals best adapted for: Illinois, Kansas, Iowa, Ohio, Arkansas, and other Middle-West coals, running 10 to 25 per cent. ash.

Draft: Natural or forced. Draft should be about .6 inch for high ash and .4 inch for low ash coals. At these drafts the stoker will average 42 lbs. of coal per sq. ft. of grate surface.

Arch construction: Flat suspended.

Constructional features: Hand operated dampers, built into place between upper and lower traveling links permit cutting off active chain-grate surface. Arrangement permits use of a "short fire" at light loads, without excessive air leakage.

Operational features: Fuel bed depth 5 to 6 inches. Rate of combustion varies proportionately to square foot of draft over fires.

Green Chain Grate Stoker

Coals best adapted for: Type "K" is built for long-flaming bituminous. Type "L" for coking bituminous coals.

Draft: Type "K" uses natural draft. Type "L" either natural or forced.

Arch construction: Ventilated flat suspended type.

Constructional features: Air leakage between chain and side walls prevented by adjustable flanges. In type "L" an inclined apron is provided to coke the fuel before it passes out onto the chain. A stationary water-back at times is used on the bridge-wall.

Operational features: Approximately 10 lbs. of coal per sq. ft. of grate surface can be burned for each .1 inch draft available over fire. .6 inch draft required to burn 50 lbs. per sq. ft. of grate surface per hour on type "K."

Playford Chain Grate Stoker

Coals best adapted for: Free-burning bituminous.

Draft: Natural. .15 to .2 inch over fire for normal loads. .2 to .4 inch over fire for loads up to 200 per cent.

Arch construction: Ventilated air-cooled flat type.

Constructional features: Air in-leakage in rear prevented by either fixed or movable water-back, or in some types of construction by a special air-cooled movable back. Stress laid by manufacturers on movable feature on ground that it permits holding fuel-bed on the grate until entirely consumed.

Operational features: By adjusting movable back large clinkers, if formed, can be dropped into the ash-pit. Backfiring of coal in the hopper prevented by water-cooling of entrance gate.

Leclede-Christy Chain Grate Stoker

Coals best adapted for: Illinois, middle Western bituminous; also Eastern long-flaming coals.

Draft: Natural.

Arch construction: Flat suspended type.

Constructional features: Air in-leakage at front and sides prevented by fuel gate being set against ignition arch and side frame construction, using ledge tile composed of special abrasive refractory. Leakage at rear prevented by baffles between upper and lower chain. Bridge-wall overhangs grate.

Westinghouse Chain Grate Stoker

Coals best adapted for: Long-flaming bituminous.

Draft: Natural. Minimum, .15 inch; maximum, .6 inch.

Arch construction: Flat suspended.

Constructional features: Air in-leakage in front and rear prevented by arrangement of frames and baffles.

Operational features: Combustion rates up to 50 lbs. of coal per sq, ft. of grate surface can be obtained.

Coxe Traveling Crane

Coals best adapted for: Anthracite and anthracite-rice, coke-breeze, as well as bituminous.

Draft: Forced only.

Arch construction: Upward inclination toward rear.

Operational features: 175 to 200 per cent. load can be carried with 3-inch pressure in the ash-pit.

Next month we will take up general instructions for chain grate operation and will also discuss the various types of overfeed and underfeed stokers.

On and after January 1, 1919, the Sanford Riley Stoker Company and Murphy Iron Works will combine their sales policies so as to render the greatest possible service to all customers.

Offices will be located at Worcester, Boston, New York, Philadelphia, Pittsburgh, Buffalo, Cleveland, Detroit, Cincinnati, Chicago, St. Paul. Each office will handle both the sales and service for the Riley Underfeed Stoker and the Murphy Automatic Furnace.

The engineers at the various offices will not only help customers to select the equipment most suitable for their conditions or requirements, but will also be at their service at all times to show them how to get the most out of their present equipment.

Electricity; Its Relation to Matter and Energy

Matter and All Forms of Energy May Be Said to Be Different Manifestations of Electricity—Atomic Theory Has Been Extended to Embrace the Ultimate Nature of Matter

By J. F. HEFFRON

THE MYSTERY OF MATTER AND ENERGY

THE aim of knowledge, the philosopher Hegel tells us, "is to divest the objective world of its strangeness, and to make us more at home in it." This idea has actuated the world's thinkers throughout the ages, and in connection with the problem under review we find that one of the chief ambitions of the early Greek speculators was to discover some one primitive substance or principle from which the contents of the universe had been developed. It may be said that at present this problem of the structure of matter has increased in importance, until it has become, among physicists, the problem of problems.

But a few years ago the actual accomplishment of providing a satisfactory answer to so difficult a problem seemed so improbable that we find so eminent an authority as Professor Tait saying that "the discovery of the ultimate nature of matter is probably beyond the range of human intelligence."

The rapid developments that have taken place in the scientific world during the last two decades have, however, opened to our view a new universe entirely unknown to the author of this quotation, and with this new acquisition of knowledge the problem of problems has received a fresh impetus which has carried it so far beyond the point reached in Tait's day, it would seem in the light of present events, that an achievement which seemed an improbability to a former generation has become a probability for the living present.

The assertion has frequently been made that the conception the physicist forms of the basic stuff out of which the universe is made is fundamentally the same as that of the earliest philosophers. In a certain sense this may be true, but in the mind of the early Greeks, this speculation had practically no basis of exact observation of nature and was not supported by a patient mastery of natural law. The Greeks made many brilliant suggestions, which it should have been the task of later generations to test and develop by actual observation of nature, but they slighted this necessary task and concerned themselves instead with mystical considerations which hung like a veil between the mind and nature. Hence their physical speculations were for the most part vague, and trifling.

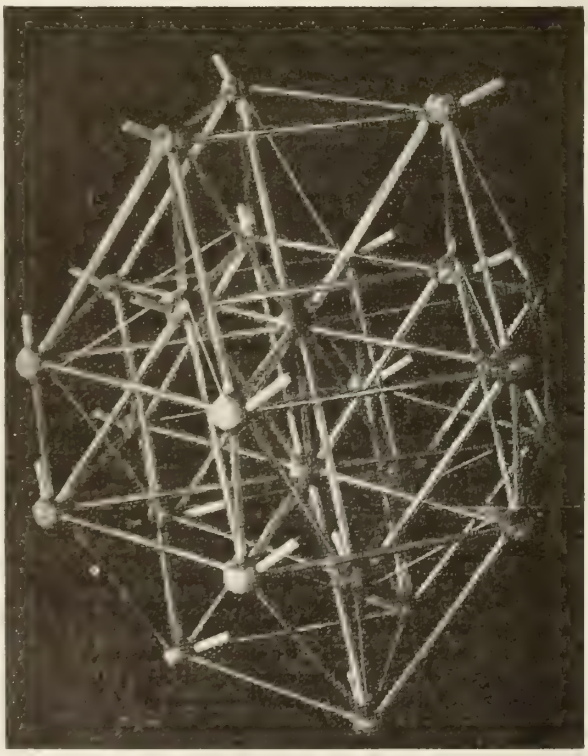


FIG. 2—DIAMOND MODEL

In our time each year sees science making additions to its already vast store of collected data, and it is to be expected that our ideas of the constitution of matter must present a very different aspect in the light of this new knowledge.

Aristotle's conception of the external world was that of a vast series of forms imposed upon a primitive stuff which underlay everything, being merely a sort of framework for various forms. The physicist of to-day, however, has learned the value of doubting an assertion until it has been checked and proven, and so continuously propose to himself the question whether there really is an "Urstoff" or "protyle" from which complex things have been evolved.

If we consider, for example, electricity, which appears a fairly concrete concrete thing, is it matter or merely a property of matter, or is it on the other hand "the" matter? Physics and chemistry as they exist to-day, can not be dissociated from it. Modern physical science can scarcely advance a pace without coming inti contact with some manifestation of electricity.

When, by a process of analysis, we follow matter back to its ultimate and so far irreducible expressions, we are ever brought face to face with clear evidences of electrical reactions. Less than twenty years ago the atom was looked upon generally as a simple piece of simple stuff. To-day, however, science is not so sure of the stability of the element, and although the atom will resist reduction beyond a certain point, science is impressed with its obvious duality. All atoms are regarded by science as having a definite structure. That is to say, every atom has a nucleus (or a circumference) of positive electricity, and a certain number of units of negative electricity—electrons. But since the electrons repel one another there seems to be proof that they cannot be arranged haphazardly in the element but must have a definite series of positions with regard to the positive nucleus, otherwise it would be impossible for them to preserve neutrality, viz., to maintain their respective positions. We see, therefore, that the simplest and smallest particle of matter of which we are at present able to conceive, possesses

a very real complexity of structure indeed.

Electrons

A discovery which has exercised a most profound influence on the development of physics in general and on our ideas of the structure of atoms in particular, was made in 1897 by Sir J. J. Thompson, when his experiments disclosed for the first time the existence of a new body having a mass of only 1/1845 part of that of the hydrogen atom. The lightest of the atoms composing the mass of the earth is that of hydrogen, and the heaviest that of uranium, which is 236.6 times heavier than the hydrogen atom, each of the atoms of the other elements weighing somewhere between these two comparatively narrow limits. This new body, at first called a corpuscle by its discoverer, and now known as an electron, is so very much lighter than the heretofore lightest known body, the hydrogen atom, that it could hardly be put in the same class with the atoms and called the atom of another element. The ratio of the mass of the hydrofien atom to that of the electron is 7.8 times as great as the ratio of the heaviest to the lightest atoms known.

In addition to this, a further unique characteristic distinguishes this body from the atoms of the elements. The electron is always associated with a negative charge of electricity, while the atoms of the elements in their ordinary condition in the earth appear to have no charge, or, if they have any, the negative is exactly neutralized by an equal amount of positive charge. A closer study of the atoms since the discovery of the electrons has made it probable that the atoms themselves are really made up of nearly equal amounts of positive and negative electrical charges, for ratio of the mass of the hydrogen atom under different conditions from the ordinary passive state and it is then found that they sometimes become charged with electricity. The electrical charge on an electron has been estimated in a variety of ways and measured with accuracy in others, and the remarkable fact has been established that in all these ways the charge upon one electron is equal to that upon any other, no matter where it is found.

Having established the constancy of weight of the individual atom and the constancy of charge on the electron, together with its small mass compared with the hydrogen atom, and coupling these facts with the observation that electrons appear to be universally present in all forms of matter, it has led naturally to the belief that the atoms themselves are structures, or assemblages of electrons grouped in different ways and in motion.

We have not the space in which to outline the very important consequences that followed in many directions from this fundamental discovery of the independent existence of the electron and its connection with matter. It was found by Kaufmann that the mass of the electron was not a constant, but increased with its speed, and from this result it was deduced that the electron was an atom of disembodied or condensed electricity occupying an exceedingly small volume whose mass was entirely electrical in origin.

The Constitution of Crystals

Science, we have stated, believes all atoms to possess a definite structure. As a striking example of what science has accomplished in opening up to our view a world incredibly minute, let us consider for a moment the form that matter sometimes assumes in the geometrical arrangement of the atoms in a crystal.

It is now well known that many substances under suitable conditions form crystals possessing a definite geometrical form. This arrangement of atoms in a crystal has been likened in plan to a thoroughly satisfactory garden city, and the form assumed is characteristic of the particular atoms or groups of atoms involved. Science has classified the great variety of crystal forms that are known and finds that each belongs to one or more of the 230 forms of point symmetry which are theoretically possible. It would seem that while considerations of symmetry are a sufficient guide to the classification of crystals, they offer no satisfactory explanation of the definite architecture of the crystals nor of the nature of the forces that cause the atoms or molecules to arrange themselves in such definite geometric patterns.

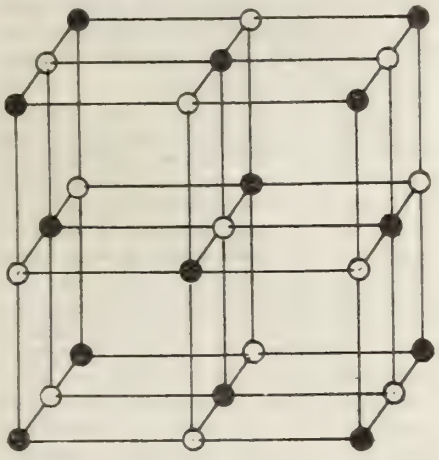


FIG. 1—MODEL OF ROCK SALT CRYSTAL

We are inevitably led to the conclusion that the atoms of the crystals are arranged according to a definite system, which is characteristic of the particular crystalline form, and the unit of structure is repeated indefinitely with continued growth of the crystal. In fact, had we no other evidence, the crystalline form of matter would itself point to the necessity of an atomic structure of all matter.

While many attempts have been made to explain the grouping of the atoms in a crystal little success has rewarded the labor expended in this connection, and it was only two years ago that Professor W. H. Bragg and his remarkable son, Doctor W. L. Bragg, applied a new and powerful method of attack on this problem.

The Braggs, father and son, have proven that the atoms in a crystal stand in regular order at definite distances apart and that these distances can be measured. They have been awarded the Nobel prize for physics in recognition of the importance of their joint work in this connection.

On account of the definite ordering of the atoms in a crystal it acts like an almost perfect optical grating. In this connection it might be well to point out that it is known that when Rontgen—X rays—are passed through a crystal, definite interference patterns can be observed. This of course shows that Rontgen rays must consist of the very short transverse waves akin to those of light. The Braggs have shown that the reflection, or rather diffraction, of Rontgen rays incident on the face of a crystal, afford a very simple method of determining the wave length of the bright lines generally present in an X-ray spectrum. By a study of the position and intensity of the spectra in different orders thrown on the crystal, it is possible to examine in detail the structure of the crystal, and to deduce the grating space, i.e., the distance between successive planes of atoms.

The subject, however, is so large and the discovery of this method of investigation so recent, that so far only a few of the typical crystals have been examined, but in all these cases we are able to obtain most positive evidence of the grouping of the atoms in the crystals. The results indicate that the atom and not the molecule is the unit of the crystal structure.

In Fig. 1 we have an illustration of the arrangement of the atoms in a rock salt (Na Cl) crystal as deduced by the Braggs. The sodium atoms are marked by little black spheres, the chlorine atoms by white spheres. It must be understood of course that the diagram is not drawn to scale since an attempt to accomplish this, owing to the relatively vast distances between the atoms would be almost impossible. The simplicity, however, of the crystal architecture is obvious, for all the atoms are equidistant. The structure of the diamond is slightly more complicated, but is one of great interest, since all the atoms in the diamond are of one kind, carbon. In the case of the diamond the atoms are all equidistant, but the general arrangement differs markedly from that of rock salt as may be observed in Fig. 2.

Having discovered a method by which we may determine the arrangement and distances apart of the atoms in a crystal, the next step will be to examine the intensity and type of the forces which are brought into play to keep the atoms in a state of equilibrium and relatively fixed in their places. The atoms are able to move to and fro about their position of equilibrium, and this is indicated by the effect of lowering the temperature of the crystal, for the intensity of the diffraction spectra increases as the amplitude of motion of the atom diminishes. The sharpness of the diffraction spectra, Rutherford tells us, suggests that the atoms are not only arranged at definite distances from one another, but that each atom is orientated in a definite position with regard to its neighbor.

Are Electricity and Matter One?

We have seen that in recent years methods have been developed for determining with precision certain attributes of any atom of matter. As a result of these investigations into the constitution of atomic structure it would appear that to-day science has reached the point where it inclines to the view that electricity and matter, together with the electron itself, have become one and the same thing.

Professor W. C. McLewis, of the University of Liverpool (England) in supporting this view, tells us that it has long been known that any substance which has been rubbed by a dissimilar substance exhibits the property of attaching to itself light particles of matter, such as paper or cork. The substance which has acquired this property is said to be electrified. Says Professor McLewis in "Science Progress" (London): "Since the attraction can be made to vary in amount (by altering the extent of the rubbing or by the use of different materials), we infer that there must be such a thing as quantity of electricity. Very early experiments also demonstrated that two pieces of the same material, when rubbed with a second substance, exhibited towards one another a certain repulsive force. On the other hand, each piece vigorously attracted the substance with which it had been rubbed in the first instance. Such observations lead naturally to the idea that electricity is of two kinds, called positive and negative respectively, and, further, that two pieces of matter carrying electricity of the same sign repel one another, while oppositely-charged pieces attract. Electrical charges of various amounts can be given to a piece of material and can be removed from it by suitable means."

If we bring sufficiently close together two substances highly charged with electricity, the one carrying positive electricity, and the other negative electricity, a spark may be observed to pass from one to the other, after which we find the materials possess no charge whatsoever, provided, of course, the initial amounts of the positive and negative charges were the same. It is possible, therefore, to discharge the electricity from a substance by neutralization with electricity of the opposite sign. It follows that an uncharged or electrically neutral substance does not necessarily contain no electricity at all. It may really possess equal amounts of the positive and negative kinds.

These early observations and deductions, however, do not give us much information about the mechanism of the process of electrification. The charges of electricity considered above reside essentially on the surface of the materials examined. The first evidence that electricity could be transported through the body of a solid was obtained when an electrical current was propagated through a wire by joining the two ends of the wire to the poles of a battery. That an electric current or electricity in motion exists under these conditions is shown by its effect on a small magnet suspended close to the wire, the magnet being rotated through a certain angle when a given quantity of electricity passes through the wire. The modern view of an electric current is that it consists of a stream of very material particles called electrons or corpuscles, each of which, as we have before pointed out, carry an electric charge. The sign of this charge has been shown in various ways to be a negative one. These electrically-charged electrons existed in the wire all the time. Their movement from one end to the other was brought about by joining the wire to the battery, one pole of which acts like a reservoir-head applying a certain electrical pressure or potential which causes the electrons to stream just as water streams from high pressure to low.

Since the electrons are thus shown to be present in the wire, they must constitute part of the atoms of which the wire itself is composed. In virtue of the fact that it allows electricity to pass through it, a metallic wire is called a conductor, its conducting power being due to the pressure of electrified particles distributed through its mass. But wire is by itself an electrically neutral piece of matter. It follows, therefore, that there must be exactly as many positively-charged particles as there are negative. We now know as a matter of fact that in a piece of metal some of the atoms have lost each an electron, so that the atomic residues are positively charged, the charge being necessarily the same in amount as that carried by the detached electron.

To quote Professor McLewis further: "Certain aqueous solutions, notably solutions of acids, bases and salts, likewise allow electricity to pass through them. They are also called conductors, but the mechanism of the process is known to differ from that in metals. In the case of solutions the carriers of electricity are particles identical in mass with atoms, of which some are charged positively, some negatively. The solution as a whole is electrically neutral, there being just as many positively-charged atoms, or ions as they are called, as there are negatively-charged ions. These ions are present all the time in such solutions. Their presence is shown when we cause them to move by putting on an electrical pressure or potential through the intermediary of electrodes. It is then found that the positive ions move in one direction, the negative in the opposite. Each ion is attracted towards the electrode which has electricity opposite in sign to that carried by the ion. When an ion reaches an electrode it gives up the electricity to the electrode, the ion becoming thereby discharged. It is now simply a neutral atom. Several things may happen to this atom; e.g., it may be deposited on the electrode as in electroplating, or it may go off in the form of gas, as happens when we electrolyze a solution of common salt and obtain gaseous chlorine at one of the electrodes —each molecule of chlorine, by the way, consisting of two atoms of chlorine which have united with one another after being discharged at the electrode—or, finally, the discharged atom may react with the water, as happens in the case of the sodium atom, giving rise to new reactions such as the production of hydrogen gas and caustic soda, the latter in the dissolved state. The essential difference between the conduction of electricity in a metallic solid and that in a solution is the fact that no chemical or other change is produced in the metal, whilst marked chemical changes may be produced in the solution."

Recent investigation has shown, however, that we are unable to add or subtract any amount of electricity we please. There is a certain limiting amount below which we cannot go. This amount is identical with that carried by the single electron. Electricity or, more properly speaking, electrical charge is built up of certain natural units, each unit being identical in magnitude with the charge on an electron. In other words, electricity must have a discrete structure, just as matter has.

Electrons constitute the cathode rays, a stream of very fine particles produced when an electrical discharge is passed through a gas at low pressure. The stream of electrons is made manifest by a glow in the Crookes tube, in which this phenomenon can be produced. The glow itself is due to the collisions of electrons with gas molecules, the latter suffering ionization. The stream can be deflected by a magnetic field, which shows that the particles composing it are electrically charged, and the direction of the deviation so produced indicates that on the usual convention of positive and negative electricity the electrons are negatively charged. In addition to the cathode rays, in which the electrons are produced from the matter composing the electrodes, we likewise meet with their production from radioactive elements, from the alkali and alkaline earth metals, and in general from any material which is excited in a suitable manner, that is by exposure of the material to short wave or ultra-violet light. It seems natural, therefore, to regard the electron with its discoverer, Sir J. J. Thompson, as one of the bricks of which atoms are built up.

The existence of the natural unit of negative electricity being demonstrated, the question arises: is there a similar unit of positive electricity? Professor McLewis says: "So far, the answer is in the negative. We have not yet encountered a natural unit of positive electricity which is indivisible and capable of independent existence as in the case of the electron. At the present time positive electricity really denotes absence of a certain amount of negative electricity, i.e., absence of a certain number of electrons. Thus, it is possible to remove an electron from an atom of sodium, leaving us with a positively charged atom-residue or ion. The quantity of positive electricity on the ion is necessarily equal in amount, though opposite in sign to that of the electron itself.

"The charge on the electron is the smallest quantity of electricity capable of independent existence. Similarly the electron itself is the smallest portion of matter capable of independent existence.

The primary quality of matter is mass, and an electron is the smallest mass of material conceivable. No smaller mass has ever evidenced itself, though it has been carefully sought for. It is known that the mass of an electron is one eighteen-hundredth part of a single atom of hydrogen, that is, the mass of an electron is 5 x 10.28 gram.

"This quantity is so very small that its removal from an atom (of hydrogen, say) leaves us with a positively-charged residue, the hydrogen ion, which possesses a mass practically identical with that of the neutral hydrogen atom itself.

"The remarkable conclusion at which we have arrived, is then this: the smallest particle of matter capable of existence is known to us only in the electrified state—an unelectrified electron is physically inconceivable—and the amount of electricity which it carries at the same time is the smallest quantity capable of existence. This 'coincidence' of matter and of electricity is exceedingly significant. In fact, Sir J. J. Thompson has shown that the whole mass of the electron is electromagnetic, that is, in the electron, matter and electricity have become one. It is impossible to define the one except in terms of the other."

Atom Worlds

The conclusion reached above may seem startling, but so are all comprehensive conclusions startling when first we come in contact with them, yet the evidence scarcely permits our doubting the correctness of the conclusions that have been reached.

Professor Tait once said that all matter is in a sense alive, "Life sleeps in the mineral, dreams in the vegetable, and wakes in man." The latest conclusions of science in this regard seem to force us to the conclusion that there is no such thing as dead matter, that instead, the keynote of the whole universe is life. Science has taught us that the world just about us is quite as wonderful and as puzzling as that great army of worlds that glitter eternally over our heads, ever commanding our admiration at night. Even the delicate, star-shaped snowflake that rests for a moment on our sleeve in its white purity before it melts, is just as much a riddle to us as the stars of the universe. It is the colossal scale of construction of the heavenly bodies that renders those flaming worlds so imposing to our sight.

We know that even the smallest formation on earth consists of innumerable millions of those minute bodies we have been discussing, and which we call atoms or electrons; we know also that these minute bodies are in incessant motion even in the stones that lie apparently motionless at our feet. Natural science and chemistry have shown us that in every body, be it ever so tiny and composed of what it may, there are so-called atom-suns and atom-planets of almost incredible minuteness which constitute the whole. If we look at a pebble, or even a grain of common salt with this fact in our mind, and fancy ourselves the size of a germ, or even thousands of times smaller, and then imagine ourselves existing on an atom-planet in our pebble, it is quite possible that we should perceive the millions of atoms, divided from each other by relatively considerable distances, in the guise of a sea of stars similar to the one in the heavens of man. The whole of the atoms forming the stone would represent a Milky Way system to the stone inhabitant; and great men have frequently expressed the idea that the inhabitants of an atom might take their atom-universe to be the only existing world, just as we believe the mass of suns and solar systems above to be the universe, beyond which there is but an inconceivable void.

Verily an odd, a bizarre idea? And yet, where is there a final measure for nature's great handiwork—what is really "great," and what "really small"? It is just as easy to imagine a world on a scale as vast as the atom-world is tiny, to whose inhabitants our Milky Way system, with its millions of suns would be naught but a small body, and its suns but atoms. Singular thoughts you say. and hardly supported by the evidence that science brings before us. Yes, that is so, and to indulge in such dreams is almost to sink into bottomless space, into a shadowy realm of misty fantasy, where all our philosophy, work and strife, our whole being, energy and desires fade into ashen grey immeasurabilities. The stern realities of this our life dissolve the grey mists of our speculations into nothingness and the strange dreams that sometimes oppress our senses accompanies them.

The world whose existence we sometimes almost argue away ever lies before us in all its pristine freshness, and it is the one foundation of our toil, our development, and our being.

ENGINEERS LIFE NOT A BED OF ROSES

Continued from page 345

About a week after this, No. 1 boiler (the old No. 1) was cut out, No. 2 having been out of commission for some time, and the two boilers pulled down. The electric service was carried on outside power, the engine from the 25 kw. set had been removed and placed on a new base to drive the CO_2 compressor. The exhaust from this engine heats the domestic hot water and also any heating during the summer months (heating during the summer months may sound somewhat extravagant, but in reality it is very necessary, as many of the patients are babies). Tearing the boilers down took about two weeks. One set of tubes was stacked in the boiler room and the drum laid on top, the other drum was hoisted up to the ceiling and hung on straps and the tubes were hoisted out of the boiler room and laid out on the street. The foundations were at once dug and the concrete run in, during which time the pumps were moved round and placed in their new positions. The feed water line is in duplicate. There had been trouble with corrosion in the feed water pipe in the old layout, so it was decided to make the new line of brass. From the feed pumps to the feed water filter the pipe is iron, but from the filter to the end it is all brass, with the exception of the Venturi meter tube. After leaving the Venturi tube the line branches to two 2 in. pipes. All the fittings are extra heavy, and the nipples are extra heavy cast brass. The threads, both male and female, were cleaned with gasoline, and turned and screwed together whilst hot, after which the joints were wiped on the outside. The result is an absolutely tight main, a thing which is very difficult to obtain with brass pipe and fittings. The two lines are valved at two or three points in their length, and are connected together with unions, so that it is possible to take either line down and still feed all three boilers. The extreme ends are valved and unions are left so as to allow for washing the boilers or filling without metering the water. One feed pump was already in service on No. 1 boiler.

As soon as the concrete was hard enough to work on, the two boilers were reassembled and bricked in. However, having room and brick enough, these boilers were given 22½ in. side walls and 18 in. back walls. This allowed the Nonpareil brick to be placed inside the red brick. The bond between the red brick and the Nonpareil brick was a header course of Nonpareil brick.

When this was done the steam services were shut off one Saturday night and the stub end of the old breeching torn down and rebuilt to the size of the new breeching. This ended the brickwork in the boiler room. The floor of the boiler room in front of the boilers was immediately laid, the concrete mixture being 1, 2, 3, with Master Builder's finish. The floor is sloped from one end and drains into the sump, having aa gutter close to the wall all round the boiler room.

As already mentioned, the middle steam nozzle on No. 1 boiler was blanked with one of the old 5 in. gate valves, so the expansion bend of 4 in. extra heavy Byer's pipe was put on and the installation of the steam main proceeded with. As was shown in the original plans, the engine main was 8 in., and the intention had been to connect this 8 in. pipe to the new main with a 6 in. connection. However, during the period of construction the 8 in. main began leaking in two or three places at the pipe threads, so it was decided to replace it with a 4 in. line. So a 4 in. line is now in place of the 8 in., and is carrying all the engine load.

As soon as the double battery was built the feed pipe was run across to No. 3 boiler and the main header was proceeded with. The connections for No. 3 boiler were blanked off with valves so as to reduce the time needed to get one boiler into service. As soon as No. 3 was under steam the steam connections to No. 2 were gone on with and then the auxiliary main was finished. Last of all the high pressure permanent mains were put in and connected. It was found advisable to provide a duplicate steam line for the main operating room service. This is made up of two 2 in. lines about 150 ft. long, and takes care of operating

room, kitchens, dish sterilizers in the wards, and also supplies steam to a 12 x 8 x 15 Duplex house and fire service pump. There is a reducing valve at the end of the line for kitchen service.

The safety valves were connected as shown in the new plans, using swing joints to take up the expansion to the outboard exhaust pipe so that there is very little noise either inside the plant or out, when the valves blow.

The bottom blow-offs were connected to the blow-off tank separately, using Byer's extra heavy pipe and extra heavy long turn fittings. The valves are a 2 in. bronze gate valve, supplied with the boilers, and a 2 in. Jenkins Y valve. All the other brass valves are Penberthy Company's, the iron body valves are Jenkins Bros. The blow-off tank is buried in the floor. It was painted with three coats of bituminous paint and placed on end on a concrete base and filled around with six inches of concrete, reinforced with ⅝ irons. The manhole of the tank is above ground. Each blow-off pipe has a suction tee on the end, which acts as a muffler. The discharge from the tank is a 3 in. pipe laid in a floor trench which acts both as pipe trench and floor drain. The boilers can be blown down thoroughly now without the men getting nerves over the job

The pipe covering was applied by the Armstrong Cork & Insulation Co., who, by the way, were the only contractors besides the building contractors. The tops of the boilers were covered with 1 in. high-pressure cement, then Nonpareil insulating brick on edge, 4½ in. thick, and a final coat of Portland cement. This has proved entirely satisfactory, the top of the covering feeling only warm to the hand.

As mentioned previously, a 2 in. Venturi meter was installed on the feed line, the recorder being in the chief engineer's office. There are also connected to the breeching of each boiler a thermocouple of a Thwing electric pyrometer, and a suction pipe for a Hay's flue gas analysis set. These are also in the engineer's office, so that it is possible for the engineer to get the feed water, the flue gas temperature and the CO_2 reading without going down to the boilers.

The stokers are driven by individual motors. These are 1 h.p. Roth, 220 v. d.c. motors, back-geared, using a rawhide pinion on to a cut steel gear. Roller chains are used to drive the stoker countershafts from the motor jack shafts. The countershafts are all in line and fitted with Clark couplings so as to allow them all tobe driven from one motor or engine if found necessary. S. K. F. ball-bearings are used on the stoker countershafts and on the ash conveyor and wherever dirty or dusty conditions prevail, and up to the present, which is now about two years from time of installation, have proved quite satisfactory.

This concludes the description of the remodelling of this plant. Any other points of interest which may develop will be made the basis of future articles.

AN AUTOMATIC ENCLOSED GASOLINE ENGINE

By FRANK C. PERKINS

The automatic four cylinder enclosed gasoline engine noted in the accompanying illustration was developed at Bridgeport, Connecticut, U.S.A. This four cycle marine motor is said to have maximum economy of fuel and upkeep. It has a bed consisting of a substantial one-piece iron casting, the lower half being octagonal in shape, cast integral with base and with large oil reservoir located in center. There are flanges on either side for bolting to the frame work, and a square groove through center of base for crank shaft bearings. The sub-base is fully enclosed and securely bolted to the bed, on top of which are mounted the cylinders, magneto and governor assembly. In the side of the sub-base are hand holes for ready access to make adjustments on connecting rod and crank shaft bearings, while the cam shaft is also located in sub-base.

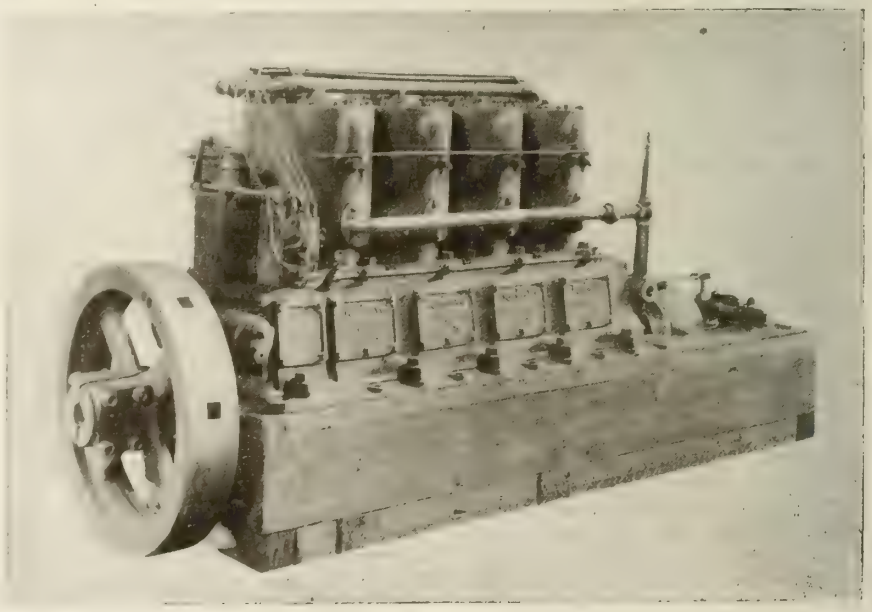
The square groove in the bed receives the crank shaft bearings and upper half of the gearing is reinforced by a steel plate onto which the cap adjusting screw rests. The bearing adjustment is made by turning an extra large octagonal head screw with keeper. This method permits adjustment without loosening the cap, which is thoroughly and permanently fastened in position. The keeper prevents this screw from working in either direction, and makes a quick and efficient adjustment.

The balance wheel is made with a split hub, bolted to crank shaft with four large bolts; also fastened with a large square key, insuring a perfect fit with no side motion or wobbling. Because of this split hub the balance wheel is easily taken off when necessary to do so. The crank shafts are hammered from solid blanks of high-carbon steel and one cam shaft only is used, of 40 carbon machinery steel and on the shaft are cams for operating inlet and exhaust valves. The solid bearings for this shaft are of cast iron with bronze bushing.

The cylinders are of L type, one-piece castings, having separate heads. The top face of cylinder is without cored holes, except one for circulating water, and this is outside, so that there is no possibility of water entering the cylinder. The cylinder heads are cast of the same iron as cylinders, with ample water space around valve hole covers. In coring the cylinder heads there is no opening whatever between the head and cylinder, except at the extension for water provided to meet extension in cylinder. The water circulation is of special interest. Extra large water space has been allowed in the cylinders, cylinder heads and around valve seats, the water being supplied by a plunger type of pump attached to the aft end of each engine and operated by an eccentric on the cam shaft.

The valves are of nickel steel, the end of the stem being threaded and provided with special clasping locknut for adjustment. The valves are so situated that they may be reground and seated without removing cylinder head. The valve head caps are of cast iron with air-cooled vanes to assist cooling spark plugs. The valve lifters are of the mushroom-head type, slightly off center of cams, and made of open-hearth steel, fitted into separate cast bushings and held securely to the sub-base. This type of lifter allows a great area of opening for a long time, which is most desirable.

The lubrication is provided by a large geared force pump, connected to the spacious reservoir in bed of motor. The question of oiling an engine thoroughly has been taken care of. The oil pump is located inside forward end of engine.



BACK VIEW.

Simple Methods of Determining Power Costs

Ability to Show Engine Room Performance by the Medium of Dollars and Cents Useful to the Engineer—How to Arrive at Costs When No Instruments Available—Easy Methods

By T. H. FENNER, Associate Editor

IT is by no means an unusual thing to hear a power plant engineer say, "It's no use trying to improve this plant. The manager won't spend a cent." In some cases this may be true, but in many more cases the reason is that the arguments put forward by the engineer fail to convince the manager or owner of the benefits to be derived from the outlay. This does not perhaps apply to the larger plants but to the average run of industrial power plants. The large power plant is usually well equipped to begin with, and costs are fairly accurately known. In the smaller plant very often the only costs that are known are the actual wages, coal, and stores as items of expense, without any definite knowledge of the proportion of power costs to manufacturing costs. This works to the disadvantage of the engineer, both as regards his chances of increased salary and his credit as a successful operator. It is therefore to the benefit of every engineer to study the elements of cost accounting so as to arrive at an understanding of his plant considered as a business proposition. That, after all, is what any power plant really is, whether it is a 50,000 h.p. central station or a 200 h.p. factory plant. The central station is manufacturing power to the public, and the factory power plant is manufacturing and selling power to the factory. The engineer should so endeavor to run his plant as to show a profit at the end of the year, and to do this he should know the actual cost of running each unit, main and auxiliary in his power house. If the office staff carries a cost accountant, the engineer, by getting in touch with him, can learn much that is of value to him, and incidentally can help the cost accountant to some extent in return. Where such a person is not employed it is up to the engineer to figure things out for himself. This does not mean that he should become an expert in costing, for that requires years of training, but a little study will well repay him by putting him in a position to be able to talk intelligently when the subject of new equipment and alterations come up. A little enquiry into the way that costs are figured will sometimes reveal things which are distinctly unfair to the power house. For instance, it is the practice of some companies to compare the weekly coal consumption against finished production. This may be a handy method of general results from the executive's standpoint, but it is grossly unfair to the engineer. For instance, we will take two consecutive weeks. The first week, the plant burns 20 tons of coal, and the factory produces 1,000 finished articles. The following week the plant burns 20 tons of coal and the factory produces 800 articles. Now this drop in production may be the result of any number of causes in which the power house does not figure, and the same amount of power may have been expended in producing the 800 articles as there was to produce the 1,000. For instance, there may have been 1,000 articles finished as far as any operations needing machine work are concerned, but still requiring some small additions, perhaps soldering, or transfer ornamenting, or final inspection. The same amount of power has been used but without producing the result. Now this comparison is probably brought to the engineer, who in many cases knows nothing about factory conditions, and he is informed that production costs are going up, and he is burning more coal than he should for the results obtained. He can't understand it, but in the face of the manager's figures,

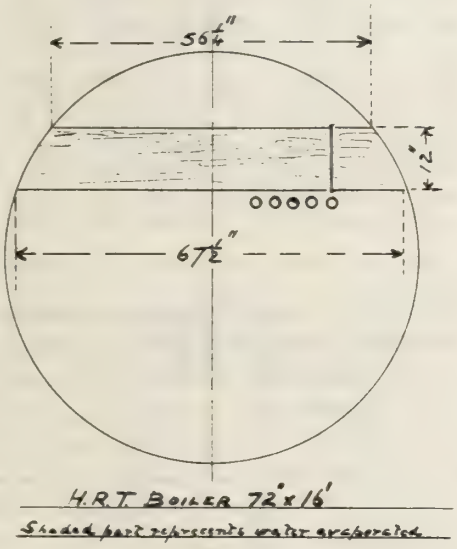


FIG. 1

against which he has none of his own, he is helpless. He feels that he is suffering from an injustice, but can not lay his finger on it. In another case, due to change of labor, breaking in new hands, inspector's carelessness, etc., a great deal more scrap may be made one week than another. In this case more power is used for less production. The engineer should always have figures to shew that his coal costs bear a definite relation to the power generated, and then production is a matter for the factor, and not for him. The means of obtaining these figures will vary according to the plant, as to its size and the provision or lack of suitable recording instruments. Let us take the simplest case, that of the plant containing one boiler, and an engine, driving a shaft through a belt, or direct connected to a dynamo. The auxiliaries in this plant will be limited to the boiler feed pump, and perhaps a vacuum pump connected to the heating system. The instruments available will be likely confined to a recording steam pressure gauge, and perhaps not even that. Here, it will be said, there is not much chance of getting particulars. However, they can be got. If the engine is driving a generator, which supplies current for power and light, the amount of power generated can be read off the switchboard instruments direct. Readings taken hourly or half hourly over a period of say two weeks will establish a very fair average of total load. By running the engine for half an hour at night with power off and all lights on, the total lighting load can be found, and the proportion of lighting load to power load determined. The next step will be to find the average consumption of coal per k.w. hour. To do this it will be necessary to run the boiler on the engine only. The methods to be pursued to do this will depend on the arrangement of the plant, but generally speaking a plant such as we are discussing will have one main stop valve on the boiler, and a branch leading to the heating system, and any steam used for process work is taken off this line. It is generally possible, by a little tact, to arrange with the several foremen or factory superintendent, to shut the steam off the factory for an hour or two, during the day, and if this can be done, the task is easy. Have the floor in front of boiler cleaned up, and the fire in good condition, when the time arranged for shutting off the auxiliary steam arrives. Then have two or three barrows of coal ready weighed, and start on them right away. Note the time, and keep the water level in the glass. When the time is up, weigh any coal that is left over, and deduct from the total used. Read the switchboard instruments carefully while the test is on. You then have a definite amount of coal for a definite amount of power, and the consumption per k.w.h. is readily arrived at. This figure includes the feed pump consumption, but as the feed pump must run whenever the boiler pump runs, this is quite legitimate. There is now to be considered the consumption on process work and heating. The best method for determining the consumption on drying ovens, etc., is to weigh the returns, and the method of doing this lies mostly with the individual engineer's ingenuity. A consumption meter devised by the writer is described in last month's POWER HOUSE. A tank placed on a scale and watched by a boy might serve, or the number of times a trap discharges in a given time could be recorded. The heating system pretty well takes care of itself in this way; that during the day time the engine exhaust is usually supplying the steam for heating, and any extra consumption at night or over week

ends observed in winter as against summer, can be put down to heating. However, if necessary, the heating consumption can be pretty accurataely figured. The total heating surface in square feet can be measured up, and then if 1.5 B.T.U. per sq. ft. surface per degree difference of temperature is allowed, the total quantity of B.T.U. required is given. Take steam at 2 lbs. gauge, and divide the total heat of one lb. of steam into the total heat required, and you have a fair estimate. This does not account for different exposure, but if it is figured on a 60° difference, it comes pretty close. It can be checked up by actual experiment. Take some Saturday afternoon or Sunday when no work is being done, and the heating system is running. Simply weigh the coal for an hour or two, and you have the coal consumption. None of these experiments have given us the evaporation per lb. coal. This can be obtained by direct observation, in a simple way. Fill the boiler till water is up to the top nut of the glass, and stop the pump, noting the time carefully. Wait till the water is at bottom nut, and note time again. Fill up and repeat several times, the more the better. Weigh the coal carefully during this time, and you have lbs. water evaporated per lb. coal actually.

Boiler 72" dia. x 16' long.
Length of glass between nuts, 12".
Width of top surfaace, 56¼".
Width of bottom surface, 67½".
Mean width =

$$\frac{\text{Top} + 4 \text{ times middle width} + \text{bottom}}{6}$$

$$= \frac{65.25 + 4 \times 63 + 67.5}{6} = 62.625 \text{ in.}$$

$$\text{Volume} = \frac{62.625 \times 12 \times 192}{1728} = 83.5 \text{ c.f.}$$

$$\text{Weight} = \frac{\text{Cub. Ft.} \times 62\ 5}{} = 83.5 \times 62.5$$

In this way the consumption of the engine can also be determined if there are no switchboard instruments to read. This does not give horsepower, but consumption steam per hour. If the plant has an indicator, then engine horsepower can be obtained, but we are taking the case of a plant with no instruments for measuring or with merely the switchboard instruments. Supposing our engineer to have been sufficiently interested in his job to make these simple tests, he can now go ahead and tabulate the results in a form that will be easily kept written up, and compared one week with another. We have determined the lbs. of coal required to produce 1 k.w.h. and also the coal required for all process work, and heating. We have also determined the evaporation per lb. coal. It is not pretended that these results are minutely correct, but they are quite close enough for the purposes required. A form drawn up as follows will enable the engineer to show exactly what he is doing, and also to see if any quantity increases suddenly from its normal. On the form should be shown the hours run per day and per week, average volts and amperes per day and week, kilowatts, and kilowatt hours. The coal consumption having been determined, the total k.w.h. generated × lbs. coal per k.w.h. gives consumption for power. The proportion of lighting load can be separated if necessary from this. As a matter of fact, where hourly or half hourly readings of the switchboard are taken, the increase due to lighting load can be plainly seen. Another column shows number of hours steam is being supplied to drying ovens, and as we have determined the steam consumption per hour, and also lbs. steam per lb. coal, the steam consumption divided by lbs. steam per lb. coal multiplied by number of hours gives consumption for this purpose. This would be

$$\frac{\text{hrs. run} \times \text{stm. cons. per hour}}{\text{lbs. steam per lb. coal.}}$$

Take another column for repairs carried out in the usual run of operation, and cost of same as nearly as can be ascertained. Keep a record of oil used per week in another column, with its cost. Summarize all these as shown, and you have detailed information regarding the operation of your plant. If any one item shows an unusual quantity you can investigate it, and find the cause. If there is a discrepancy between the amount of coal actually burned, and the amount accounted for by your form, look into it. The two quantities should check up nearly equal. In making up the cost per k.w.h. the first cost is determined by simply taking the lbs. coal burnt per k.w.h. as determined by test. Say that 4 lbs. coal is burnt per k.w.h. was the quantity determined. There are 2592 k.w.h. generated, 2592 × 4 = 10368 lbs. coal. Coal

Day	Hrs Run	Av Volts	Av Amps	KW	KW Hr.	Dry Kilns A	B.	C.	Total	Heating Day	Night	Tot.	Boiler From	To	Days
Sun	—	—	—	—	—	5	7	-	12	3	5	8	2	19	17
Mon	10	110	450	495	495	12	10	8	30	-	3	3	·	20	18
Tue.	10	116	400	46	460	7	6	9	22	-	5	5	·	21	19
Wed	10	112	415	464	464	5	8	4	17	-	3	3	·	22	20
Thu	10	110	425	467	467	3	10	8	21	-	3	3	·	23	21
Fri.	10	112	430	481	481	7	8	9	24	-	3	3	·	24	22
Sat	5	110	410	451	225	4	5	4	13	3	6	9	·	25	23
Tot	55	111	420	466	2594	43	54	42	139	6	28	34			

	Prev. Week	Consumed	On Hand	Cost
Coal	330000 lbs.	17149	312851	$42.87
Cyl. Oil	Gals 35	3	32	1.20
Eng. "	" 115	5	110	1.50
Coal "	" 60	1	59	.25
Grease	lbs. 75	1	74	.30
Waste	" 110	5	105	.60
Total				$46.72

REPAIRS

Unit	Material	Cost
Engine	5 Cln. Packing	10.00
Feed Pump	Set of Suction Valves	5.00
Vacuum Pump	— - -	
Heating Line	2 new gaskets	.75
{Reduced Steam Line	½" Valve	1.50

Summary of Costs

	Quantity	Price	Amount
Coal consumed for Power	10368 lbs.	$.5.00	$25.92
Do. Do. Drying	5453 "	"	13.63
Do. Do. Heating	1328 "	"	3.32
Oil consumed (charge to Power)			3.85
Repairs - Power			15.00
" - Dry Kiln			1.50
" - Heating			.75

REMARKS:- Water evaporated per lb coal as fired (by test) 8 lbs.
Steam generated = 137192 lbs.
Cost per 1000 lbs = 31.3 cts. fuel only.
Cost per KW Hr = 1 cent "
" " " " = coal & maintenance (wages - Repairs - depreciation etc)

Engine Room Report. Week ending March 25/18

James Smith Chief Engineer

FIG. 2

at $5 per ton is ¼ cent per lb. $10368 \times .25 = 2592$ cents.

$\frac{2592}{2592} = 1$ cent per k.w.h. Cost of steam per 1000 lbs. is taken by multiplying the total coal burnt by the evaporation figure obtained. Say this is 8 lbs. steam per lb. coal. Total coal burnt is 17149 lbs.

$17149 \times 8 = 137192$ lbs. steam.

$4287 \div 137.192 =$ cost per 1000 lbs.

or $\frac{1000}{8} \div$ lbs. coal per 1000 lbs. steam.

$\frac{125 \times 500}{2000} =$ cost per 1000 lbs.

In making up the cost per k.w. hour, including maintenance charges, etc., we must figure proportion of wages, etc., to be charged to power only, also depreciation of buildings, repairs, etc. In the kind of plant we are thinking of the engineer will probably do all his repairs himself. He will have a fireman all day, and the night work will usually be attended by the the watchman. As there will be no power at night this does not come in. We have a total amount of coal burnt, 17149 lbs. The proportion of this coal for power only is $\frac{10368 \times 100}{17149} = 60.4\%$.

We will say the engineer's wages are $25 per week, and the fireman $18, that is $43. The proportion of this amount to be charged to power will be $\frac{43 \times 60}{100} =$ $25.80. Repairs amount to $15. Oil to $3.85. The depreciation charges must be obtained from the office, in fact this item could be made up entirely by the office staff. However, taking the costs we have, we get—

Coal	$25.92
Wages	25.80
Repairs	15.00
Oil, etc.	3.85
	$70.57

$\frac{70.57}{2592} = 2.72$ cents per k.w.h.

The cost should be, generally, much less than this, but will, of course, depend on the efficiency of the boiler and engine. In the case of the engine driving the factory through a belt, the cost per horsepower would have to be taken, instead of that per k.w.h. The consumption per horsepower can be arrived at by use of the indicator, or if there is none, by using the measurement of water evaporated as already explained. With these quantities on file week by week, the engineer is able to meet the manager on ground which the manager is familiar with, and is able to shew if production costs are rising, whether the power plant is to blame or not. The initial determination may entail some work, but once obtained the figures are good unless some radical alteration in the fuel is made, or the equipment suffers deterioration. The figures themselves will show if efficiency is going up or down.

The Control of Large Amounts of Power

The Author, in a Paper Read Before the Institution of Electrical Engineers, England, Gave Some Interesting Information Regarding the Control of Large Amounts of Power and Use of Reactances

By E. B. WEDMORE

THE increasing use of electrical energy and its economical production require the use of larger generating stations and the linking together of existing plants. These extensions involve something more than the use of larger units and the adding of unit to unit. New conditions are reached. Factors which were negligible in smaller aggregations of plant become serious and limiting features.

The forces accompanying a disturbance are increased, and the total number of disturbances to which a system is subjected increases automatically with each extension; thus there are introduced new problems in the design of individual parts of the plant and in the arrangement of them.

There are no insurmountable difficulties in the design of larger machines, heavier cables, and of switchgear all able to cope with larger forces than have yet been met with, but a little consideration will show that the limiting features are to be looked for not only in the generating station, but in the distributing system. Stations and networks spread over a large area may be coupled together without necessarily seriously modifying the forces to be dealt with at any point, but a striking characteristic of developments now in prospect in the principal industrial areas is the increased concentration of large amounts of power in small areas. This inevitably follows the extended use of electricity for domestic purposes as well as for power production, and introduces new conditions not yet fully recognized.

One may double the size of a generating station with advantages in economy and without excessive expenditure on switchgear to take care of the conditions in the station itself; but for every machine, switch, and conductor in the main station there are large numbers of smaller machines, switches and conductors in the distribution system, and if these also are subjected to increased forces a very heavy expenditure may be necessary to ensure satisfactory service. Not only is this true as applied to an individual town, but similar conditions may arise where a large bulk-supply scheme is devised and a number of existing small plants are linked up to a common and larger source.

It is, therefore, very necessary to give full consideration to the new conditions introduced, and in this paper an attempt is made to anticipate the probable developments of the immediate future, and to show how the conditions arising may be dealt with.

The problem of maintaining continuity of supply and of protecting the plant is found to require for its solution the proper proportioning of the impedance of the different parts of the system.

There are also a number of practical details to be considered in the design and arrangement of the distribution apparatus and the feeder system.

The employment of current-limiting reactances has been already dealt with in a paper by Messrs. Faye-Hansen and Peck, but the subject has been treated afresh with the object of ascertaining the limiting features in the practical applications of reactance and presenting them in a form for immediate use.

Prospective Developments

Engineers have long since anticipated the possibilities of big developments in the use of electric power, and in its more economical production and distribution. The use of electricity in metallurgical and chemical processes is opening up a new field, but apart from new outlets there is scope all over the country for manifold extensions in the use of electricity for domestic and general industrial purposes.

In this report the design and use of alternating-current generators in units up to 50,000 h.p. and over has been discussed.

Stations have been laid down for an ultimate output exceeding 200,000 k.v.a., and this figure has been approached in installations already in operation.

In this paper the station with 100,000-k.v.a. output is taken as typical, but consideration is also given to the linking together of such stations, and of smaller sources of power such as waste-heat stations and existing generating stations of limited capacity.

As for the size of generating units, it will be seen in what follows that the general use of generator units of the order of 50,000-k.v.a., output would

throw excessive stresses on distribution apparatus and small plant generally unless special precautions are taken. There are, however, other considerations also which point to the use of smaller units.

In the first place the question of spare plant has to be considered. We have to consider that a large unit may fail at a time when another similar unit is temporarily out of commission, pointing to the provision of two spares of the largest size. This is increasingly important on large systems where more and more services become dependent upon the electric supply, and where the load factor is high. The time required to restore to service units of this magnitude that may have been put out of commission is much greater than in the case of units with which most of us are familiar.

This and the fact that such large units could not be employed economically except on large interconnected systems with a total output greatly exceeding 100,000 k.v.a., all supports the contention for the general use of machines of 20,000 to 30,000 k.v.a.

Means must be found to ensure maintenance of voltage at all parts of the system and to prevent the disturbance of running machinery.

Means must also be found to limit the power which can be concentrated at any point on a fault occurring, and to a figure not calling for excessive expenditure in the construction of individual pieces of apparatus.

That special steps are necessary will be abundantly clear when it is stated that if practice hitherto prevailing is followed in the extension of existing plants, switchgear on consumers' premises may be subjected to forces comparable with those now met with in large generating stations.

Let us assume a generating station of 100,000 k.v.a. output feeding a large town by stepping up to 20,000 volts and transmitting 20,000 k.v.a. to each of five centres at a distance of about 3 miles. The generators and step-up transformers may be taken to have 14 to 15% short-circuit reactance; thus there will be liberated 700,000 k.v.a. on a fault near the station. Allowing 4% reactance in the step-down transformers, and allowing for feeder impedance, there will be 200,000 to 350,000 k.v.a. liberated on a fault on the busbars at a distributing centre according to whether or not these centres are interconnected.

If now the pressure is stepped down to 6,000 volts for distribution through 0.1 sq. in. feeders a mile long, the additional impedance of individual feeders will not limit the energy liberated even at the remote end to below 100,000 to 150,000 k.v.a., and this figure may be doubled by feeders in parallel. Thus not only will all switches on consumers' premises within a mile radius have to meet these severe conditions, but all conductors or pieces of apparatus will be subjected to the corresponding mechanical forces and heating effects.

It must be remembered, too, that these figures of 100,000 to 150,000 k.v.a. represent values which will not be materially reduced before the switches open, even though delayed as much as a second, as the generating plant is much better able to maintain this output than it can the heavier short-circuit currents met with close to the source of supply (see Fig. 1).

If the plant was originally a small one supplying at 6,000 volts and were to be extended to the same capacity of 100,000 k.v.a. output, there would not be the limiting effect of the step-up transformers, and the maximum short-circuit near the source would be 1,000,000 k.v.a., and at the end of parallel 0.1 sq. in. feeders one mile from the distributing centres 400,000 k.v.a.

This figure is about 20 times what commercial switchgear on consumers' premises will withstand without support. It would raise the temperature of the feeder conductor at the rate of 2,000 degrees C. per second, and this fault in an individual consumer's premises would pull down the voltage throughout the whole system.

By suitably proportioning the impedance of the different parts of the system, and by the employment of quick-acting selective protective apparatus, we can, however, both limit and localize these disturbances.

Limitation by Sectionalizing and the Employment of Reactance

By the crude method of sectionalizing the plant we reduce the conditions to what they would be on small plants, and this has been done extensively. The object, however, of large combinations of generating plant is economy in production, and this is obtained by an interchange of energy between the different sections, which enables larger and more economical units to be employed, reduces the number of spare machines necessary, and improves the load factor. Thus it is interchange of power we have to provide for.

On a large plant we can to a considerable extent regain the easier conditions of small plants by dividing the system into sections and paralleling these through reactances. This will admit of the interchange of energy for purposes of economy, and at the same time limit both the interchange of energy during severe faults and the disturbance of sound sections.

The employment of reactances for interconnecting, whether between busbar sections in an individual station, in trunk mains between busbars in different stations, or in interconnectors between adjacent parts of the distributing system, has the distinctive merit that, so placed, they carry only that portion of the load being transferred from section to section, and thus waste a minimum of energy and do not interfere with regulation.

Reactance may also be employed in series in any part of the system, but, so used, the reactance will have to carry the total load fed to that part.

Wherever employed the reactance limits the disturbance in all parts of the system beyond it and tends to isolate the disturbance from all parts nearer to the source of supply.

The desired results will be most economically obtained when interconnecting reactances are employed, but if the inherent reactance of the circuits, transformers, etc., is insufficient adequately to localize the disturbance, the employment of a certain amount of artificial reactance in series will be necessary also.

The different methods of employing reactance with their advantages and disadvantages are set forth in the schedule given herewith.

The conclusions in the schedule are now to be explained and illustrated.

In discussing the use of reactance it is found convenient to rate the reactance in terms of the percentage reactive voltage-drop it will give on the full-load rating of the part of the plant with which it is associated. Just as we speak, for example, of a transformer having a reactance of 4 per cent., so we speak of a busbar section reactance of 10 per cent. based on the current rating of the section. This rating of reactances is considered further along.

Limitation by Generator Reactance

Reactance may be employed at the source, viz., in or with the generators themselves, where it need not interfere with the losses. It is anticipated that this method will be carried further than it has been hitherto.

It is quite feasible to build machines economically with much larger internal reactance than has been common practice hitherto. The inherent regulation will not be so good, but the normal load fluctuations on large plants with large machines are relatively slow, so that no difficulty arises in practice.

Some of the reactance may be external to the machine. Whether the reactance be internal or external the busbar voltage is maintained by hand or automatic control of the field.

An external reactance serves to limit the short-circuit current which can flow into a faulty machine, but this provision should not be necessary. After provision has been made on a large system for the proper protection of supply and of the plant generally, it will be found that the generator will not be subjected to excessive forces. From this standpoint it is better to put the reactance into the machine.

Most generating sets will be used in conjunction with step-up transformers, the machine and transformer forming one unit. In this case the transformer reactance will be additional to that in the machine and will add, say, 4 per cent., but there is no reason why the transformer should not be designed to give more than this, and at a lower cost than that of employing a separate external reactance.

There is a practical limit to the extent to which satisfaction can be obtained by the use of generator reactance, and that arises from the fact that reactance in this position serves only to reduce the magnitude of the short-circuit currents and does nothing towards maintaining the supply voltage in the rest of the system in the event of loss of voltage by a fault at a point. In order to maintain the supply voltage, we must employ a proper ratio of busbar reactance to generator reactance and of feeder reactance to generator reactance; and as it will be found that the amount of busbar or feeder reactance which can be used is limited on account of interference

SCHEDULE.

CONTROL OF LARGE AMOUNTS OF POWER BY USE OF REACTANCE

Requirements.

To limit the area affected by a disturbance at any point.

To limit the power concentrated at any point on a fault occurring.

Characteristic.

Wherever employed, reactance limits disturbance in all parts of the system beyond it, and tends to isolate disturbance from all parts nearer to the source of supply.

Means.

A—*Utilization of inherent reactance.*—Advantages: Saves cost of special reactances and does not add to resistance and consequent losses.
Limitations: Where the load is at all concentrated. cannot be carried far enough for economical reasons.

B—*Utilization of artificial reactance.*—Advantages: Can be located where most effective.
Limitations: Must not interfere with regulation.

Method of Employing Reactance in General.

I—*Reactance in series.*—Advantages: Easy to apply.
Limitations: Carries total load fed to part protected.

II—*Reactance in parallel.*—Advantages: Carries only portion of load transferred. Wastes less energy.
(Sectionalizing or interconnecting) Interferes less with voltage regulation.
Limitations: Requires sectionalizing of distributing system. Is not sufficient alone if good regulation maintained.

Methods of Employing Reactance in Series.

(*a*) *In generator.*—Advantages: Cheaper. Does not hinder voltage control under normal conditions.
Limitations: Considerations of design of machine. Must not swamp isolating effect of busbar and feeder reactances.

(*b*) *Added to generator.*—Advantages: Limits current which can flow into faulty machine.
Limitations: Increased cost and space required. Must not swamp isolating effect of busbar and feeder reactances.

(*c*) *In feeder.*—Advantages: Gives best protection to rest of system.
Limitations: Interferes most with voltage on part protected.

(*d*) *In group of feeders.*—Advantages: Minimum number of reactances required. Protects feeder switchgear.
Limitations: Involves several feeders where fault in one.

with regulation, it follows that the generator reactance is also limited if a proper ratio is to be maintained between the two.

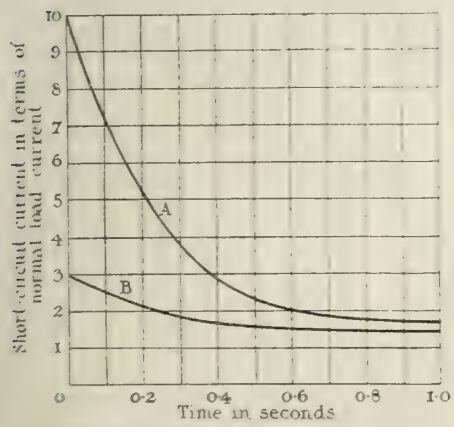
We are concerned with the magnitude of the rush of current which follows the development of a fault. The heavy current demagnetizes the field and reduces the current values, as indicated in Fig. 1, but at the first instance the field is sustained by eddy currents set up in the magnetic circuit, and the current is limited solely by the reactance of the windings.

Limitation by Feeder Reactance

The employment of artificial reactance in series with the load leads in any case to waste of energy and impaired regulation, and is, therefore, to be sanctioned only where no better solution is available.

Resistance and reactance in an individual feeder anywhere in the system affect disturbances in the following manner:—

(1) The feeder impedance helps to



A=Dead short-circuit
B=Short-circuit limited by reactance in circuit

FIG. 1—SHOWING DECREMENT OF SHORT CIRCUIT CURRENTS IN TYPICAL GENERATOR.

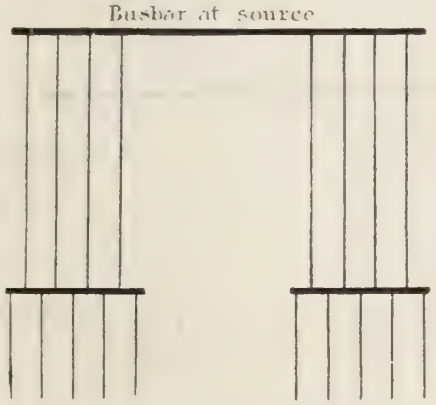


FIG. 2—ARRANGEMENT OF FEEDERS. GIVING LOW INHERENT IMPEDANCE.

maintain the voltage on all parts of the system connected on the source side of the impedance.

(2) The feeder impedance assists in limiting the magnitude of the fault current at any point beyond the impedance.

(3) The voltage at all points beyond the impedance is equally disturbed.

If artificial reactance is to be employed, functions (1) and (3) call for the reactance to be located as near as possible to the point to be protected, whilst function (2) calls for the reactance to be located as near as possible to the source of supply.

Inherent reactance may be utilized, however, in such a way as to serve all three functions, as may be seen by comparing Figs. 2 and 3. Fig. 2 shows power fed through eight feeders to two substations and distributed through 10 outgoing feeders. In Fig. 3 the same eight feeders are divided into four groups of two and there are 16 outgoing cables of smaller section.

It is clear that in the latter diagram we have not only increased the number of sections and thereby reduced the area affected by a given fault, but we have doubled the impedance between each substation and the main station, and greatly increased also the impedance in the outgoing feeders.

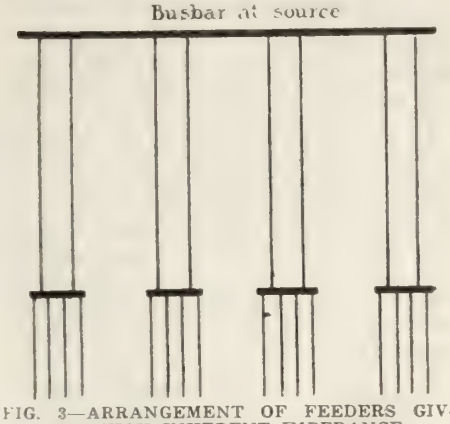


FIG. 3—ARRANGEMENT OF FEEDERS GIVING HIGH INHERENT IMPEDANCE.

From the practical standpoint, Fig. 4 may require more cables by way of spares and a larger staff of attendants, but there is an offset in that the substations may be placed nearer to the demand and the average length of the feeder reduced. Moreover, cable can be reduced by interconnecting stations if appropriate protective apparatus is employed, so that in fact subdivision can be pushed a long way without increased cost of distribution, and with great advantage from the standpoint of continuity of service.

Thus by separation of feeders we can introduce more impedance both near the source and near the parts to be protected.

At the same time if the total section of copper remains the same (neglecting the slight impairment of load factor) the losses are not increased and the regulation is unaffected.

In large systems where step-up and step-down transformers are employed, these introduce further inherent reactance, so that in practice, except where there is considerable concentration of load, the use of artificial feeder reactance should be avoidable.

Where artificial reactance is required, it should be put as near as possible to the point to be protected. Thus in Fig. 4 reactance should be inserted at "X" only if it is necessary to protect the substation plant. For the protection of consumers' apparatus position "Y" is the best, as this gives better voltage regulation.

Fig. 4 represents a distributing system with series reactance inserted at the source end and at distributing centres, in successively smaller branches of the system. We have to consider the relative merits of the two positions. The reactances at X and Y respectively carry each one-quarter and one-sixteenth of the total output. If we require to protect the individual feeders and their equipment, should we select the position X or Y? For equal protection we shall require equal ohmic value in the reactance in either position, so that the k.v.a. ratings will be proportional to the square of the current capacity. The cost of the reactances will be very roughly proportional to the square root of the k.v.a. rating, so the total cost of the reactance equipment will be of the same order for either position.

The effect on the working conditions, however, will be very different, for reactance at X will give four times the drop and waste about four times the energy of reactance at Y.

The use of series reactance interferes with the regulation to an extent which

may be quite serious for lighting unless the energy is transformed to continuous current. The permissible pressure drop ultimately decides the practicability of the proposition.

If the power factor of the load is 80 per cent., then the magnetizing component is 60 per cent. and a 10 per cent. reactance will cause a 6 per cent. drop, and for other sizes pro rata.

In the case cited where the inherent reactance limits the kilovolt-amperes on short-circuit to 100,000 to 150,000 k.v.a., for example, this figure can be reduced to 20,000 k.v.a., or well within reasonable limits for consumers' premises, by the employment of series feeder reactance introducing potential drops as follows on a load circuit of 80 per cent. power factor:—

Load.	Potential drop.
1,000 k.v.a.	2½ per cent.
2,000 k.v.a.	5 per cent.
5,000 k.v.a.	12½ per cent.

In this case the potential drop could be reduced only by improving the power factor, or by the use of less reactance and switches of larger rupturing capacity.

We shall see, however, that much better conditions can be obtained by a proper use of reactance at the generating station, in the machines, busbars, or feeders as required, to reduce the short-circuit currents at the substations.

In new large power stations it is wise to provide space for the possible addition of feeder reactance.

We conclude that inherent reactance should be utilized as far as possible, and additional artificial reactance should be used only to ensure that disturbances should be sufficiently localized and plant adequately protected against excessive stresses.

These two conditions require a similar distribution of reactance in the system, but the results obtainable from the standpoint of voltage disturbance depend upon the kind of plant employed.

Limitation of voltage disturbance:—We may consider three typical cases, viz.—

(a) Distribution for lighting, through transformers.
(b) Distribution through induction-motor-driven sets.
(c) Distribution through rotary converters and synchronous motors.

(a) Where the distribution is by transformer the voltage must necessarily be disturbed to an extent visibly affecting the lighting on sections adjacent to the faulty one, but the disturbance will last only until the protective gear has isolated the fault.

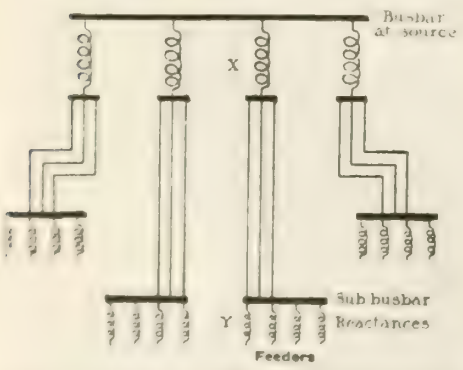


FIG. 4 LOCATION OF FEEDER REACTANCES.

(b) In the case of induction motors a heavy fall of voltage is not serious so long as the fault is cleared in about 2 seconds or less, which lies well within the capacity of modern protective apparatus.

(c) In the case of rotary converters and synchronous motors, we have only approximate data, but can form a good general idea of what is required. A rotary converter running fully loaded will not be pulled up if the voltage falls to one-third or one-quarter of normal, but the machine is sensitive to sudden changes of phase angle. The reactance which limits the voltage drop also reduces the phase-swinging. Faults remote from the source present no difficulty, but we cannot employ sufficient reactance in outgoing feeders in the generating station to prevent the voltage being pulled down on a fault. It is likely, however, that the machines on sound

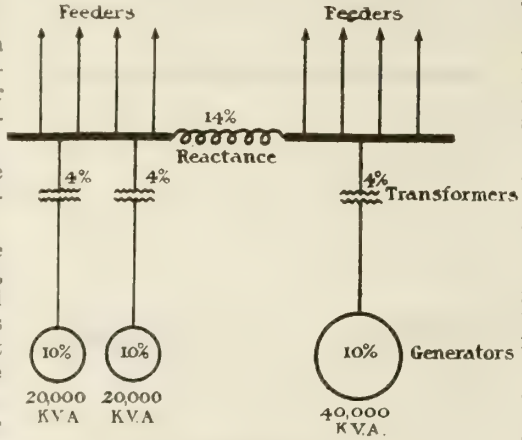


FIG. 5 ILLUSTRATION OF RATING REACTANCES.

circuits will not be disturbed if the voltage does not drop below 50 per cent. of normal at the source. At the first instant the drop will be much less than this, but the generators will be quickly demagnetized and the voltage will approach the limit in less than a second.

If the generators have a short-circuit reactance of 15 per cent. and are furnished with potential regulators, it is likely that they would require a feeder reactance of 33 per cent. based on the generator rating to meet this condition. If now there are 10 feeders (and about the same proportion of spare feeders and spare machines), this requires at full load a feeder reactance of only 3.3 per cent. based on the feeder rating. At times of light load, however, when, say there is only one machine running, the feeder reactance would have to be proportionally higher, so that it is clearly not possible fully to protect the rotary converters all the time, even with reactances in each outgoing feeder.

It should be borne in mind, however, that in modern practice where the mid-point of the system is earthed, all faults to earth will be cleared without serious voltage disturbance, and the large majority of cable faults in particular are of this character. Moreover, the above figures apply only to the worst possible

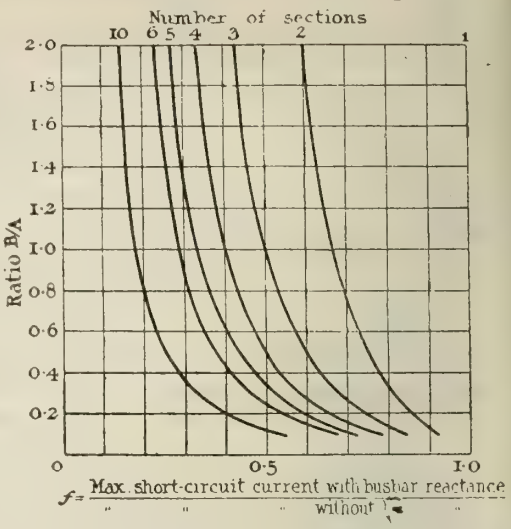


FIG. 6—REDUCTION OF SHORT CIRCUIT BY EMPLOYMENT OF REACTANCES IN STAR.

case, viz., that of faults close to the source.

There is no doubt that the conditions are further greatly improved by the employment of quick-acting switchgear able to clear a fault in one-fifth of a second or less.

Use of feeder group reactances:—A group of feeders running between two common points may be treated as a group and have a common reactance. The number of reactances may be reduced in this way and further protection given to the switchgear controlling individual feeders. The reduction in cost of reactances is partly offset by the additional cost of the necessary group busbar and group switchgear.

Where feeders are grouped only at the source it is better to employ separate feeder reactances rather than group reactances, so that disturbances on any one of the sections fed shall be isolated from the others. In such a case, however, some group reactance may be employed on occasion to protect the feeder switches, as, for example, in incorporating existing feeder switchgear in a larger scheme.

Limitation by Busbar Reactances

The method of employing busbar reactances is intimately connected with the subject of the design and arrangement of the busbars themselves. It is sufficient here to recognize that there are two distinct methods of connecting up the reactances, known respectively as the "star" and "ring" methods and illustrated in Figs. 7 and 8 respectively. It is shown in the Appendix that the star design is generally preferable after considering the operating conditions. Either system will give about equal protection, but here again the advantage in the extreme case lies with the star design.

Sectionalizing the distribution system: It is the system which has to be sectionalized and not the main busbars alone. Clearly the sectionalizing of the busbars is of very little value if the sections are

tied solidly together outside the generating station. This requires that there shall be a correspondence between the busbar sections and the sections of the distributing system. The ultimate plan must as far as possible be pre-arranged from the commencement so that adequate provision may be made in each section of the busbar for the ultimate equipment required by the corresponding section of the distributing system.

The problem as it applies to the main switchboard is simple in comparison with the problem as it applies to the distributing system. It is not possible to lay down general rules for the latter, as the requirements depend so much upon local conditions, but it is essential to have a definite plan in view and to consider each addition to the plant from the point of view of the requirements of the final scheme. It is not necessary actually to sectionalize the system from the commencement into the number of sections which will ultimately be required, but details should be arranged so as to permit of a section being divided into two when it exceeds the predetermined limit. The alternative course will result not in immediate disaster, but in a gradual lowering of the factor of safety until serious trouble points to the cause and necessitates a far more costly remedy. So far as it affects the main station switchgear the problem consists principally in arranging sufficient space for additional circuits on a section and for the ready transfer of circuits from one section to another as the system grows.

Current-limiting Effect:—In considering what results can be obtained by the use of busbar reactance the subject of the transfer capacity required is important, because for a given voltage difference between sections the amount of current to be transferred limits the amount of reactance which can be employed and, therefore, the amount of protection obtainable by this method.

In investigating the limiting effects of different combinations of reactances, the reactance associated with an individual machine, whether internal or external, or in the step-up transformer, is treated as one item, described as generator reactance and indicated by the letter A. The busbar reactances, however connected, are indicated by the letter B. Thus in Fig. 5 A = 14 per cent., B = 14 per cent., and B/A = 1.

Fig. 6 gives a good idea of the results obtainable by the introduction of busbar reactances. The short-circuit current, on the assumption that no reactance is employed, is taken as unity, and the curves show how much this figure is reduced by the employment of busbar reactance. It will be seen, for example, that with B/A = ½ and with five busbar sections the short-circuit currents are more than halved. From the data there given it will be seen, for example, that with five busbar sections, with generator reactance of 17 per cent. and busbar reactance of 6 per cent., it is possible to keep the maximum value of the short-circuit k.v.a. down to three times the plant capacity, instead of 10 times the plant capacity, a common figure at the present day. That is, we build a 100,000-k.v.a. plant in which the conditions will be no more severe than in a present-day 33,000-k.v.a. plant.

Provision of spare machines:—The arrangement of spare plant will be found to be a question which vitally affects the design and use of reactances. If we plan for five machines clearly we cannot employ six busbar sections, or a symmetrical arrangement of three, and if we use four the fifth machine cannot conveniently be connected up as a spare to any one section.

This could be done through the auxiliary busbar, but not without involving complicated switching operations and seriously limiting the flexibility (the measure of flexibility is roughly the number of different simple ways in which one can meet usual and unusual conditions of service).

The number and size of machines should preferably be determined so that with adequate provision for spares the machine capacity will be divided equally between the sections, the number of sections being such as to give the required degree of protection whilst suiting the local conditions.

If the machines are not uniformly distributed as to capacity amongst the sections, certain sections will give much higher short-circuit currents than others, and this cannot well be remedied by using higher reactances with these sections, as the permissible reactance is limited by other considerations.

For reasons previously given it is assumed that there will generally be two machines in excess of the total corresponding to the maximum output; thus, of eight sections, two will be spare. There may be four busbar sections with two each, but the total maximum output will be that of six, and the total maximum output of a section that of 1½ machines. This exercises a large influence on the reactance rating, as it limits the transfer of current necessary.

Transfer of Power:—We desire to transfer power from section to section for purposes of economy, and this transfer may amount to 20 to 70 per cent. of the capacity of a section. This transfer may take place in either direction. For it to take place at all it is necessary to set up a difference of potential between sections, whereas working conditions require that the sections shall be at substantially the same voltage.

The transfer of the energy component of current through the reactance will not require a potential difference greater than is necessary to overcome the ohmic resistance, and this will be some fraction of 1 per cent., perhaps one-fifth with 10 per cent. reactance between sections. To transfer magnetizing current, however, will require a relatively large potential difference, and this will be in fact the reactance drop at the current in question, and this proves to be the limiting feature.

For example, with 10 per cent. reactance between sections, the difference will be 1 per cent. if the magnetizing current transferred is numerically one-tenth of the rated current capacity of a section. That is to say, to transfer this amount of magnetizing current would require that the busbars should be run respectively one-half per cent. above and below normal.

If the load is transferred at 80 per cent. power factor the magnetizing component will be 60 per cent. of the k.v.a. transferred. If therefore this magnetizing component is limited to one-tenth of the section capacity, the load transferred would be limited to 10/6ths of this figure, i.e. one-sixth of the section capacity, whereas we want to transfer perhaps four times this load.

The obvious solution appears to be to transfer the load at a higher power factor and to make up the shortage of magnetizing current by supplying it from the machine or machines tied to the section in question.

In pushing the use of reactances up to the limit it is necessary to utilize this method of maintaining the voltage, but it is not one which should be used under daily working conditions. It involves underloading one or more of the machines, extra care in running adjustments, and in case a fault occurs on the section receiving current, the voltage drop will be greater.

Results Obtainable:—The practical possibilities of this method of control are investigated in Appendix IV., and it will be found that ample protection can be obtained by the use of generator and busbar reactances under normal working conditions without resorting to transference at a power factor above that of the load; but this method can be advantageously resorted to under emergency conditions.

As a result of this investigation it is possible to furnish a table showing results obtainable under practical working conditions, and this has been done in the Appendix.

There is a preponderance of advantage in the use of two unit machines per section, or, of course, the equivalent in smaller machines. If larger units are installed later than were originally contemplated, these may be of twice the size and arranged one per section with suitable reactances and without materially affecting the short-circuit factor.

As a typical example of what can be done we may take the case of five sections and two machines per section. Here with generator reactance of 15 per cent. and busbar reactance of 7½ per cent. we get a short-circuit factor of 3.3 on the maximum output. That is, a station rated to give 100,000-k.v.a. output would give 333,000 k.v.a. on a fault between phases near the source.

Protection of Live Load on Sound Sections:—In considering the use of feeder reactances it has been shown that where a phase-to-phase fault occurs on the load side of the reactance, it is possible to maintain sufficient voltage on the source side of the reactance to keep rotary converters in step.

From what has been said above, it is evident that the use of any such reactances would seriously limit the energy transfer that could be made with any reasonable voltage difference between sections, so it is not possible by this means alone completely to protect running plant attached to sound sections. At the same time it is clear that the use of busbar reactances operates in a helpful direction.

The figures given apply to the sustained short-circuit values. At the first instant, and before the generator voltage is seriously reduced by armature reaction, the busbar reactances have a much greater effect on the voltage on the sound sections.

To be continued

The MacLean Publishing Company
LIMITED

(ESTABLISHED 1888)

JOHN BAYNE MACLEAN - - - - - President
H. T. HUNTER - - - - - - Vice-President
H. V. TYRRELL - - - - - - General Manager

PUBLISHERS OF

POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power, and to the design and operation of Refrigerating Machinery.

B. G. NEWTON, Manager. A. R. KENNEDY, Editor.

Associate Editors:
W. F. SUTHERLAND J. H. RODGERS (Montreal) T. H. FENNER

OFFICES

CANADA—

Montreal—Southam Building, 128 Bleury St., Telephone Main 1004.
Toronto—143-153 University Ave., Telephone Main 7324.
Winnipeg—1207 Union Trust Building, Telephone Main 3449.
Eastern Representative—H. V. Tresidder.
Ontario Representative—S. S. Moore.
Toronto and Hamilton Representative—J. N. Robinson.

UNITED STATES—

New York—A. R. Lowe, 111 Broadway, New York, Telephone 8971 Recto:
Chicago—A. H. Byrne, 900 Lytton Bldg., 14 E. Jackson Street, 'Phone Harrison 1147
Boston— C. L. Morton, Room 733, Old South Bldg., Telephone Main 1024

GREAT BRITAIN—

London—The MacLean Company of Great Britain, Limited, 88 Fleet Street, E.C., E. J. Dodd, Director, Telephone Central 11960. Address: Atabek, London, England.

SUBSCRIPTION RATE

Canada, $1.00; United States, $1.50; Great Britain, Australia and other colonies, 4s. 2d. per year; other countries, $1.50. Advertising rates on request.

Subscribers who are not receiving their paper regularly will confer a favor by telling us. We should be notified at once of any change in address, giving both old and new.

Office of Publication, 143-153 University Avenue, Toronto, Ontario.

Vol. XI. DECEMBER, 1918 No. 12

PRINCIPAL CONTENTS

Engineer's Life Not Always a Bed of Roses 341
Historical Development of Steam Turbine 346
The Growth and History of Refrigeration 351
Power Plant Management: Mechanical Stokers 353
Electricity—Its Relation to Matter and Energy 356
Simple Method of Determining Power Plant Costs 361
The Control of Large Amounts of Power 363
Editorial 368
Association and Personal 369
Operators' Point of View 370
Selected Market Quotations 372
Industrial News 50

Cleanliness in the Power Plant

IN going through one of the stations of a large public utility corporation one is forcibly impressed with the immaculate cleanliness of the floors and equipment. The management, indeed, go so far as to warn the employee of his dismissal if caught spitting or throwing matches or cigarette butts on the floor. It may be asked what this has to do with the average power plant where conditions are in many respects different and help perhaps is hard to get? Just this, it is as easy for the engineer in charge of a small plant to enforce cleanliness as it is for those having the operation of the large plants in their care.

The cultivation of habits of personal cleanliness is surely an easy matter and the placing of cuspidors in convenient locations, if spitting must be done, waste-baskets for waste paper and lockers for clothing certainly doesn't cost much and is well repaid in the improved appearance of the plant.

Even when construction work is being undertaken in the plant referred to neatness is strictly enforced and the construction men are held responsible for the keeping of the floors and building as clean as possible.

The proper storing of packing and other supplies is often sadly neglected in the small power plant. Packing costs good money and if it is allowed to lie around on top of the engine room lathe, together with a bunch of ells, tees and what not, it is bound to be the worse for it. Speaking of the lathe, is there no reason why, if one is used at all, it should not be taken care of, the ways greased and gears and other finished surfaces properly protected from rust? It might also be a good thing so far as appearances go to take that burned-out motor from underneath the lathe bed and to remove the accumulation of rubbish that has collected with it.

It might be well to point out that the engineer who neglects the general appearance of his plant is usually as careless in the looking after those conditions which affect economy. An engine covered with oil usually finds the counterpart in the boiler room, in the soot-covered tubes.

Progress of the Oil Engine

THE gradually increasing number of motor ships of various sizes is worthy of note. The oil engine for marine purposes is strongly entrenched in various parts of the world, and Great Britain, at the time of writing, holds the record for the largest ship built fitted with this type of engine. The British built motor has a good record all over the world, and now that the engineering shops are relieved from the stress of war work, a further effort is likely to be made in this class of engine. Sweden is a strong competitor, and the United States are going in for the manufacture of oil engines on quite a large scale. The indications are that a large business will be done in the near future by manufacturers in this line.

Government Control in Britain

WITH the approach of peace, the position of the British mercantile marine is causing considerable anxiety to shipowners in the Old Country. Before the war Great Britain owned half of the entire shipping of the world, and among them a splendid fleet of liners which were the express messengers between the outlying posts of Empire. In their war efforts, the people of Great Britain gave freely of their ships, and their shipbuilding yards were mostly given over to fighting ship construction of various sorts. On Great Britain fell the heaviest shipping losses, and especially on the fleet of superb liners which were her pride. Now that the United States, Canada, France and Japan are all building ships, British shipowners are anxious for the Government to relax its control over them. They feel that, left to themselves, they can once more make Britain supreme on the wave, but if the strangling effects of Government control continue they will be forced out of their proud position forever. It would seem to be the irony of fate, that the country which threw its greatest commercial asset freely into the hazard of war for the benefit of the rest of the world should be rewarded by having her maritime trade taken over by the ships of the nations she saved.

Association and Personal

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS MEET

THE increasing value of a sound, technical education to the plant engineer or other technically trained men was very clearly brought out at the Past President's night of the Canadian Association of Stationary Engineers held in the Temple Building on Wednesday night, November 27th. The founding of this Society in the first place was due solely to a desire on the part of a number of engineers to raise their own educational standards and those of their fellow engineers to a higher plane, and the history of the Association as outlined by A. M. Wickins, the first past president, shows what a factor the Association has been in the improving of the facilities for technical education in Toronto and in the establishing of the Old Mechanics' Institute now long since absorbed in the present technical school system of the city.

The usual business of the lodge was transacted and three new members initiated and at the conclusion of the business session refreshments were served with the oldest past president, A. M. Wickins, in the chair. The Toast Master proposed a toast to the King, and Mr. H. E. Terry proposed that to the City of Toronto, and soid that it was a most pleasing duty. Toronto was possibly the most loyal city in the British Empire and no city had done more towards the winning of the war in the giving of her sons and in the furnishing of munitions to the Allies. Mr. Terry has lived in the city for about 36 years and needless to say Toronto was not as big then as it is now.

In responding to this toast, Controller Maguire stated that it gave him great pleasure to do so. He was born in the city and took a great deal of interest in its development and in this connection wished to emphasize the importance of public ownership and the purchase of Toronto's railway system, which was due in another year or two. It had been said on good authority that if Toronto's street railway were taken over at its scrap value and all modern improvements made on it necessary to bring it to a high state of efficiency, that it would be paid for completely in ten years' operation. The housing problem was also a serious one for Toronto and the question of wages after the war and other reconstruction problems were dwelt upon at some length.

A matter touched upon by Controller Maguire which was of great importance so far as the engineers were concerned was the recent appointment of a man with no engineering credentials of any kind to the position of foreman of the filtration plant at the City of Toronto Water Works Pumping System. This was characterized as a most unwise policy for any city to attempt. The importance of having men capable of the wise operation of steam plants in charge of works of such nature was very strongly emphasized.

The toast to the technical press was proposed by Mr. G. D. Bly, and responded to by B. G. Newton and A. R. Kennedy. Mr. Newton in replying emphasized the importance of the technical press during the last four years of war activities. The men and engineers of the country have been seeking information as never before from the columns of the technical press along all lines. The cost of preparing information and publishing literature of this nature was very great and the advertising pages were almost the sole source of revenue.

An interesting item of news was given out in the information as to what "Canadian Machinery" had done during the war, in the help it had extended to the munition business. It was the first in the field in Canada, and not only Canadian and American technical papers followed it very closely, but those of Europe and Australia and other allied countries were in constant communication with "Canadian Machinery." To such an extent was this the case that the Australian Shell Committee went to great expense to reprint completely one special shell number of "Canadian Machinery" and distributed it amongst all munition shops in Australia as a text book on the subject.

A number of French officers were in Canada recently inspecting the shell shops here and paid a high tribute to the excellence of the work turned out, the quantity produced and the general design of the machine shops as a whole. They stated that there were few shops in England or on the continent which could compare with the Canadian shops in these respects. A matter of special importance touched upon was that of the relation of the technical paper to the readers of it, and particularly the contributors, and the great advantages of imparting information to the paper through contributing to it were dwelt upon.

Mr. Kennedy spoke in part of the interesting work of the editorial management of technical papers. The character of the work was very much more substantial than that of the daily press.

It was one of the most interesting things to study men and to analyze the qualities which lead to their success, in many cases, in spite of extreme poverty and the lack of advantages in their early education. In general it might be said that a man owed his success in his chosen profession to a combination of four things — the first was the night school, the second the correspondence school, the third the technical press and books and the fourth determination. It has always seemed wrong that a man should be forced to leave school at an early age and, lacking the advantages which others possessed, had to study for long hours at night, plugging and working alone by himself for education which, after all, was really his by rights, and which should have been provided him before he made his plunge into the serious task of earning a living.

The engineer of to-day had a very serious load of responsibility placed on his shoulders. The conservation of fuel was still uppermost in the minds of those who govern the various Allied countries and even though the war were over it was still a very serious problem. The majority of engineers fully appreciated the fact that fuel saving was an important item and conservation to them was a very desirable object, but in many cases plant owners and those in authority were still very blind to the fact that appliances for efficient operation were needed before coal could be saved.

Mr. Fenner, associate editor of "Canadian Machinery" and POWER HOUSE, gave a very acceptable rendering of the **"Admiral's Broom"**

Brother W. C. McGhie, in proposing the toast to the Canadian Association of Stationary Engineers, stated that the question of appointing engineers with no certificate qualifications to positions of importance on civic and municipal works was something with which his department had very much to do, and the particular case cited by Controller Maguire had never been brought to his attention by engineers or others; however, it would be looked into. The issuing of certificates to engineers was an important matter and the C.A.S.E. was

a most important factor in the education of the engineer to appoint where he was capable of fulfilling the most important positions. The growth of the organization was dwelt upon and it was stated that whereas 10 years ago the membership was only in the neighborhood of 4,000, it now numbered 12,000, and was increasing very rapidly.

The important question of graded certificates and graded plants, was one which was very likely to come up some time in the near future for settlement, and it was hoped that some equitable and satisfactory arrangement would be reached.

A. M. Wickins, or as he is more familiarly known by the members of the C.A.S.E., Dad Wickins, gave some interesting facts about the organization from its inception over 30 years ago. It was originally the conception of a number of the engineers of that time to get together and form an association for the mutual improvement of its members.

The education of the engineer was recognized at that time as being one of the most important features of the organization which could be formed for his welfare, and in consequence as a model or emblem for the Association an arch was chosen with the keystone knowledge and the two cornerstones of integrity and reliability as a self-standing feature. No politics, religion or other controversial matters ever entered into the organization's plans or meetings of any nature.

During the course of the years the Association had got along remarkably well and had considerably raised the standard of the engineers throughout Ontario. It was recognized that much of the Association's usefulness to the engineer could be extended in the locating of positions for any particular engineer, and on entering the Association an examination was give to the engineer for his classification, so that in the event of a position being available the proper engineer could be found to fill it. After the Association had been in existence for two or three years it was found advisable to incorporate it so that it could hold property, and be conducted in a business-like way. Lodges were formed outside of Toronto and the status of the engineer improved eventually by the obtaining of the permissive license law whereby engineers were granted licenses for the holding of the Ontario certificates.

The engineer has a very serious responsibility on his shoulders, and might even be said to have more responsibility than the average doctor—for the doctor when he gives the man the wrong medicine and the man dies can very easily say that it was a case where the man would have died in any case, but the engineer is responsible for his every mistake.

A little known fact about the Association is that it was the original means of starting Toronto's Technical School system, and a great factor in its development to which it is to-day. No. 1 class started the first technical school in the old Wycliffe College, where five teachers were engaged for five nights a week and six months in the year. The equipment was purchased and teachers obtained from the School of Practical Science, and it was expected that on the first night 150 scholars would be obtained. The immediate popularity of the innovation was seen on the second night when 277 applications were made for admission to the classes. The Old Mechanics' Institute, as it was known, was in a few years' time organized, and at one time eleven hundred scholars were in attendance with day and night classes in both commercial and engineering subjects. The organization had certainly done a lot for Toronto's education and necessarily much of this was not appreciated by the public at large.

The Operators' Point of View

HOME-MADE TOOLS FOR THE ELECTRICAL REPAIR MAN

BY MAURICE CLEMENT

IT is surprising to note the large number of homemade tools one can see in an electrical repair shop; the fact that none of these tools can be bought ready-made, but must all be specially constructed, gives them an interest that is lacking in all standard tools; everything from a coil taping needle to an armature banding tension block, can be seen among an armature winder's tools.

For the benefit of those who are interested, I shall go into detail concerning these tools. The first, and most simple, is the "coil taping needle." This is made of a length of No. 14 banding wire, as shown in Fig. I. As only one foot of the wire is used in making the taping needle, it can be had at a very low cost; the taping needle is used for taping coils in closed slot stators, and when the user becomes accustomed to it, much speed can be attained, thereby saving considerable time.

The coil raiser, also in Fig. 1, is simply a piece of steel, 16 inches long, 1 inch wide, and 3-16 inch thick, with a 4-inch one-sided taper to it on one end. This tool is used mainly in stripping open slot armatures and stators, but can also be used to good advantage in removing grounded coils sufficiently to allow for insulating a weak spot in the coil, the main object being, in this case, to lift out a tight fitting coil without damaging the insulation.

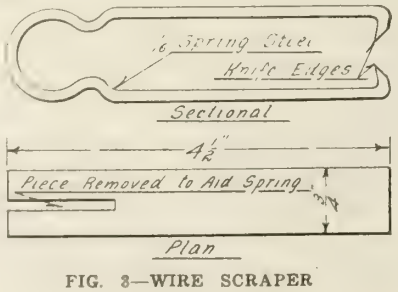


FIG. 3—WIRE SCRAPER

Fig. 2 shows the armature sling, which is made of a piece of 1-16 inch sheet iron, 2 feet long and 10 inches wide; at each end is a steel triangle, made of a ¾-inch steel bar, for hooking on to a crane. Without this sling, a rope or wire cable strap would be used, with the danger of springing the shaft; in a recent test this sling has held a weight of one ton, without apparent strain.

The wedge-drift is a piece of tool steel 8 inches long, ⅝ inch wide, and 3-32 inch thick; over which is fitted a loose fitting steel sleeve, 1-16 inch thick The wedge-drift is used for driving fibre wedges between top of coil and lamination overhang in closed slot machines; to use the wedge-drift most efficiently, the fibre wedge must first be inserted about a quarter-inch into the

slot, then with the drift pulled back in the sleeve, fit the sleeve over the wedge and drive to the proper place; the sleeve holding the wedge in its position properly and preventing breakage.

The wire scraper, Fig. 3, is one of the best little time-savers of the whole lise. In ordinary circumstances a knife is used to scrape wires prior to connecting, but with the rough treatment a knife receives in scraping wires, its life is very short, necessitating frequent renewal of knives and incidentally, added expense. The wire scraper is made of spring steel and is primarily 1 foot long and ¾ inch wide; before bending to the desired shape, grind a knife edge on each end and cut out a piece 2 inches by ¼ inch from the centre.

After bending to proper shape, knife edges can be retouched with a file. The open space, which is now at back end of scraper, gives a greater spring effect and allows knife edges to be brought together with a minimum of pressure. In Fig. 4 we have the cell shaper, which, when we take into consideration the valuable work it does, is well nigh indispensable to any well regulated repair shop; the base of the cell shaper is of hard wood, in this sase being maple; it is composed of two pieces, one being 16 in. x 4½ x ¾ in., the other is 16 in., x 2 in. x ¾ in. These pieces are hinged together on the long edge.

Where the two pieces of wood meet, a half-inch metal strip is piaced. This strip is shaped at the ends so as not to interfere with the action of the hinges, and held down by screws; between the hinges the strip is raised sufficiently to allow the inserting of a reasonable thickness of fish-paper.

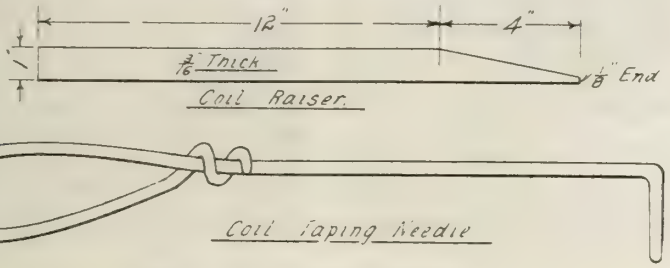


FIG. 1—COIL TAPING NEEDLE

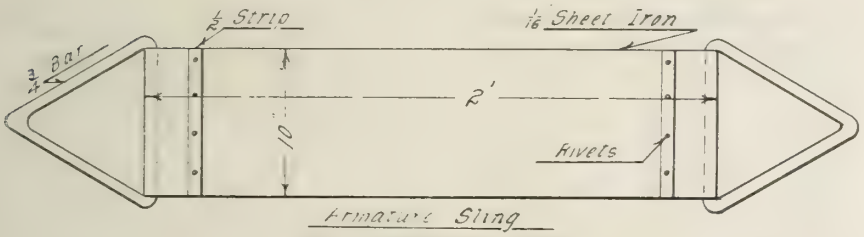


FIG. 2—ARMATURE SLING

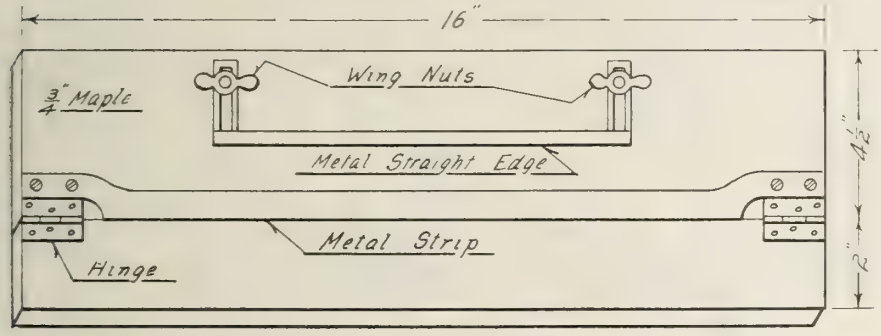


FIG. 4—CELL SHAPER

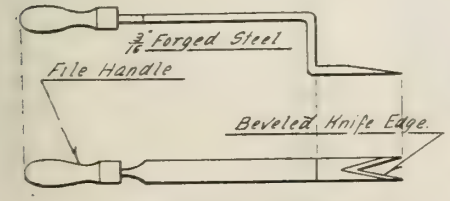


FIG. 5—CELL CUTTER.

Behind the metal strip is an adjustable metal straight edge with wing nuts to hold it in place; to make a cell for a closed slot stator or armature, length of slot must first be determined, allowing for a short projection. Next, height of slot, measuring from bottom of slot to bottom of lamnation overhang; width of slot at the bottom must also be determined. This gives us the following:—

Length of slot + projection = one dimension.

Height of slot x 2 + width at bottom = other dimension.

In cutting the fish-paper for these cells, it must be remembered that there is a proper and improper way of doing it; the grain of the paper must be taken into consideration. The right way to cut it is to lay out the first dimension with the grain and the second across the grain. In adjusting the cell shaper, the distance from the forward edge of metal strip to the metal straight edge should be equal to the height of slot.

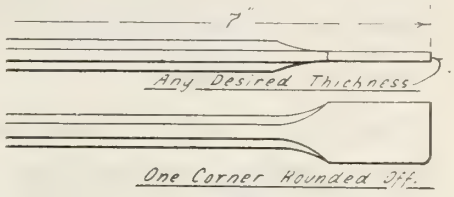


FIG. 6—DRIVING DOWN TOOL

To shape cells, insert fish-paper under metal strip until it is squarely against straight edge and turn hinged base on hinges; this will make a neat fold in the paper; turn paper around and make another fold on opposite side, all is now ready to use.

In Fig. 5, the cell cutter is another very simple, but very effective tool. It is composed of a piece of forged steel, 14 inches long, ¾ inch wide and 3-16 inch thick, with a set of bevelled knife edges at one end and a file handle at the other; the handle is raised so as to allow free movement of the cutting end. It is used in cutting projecting insulation from slots of open slot windings after coils have been assembled.

In Fig. 6 we have the driving down tool, which is nothing more than a thin bladed chisel, with the end squared off. It is used for driving down leads into commutator slots. It is advisable to have four or five chisels with various blade thicknesses, to provide for different sizes of wire. The armature banding tension block, shown in Fig. 7, is a device which does away entirely with the necessity of a banding lathe; in the

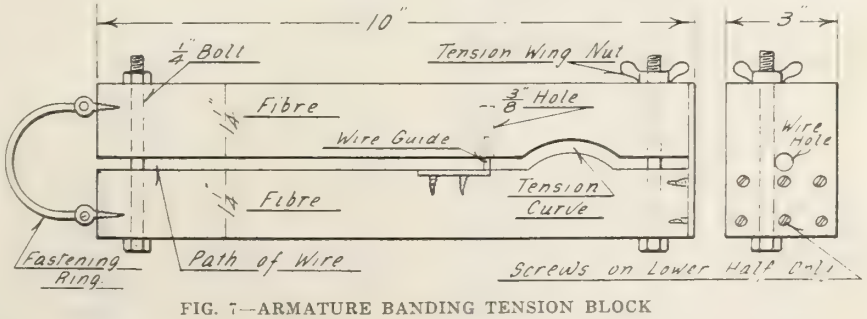


FIG. 7—ARMATURE BANDING TENSION BLOCK

WHERE DOES THE ENERGY GO?

SCIENTISTS tell us that by the principle of the conservation of energy no energy is ever created or destroyed. The editor of POWER HOUSE recently had an interesting paradox, which he is passing along, propounded to him which bears upon the above law of the conservation of energy. Let us suppose a spring of steel bent in such a manner that work is done in the storing up of potential energy in the spring. Furthermore suppose this spring to be clamped in such a manner that it retains its stored up energy and then let it be placed in an acid bath so that it will be eaten away uniformly by the acid. The question arises as to where the stored up energy goes and what becomes of it. The arrangement of the mechanism is of small importance so long as the spring is eaten away uniformly and does not suddenly break. Perhaps some of our readers would like to take a fling at the problem. If so let us hear from you.

small shop, where the armature winder does his own banding, the tension block is an innovation worthy of notice; the armature does not have to be removed from the stand to be banded.

About one foot of stout line with a hook lashed to one bed is made fast to the fastening ring on the tension block and hooked to an eye bolt, which is set in the floor for that purpose. The spool of banding wire is placed on a small stand beside the eyebolt; the wire passed between the two blocks at the rear end, through hole in first wire guide over tension curve, and through second wire guide hole, thence to the armature.

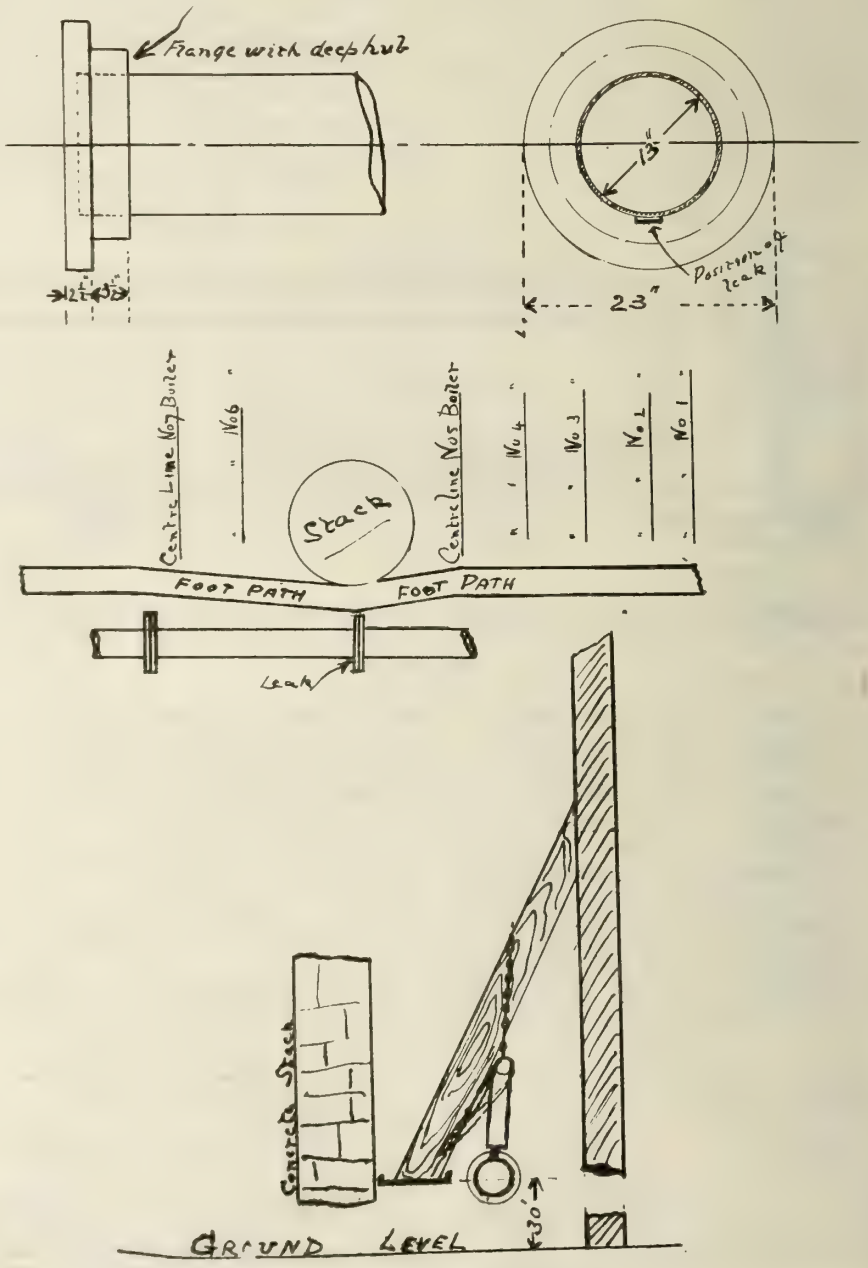
The tension can be regulated by the wing nut at the forward upper end of the block; by screwing down the wing nut, both sides of the block are brought nearer together, thereby narrowing the tension curve over which the wire must pass, this increases the resistance on the wire and incidentally the tightness of the band; a pipe wrench is used on the shaft to revolve the armature. It will be noticed that the forward end plate is screwed down to the lower half only, so as not to interfere with the tension wing nut and bolt.

REPAIRS TO MAIN STEAM HEADERS

T. H. F.

The writer, while in charge of a steam plant, had occasion to make some repairs on a 14" main steam header, which may be of interest to readers.

The boiler plant consisted of seven B. & W. boilers, six of them being 250 H.P. and one 125 H.P. The main header was 150 feet long, and was 12" dia. at No. 1 boiler, increasing to 14" o.d. at No. 2 and carried along the rest of the length at the same diameter. The boilers were arranged in pairs, except No. 1, all boilers being numbered from the right to left. Thus No. 1 was separate, No. 2 and 3 together, No. 4 and 5 together, then a 22 foot space containing the feed pumps, heaters, etc., and No. 6 and 7 boilers together. Steam for main engines was taken from the header at right hand side of the stack, and at the far end of the line the 80 lb. reducing valve was fitted, distributing steam to all factory heating lines, and some of the auxiliary machinery. Steam for circulating and dry vacuum pumps was taken from main header at left hand side of stack, while the main feed pump steam was taken from header on short length situated immediately behind stack. It was on this length that the first repair was made. A bad leak had developed at some time previous to the writer's taking charge, in the thread of the pipe, and the pipe had been taken down, and flange screwed up. This, as far as could be learned, had been repeated on two or three occasions, after which the leak would stop for a while. When the writer took charge, the leak was pretty bad, and getting worse all the time. It was plainly a case of taking the pipe down, and keeping it down long enough to make a permanent repair. The plant had to keep running in the meantime, so it was decided to have two blank flanges made, and blank the main header off after the pipe was taken down, and running the boilers on each side of the break as a separate plant. Thus Nos. 1 to 5 were



REPAIRS TO STEAM HEADER.

available for main engines, and Nos. 6 and 7 had to carry the auxiliaries, steam for factory, lubricating pumps for main engines. The connection for the feed pump being on the piece of the header to be taken down, as was also the steam supply to lubricating pumps, provision had to be made for these, on another part of the header. As there were convenient plugs in header, this presented but small difficulty. The flanges were made, and necessary valves and fittings procured for alterations. One feature of the job was the awkward position of the header for any handling. It was about 30 feet above the ground level, and from the header to roof trusses of power house was about 35 again. The header was supported on rollers, on a steel framing, and the only provision for getting around was a footing made of a 12" channel, laid flat with flanges looking up. No provision of any kind had been made for tackle, to lift the pipe or valves, as evidently repairs were thought by the designer to be unnecessary. One end of the length to be taken down, came right behind the stack, and close up to it, so that the footway had to be angled to pass it. Owing to the roof trusses being pitched 17' apart and being so hard to reach, the use of them for lifting tackle was out of the question. The method adopted was to place 6" x 6" timber from footway to wall, and hang the tackle from that. Chain blocks were used till all bolts were out and pipe lowered down clear, when rope blocks were made fast, and pipe lowered to the ground. The blank flanges were put on, connections made to feed pumps, etc., and steam put on to the two separate headers. I may say that we had practically no trouble in operating this way excepting that the firemen, at first, would have trouble in feeding their respective boilers. This was because the man on Nos. 6 and 7 would allow his steam to drop below the working pressure, and his check valves being open, the pump would feed all into 6 and 7, and none to the other battery. After a while the firemen were made to understand this, and there was no more trouble.

The pipe on examination was found to be pretty badly cut in the thread. In fact, a slot 1½" long by 1/16" wide, was cut right through the thread the full thickness of the flange. To get over this, it was necessary to cut the bad piece off altogether. To make up what was cut off the length, a pattern was made, and a flange cast with a long hub, so that the pipe and flange when made up would be the same length as the original. The pipe being 10 feet long, and the biggest lathe we had being only nine feet, the thread cutting looked like being difficult. However the tail stock was taken off the lathe, and a wooden block put on to carry the free end of the pipe. A steady rest was put in the centre and the end to be repaired was held in the chuck. The new thread was cut starting from the end of the old, and cut as nearly to size as possible, and then the bad end was cut off. The flange was then put on the lathe and bored and screwed, the pipe being fitted in while the flange was on the lathe. It was fitted so as to go up about half way on the thread by hand, and then tightened home in the usual way. Special care was taken to get the correct length and particularly to get the holes in line with the holes in the other flange. This was done and the pipe was ready to put up which was done on the following Sunday. When I left the plant two years after it was still perfectly tight.

Another length was repaired in the the same way but owing to it being the length connected to Nos. 6 and 7 boilers, it was necessary to make provision to keep the header continuous while the repair was being made. This was done by taking the blank flanges previously used and boring them out to take 6-in. pipe. A piece of 6-in. pipe the requisite length was procured and the flanges screwed each end. This pipe was then put up in the place of the main leader length and though so much smaller, did fairly satisfactory work while the repair was carried out. The only difficulty was that the pressure on the low pressure side of reducing valve was some 10 lbs. lower than normal. This was not of great importance for the time necessary to make repairs.

OPERATOR ORGANIZATIONS

British Columbia Association of Stationary Engineers, Vancouver.—Subordinate Lodges at Vancouver, Victoria, New Westminster, Cumberland, Merritt, and Fernie.

North-West Association of Stationary Engineers, Edmonton, Alta.

Manitoba Association of Stationary Engineers, Winnipeg.

Canadian Association of Stationary Engineers, Hamilton, Ont.—Subordinate Lodges at Montreal, Toronto, Hamilton, Ottawa, Brantford, Guelph, Kitchener, Chatham, Ont.; St. John, N.B.; Owen Sound, London, Stratford, Belleville, Kingston, Sudbury, St. Thomas, North Bay, Port Arthur, Sarnia, and Windsor, Ont. The executive officers of the C.A.S.E. Grand Lodge are as follows:—

Past President—W. G. Forbes, Montreal, Que.
President—R. F. Gofton, Kitchener, Ont.
Vice-President—Wm. Cooke, Belleville, Ont.
Treasurer.—A. W. Heath, Hamilton, Ont.
Conductor—S. Balmfirth, Toronto, Ont.
Doorkeeper—George Moll, London, Ont.
Secretary.—John H. Hale, Hamilton, Ont.

RUST-PREVENTING VARNISH

Resin six parts, sandarac nine parts, gumlac three parts, turpentine six parts, and rectified alcohol nine parts. The resin, sandarac, and gumlac should be mixed together in a pounded condition and then carefully heated until melted. When they are well melted the turpentine should be added very gradually, stirring all the while. The mixture should then be digested until dissolution takes place. Then add rectified alcohol up to the amount stated above. It should afterwards be filtered through a fine cloth or thick filter paper, and preserved in well stoppered bottles so that no evaporation can take place.

SUGGESTION FROM WEST

A proposal that Alberta and Saskatchewan deposits of low-grade coal, which will not stand shipment by reason of its friability, be utilized for the generation of electricity for light and power, has been made to the Advisory Council for Industrial and Scientific Research by Hon. C. A. Dunning, provincial treasurer of Saskatchewan. The suggestion is that power houses be erected at the mine fields and the current be distributed to farmers and other consumers. The proposition has been referred to the council's lignite committee for investigation.

CRITICISM OF EACH OTHER'S WORK IS BOUND TO PRODUCE RESULTS

Dear Sir: In answer to your correspondent A. L. Haas, re line shaft repair. I quite agree with him in the cast of the shafting being of a light nature, and also, the work being the same, the ways and means mentioned would have been all right. As a matter of fact I have run a line shaft break with the aid of two lathe dogs with holes countersunk in the shafting to accommodate the set screws, but be aware it was in the case of a shafting 2½ inches diameter, also with setting shafting collars up tight against the hanger bearings. For a shaft of 6 in. diameter you are not always in a position to pick up a coupling of the above diameter and cutting the keyway would take almost as long as cutting same as I mentioned, and would also have had the trouble of losing about three large pulleys that were dead against the face of the hanger bearings and sliding; in any case one length of the shaft back to put on the coupling. As to solid drawn tubing that is out of the question in this case as I consider I would have a lively time in securing tubing of this size, and I think that it would not stand up to the work it had to do.

The pulley boss would be all right in some cases as I have also used this means of repairing a shaft, not a line shaft but one in a machine.

I must mention that in the case of the pair of collars the break was a direct and nearly even twist break as we found the same had been fractured for some time, as I should say 1-5 of the way through the break it was very rusty, which clearly shows my above statements to be correct.

If I am not mistaken I think the repair took us about nine hours or thereabouts.

I am pleased to know your correspondent took an interest in contradiction as to my method as it shows other ways and means of doing the job, and I have always maintained that if there were more of these good-natured criticisms of one another's work it would be much better for all concerned. Trusting I may have the pleasure of sometime renewing the acquaintance of Mr. A. L. Haas.

A. H. HOULDSWORTH.

SELECTED MARKET QUOTATIONS

A Record of Prices Current on Raw, Semi-finished, and Finished Materials Entering Into the Manufacture and Operation of Power Plant Equipment

BOILER TUBES

Size	Seamless	Lapwelded
1 in.	$36 00	$.....
1¼ in.	40 00	.....
1½ in.	43 00	36 00
1¾ in.	43 00	36 00
2 in.	50 00	36 00
2¼ in.	53 00	38 00
2½ in.	55 00	42 00
3 in.	64 00	50 00
3¼ in.	.....	58 00
3½ in.	77 00	60 00
4 in.	90 00	75 00

Prices per 100 feet, Montreal and Toronto.

PLATES

	Montreal	Toronto
Plates, ¼ to ½	$10 00	$10 00
Heads	10 30	10 25
Tank plates, 3-16 in.	10 50	10 10

WROUGHT PIPE

Effective Jan. 7, 1918.
Standard Buttweld.

Size	Black Per 100 feet	Galvanized Per 100 feet
⅛ in.	$ 6 00	$ 8 00
¼ in.	5 16	7 29
⅜ in.	5 16	7 29
½ in.	6 55	8 12
¾ in.	8 28	10 41
1 in.	12 24	15 39
1¼ in.	16 56	20 82
1½ in.	19 80	24 89
2 in.	26 64	33 49
2½ in.	42 72	53 53
3 in.	55 85	70 00
3½ in.	70 84	87 86
4 in.	83 93	104 10
	Standard Lapweld	
2 in.	29 60	36 08
2½ in.	44 46	54 70
3 in.	58 14	71 53
3½ in.	72 68	90 62
4 in.	86 11	107 37
4½ in.	97 79	122 56
5 in.	114 00	142 82
6 in.	147 80	185 28
7 in.	192 80	241 57
8L in.	202 50	253 75
8 in.	233 30	292 32
9 in.	279 50	350 18
10L in.	259 20	324 80
10 in.	333 70	418 18

Prices—Ontario, Quebec and Maritime Provinces

WROUGHT NIPPLES

4" and under, 45%.
4½" and larger, 40%.
4" and under, running thread, 25%.
Standard couplings, 4" and under, 35%.
4½" and larger, 15%.

IRON PIPE FITTINGS

Malleable fittings, class A, 20% on list; class B and C, net list. Cast iron fittings, 25% off list. Malleable bushings, 25 and 7½%; cast bushings, 25%; unions, 45%; plugs, 20% off list. Net prices malleable fittings: Class B black, 24½c lb.; Class C black, 15¾c lb.; galvanized, Class B, 34c lb.; Class C, 24½c lb. F.O.B. Toronto.

COLD ROLLED SHAFTING.

At mill ..... list plus 40%
At warehouse ..... list plus 50%
Discounts off new list. Warehouse price at Montreal and Toronto.

FINISHED IRON AND STEEL

Per lb. to Large Buyers	Cents
Iron bars, base, Toronto	$5 25
Steel bars, base, Toronto	5 50
Steel bars, 2" to 4" base	6 00
Iron bars, base, Montreal	5 25
Steel bars, base, Montreal	5 50
Reinforcing bars, base	5 25
Small shapes	5 75

SHEETS

	Montreal	Toronto
Sheets, Black, No. 28.	$ 8 00	$ 8 25
Sheets, Black, No. 10.	10 00	10 00
Canada plates, dull, 52 sheets	9 00	8 65
Canada plates, all bright	9 50	9 50
Apollo brand, 10¾ oz. galvanized	....	....
Queen's Head, 28 B.W.G.	....	....
Fleur-de-Lis, 28 B.W.G.		
Gorbal"s Best, No. 28.		
Colborne Crown, No. 28	....	....
Premier, No. 28 U.S.	....	9 20
Premier, 10¾ oz.	....	9 50

PROOF COIL CHAIN

B

¼ in.	$14 35
5-16 in.	13 85
⅜ in.	13 50
7-16 in.	12 90
½ in.	13 20
9-16 in.	12 70
⅝ in.	12 50
¾ in.	12 40
⅞ in.	12 90
1 in.	12 65
Extra for B.B. Chain	1 20
Extra for B.B.B. Chain	1 80

ELECTRIC WELD COIL CHAIN B.B.

¼ in.	$13 00
3-16 in.	12 50
¼ in.	11 75
5-16 in.	11 40
⅜ in.	11 00
7-16 in.	10 60
½ in.	10 40
⅝ in.	10 00
¾ in.	9 90

Prices per 100 lbs.

FILES AND RASPS

	Per Cent.
Great Western, American	50
Kearney & Foot, Arcade	50
J. Barton Smith, Eagle	50
McClelland, Globe	50
Whitman & Barnes	50
Black Diamond	37½
Delta Files	37½
Nicholson	37½
Globe	50
Vulcan	50
Disston	50
P.H. and Imperial	50

OILS AND COMPOUNDS

Castor oil, per lb.	....
Royalite, per gal., bulk	18
Palacine	21
Machine oil, per gal.	26½
Black oil, per gal.	15
Cylinder oil, Capital	49½
Cylinder oil, Acme	39½
Standard cutting compound, per lb.	06
Lard oil, per gal.	2 60
Union thread cutting oil antiseptic	88
Acme cutting oil, antiseptic	37½
Imperial quenching oil	39½
Petroleum fuel oil	13½

BELTING—No. 1 OAK TANNED.

Extra heavy, single and double	30-5%
Standard	40%
Cut leather lacing, No. 1	$1 95
Leather in sides	1 75

COAL AND COKE.

Solvay Foundry Coke	.....
Connelsville Foundry Coke	.....
Steam Lump Coal	.....
Best Slack	.....

Net ton f.o.b. Toronto.

BOLTS, NUTS AND SCREWS

	Per Cent.
Coach and lag screws	25
Stove bolts	55
Plate washers....list plus	20
Machine bolts, 7-16 and over	net
Machine bolts, ⅜ and less	10
Blank bolts	net
Bolt ends	net
Machine screws, fl. and rd. hd., steel	27½
Machine screws, o. and fil. hd., steel	10
Machine screws, fl. and rd. hd., brass ....add	20
Machine screws, o. and fil. hd., brass ....add	25
Nuts, square blank ....add	$1 50
Nuts, square, tapped....add	1 75
Nuts, hex. blank ....add	1 75
Nuts, hex. tapped ....add	2 00
Copper rivets and burrs, list plus	30
Burrs only list plus	50
Iron rivets and burrs	15
Boiler rivets, base ¾" and larger $8	50
Structural rivets, as above	8 40
Wood screws, flat, bright	72½
Wood screws, O. & R., bright	67½
Wood screws, flat, brass	37½
Wood screws, O. & R., brass	32½
Wood screws, flat, bronze	27½
Wood screws, O. & R., bronze	25

MISCELLANEOUS.

Solder, strictly	0 60
Solder, guaranteed	0 70
Babbitt metals	18 to 1 00
Soldering coppers, 3 to 6 lbs.	0 64
Putty, 100-lb. drums	5 20
White lead, pure, cwt.	16 20
Red dry lead, 100-lb kegs, per cwt.	15 50
Glue, English	0 35
Gasoline, per gal., bulk	0 33
Benzine, per gal., bulk	0 30½
Pure turpentine, single bbls., gal.	1 03
Linseed oil, raw, single bbls.	1 95
Linseed oil, boiled, single bbls.	1 98
Lead wool, per lb.	0 15
Plumbers' oakum, per cwt.	9 00
Sandpaper, B. & A....list plus	20
Emery Cloth....list plus	20
Sal Soda	0 03½
Sulphur, rolls	0 05
Sulphur, commercial	0 04½
Rosin "D," per lb.	0 03
Rosin "G," per lb.	0 03½
Borax crystal and granula.	0 14
Wood alcohol, per gallon	1 80
Whiting, plain, per 100 lbs.	2 20

COPPER PRODUCTS

	Montreal	Toronto
Bars, ½ to 2 in.	$42 50	$43 00
Plain sheets, base 16 oz. and heavier	46 00	44 00
Copper sheet, tinned, 14x60 in., 14 oz.	48 00	48 00
Copper sheet, planished, base 16 oz. and heavier	57 00	45 00
Braziers' in. sheets, 6x4 base	45 00	44 00
Tubing T.P.S., base ¾ in. up to 3 in.	60 00	60 00

Above prices are full sheets and bars. Cut sheets and bars are 5c per lb. higher.

BRASS PRODUCTS.

Brass rods, base ½" to 1" rd.	$0 43
Sheets 24 oz. and heavier base	0 42
Brass tubing, seamless	0 55
Tubin, I.P.S., 1" base	0 55

POLISHED DRILL ROD.

Discount off list, Montreal and Toronto	Net

RUBBER BELTING

Standard	10%
Best grades	15%

WASTE

White.	Cents per lb.
XXX Extra	21
Peerless	21
Grand	19¾
Superior	19¾
X L C R	18½
Atlas	18½
X Empire	17¼
Ideal	17¼
X press	16
Colored.	
Lion	15
Standard	13½
No. 1	13½
Popular	12
Keen	10½
Wool Packing	
Arrow	25
Axle	20
Anvil	15
Anchor	11
Washed Wipers	
Select White	11
Mixed colored	10
Dark colored	09

This list subject to trade discount for quantity

MILLED PRODUCTS

	Per Cent.
Set screws	25
Sq. & Hex., Head Cap Screws	20
Rd. & Fil Head Cap Screws	Net
Flat & But. Hd. Cap Screws plus	Net
Fin. & Semi-fin. nuts up to 1 in.	25
Fin. and semi-fin. nuts, over 1 in., up to 1½ in.	20
Fin. and semi-fin. nuts, over 1½ in., up to 2 in., list plus	10
Studs	20
Taper pins	40
Coupling bolts, pins	10
Planer head bolts, without fillets ....list plus	10
Planer head bolts, with fillet list plus 10 and	10
Planer head bolt nuts, same as finished nuts.	
Planer bolt washers	net
Hollow set screws..list plus	20
Collar screws...list plus 30,	10
Thumb screws	20
Thumb nuts	65
Patch bolts ....add 40,	10
Cold pressed nuts to 1½ in. ....add	$4 50
Cold pressed nuts over 1½ in. ....add	$7 00

METALS

	Montreal	Toronto
Lake copper	$31 00	$29 50
Electro copper	31 00	29 50
Castings, copper	30 00	28 50
Tin	125 00	125 00
Spelter	11 50	11 00
Lead	10 00	10 00
Antimony	17 50	18 00
Aluminum	55 00	58 00

Prices per 100 lbs....

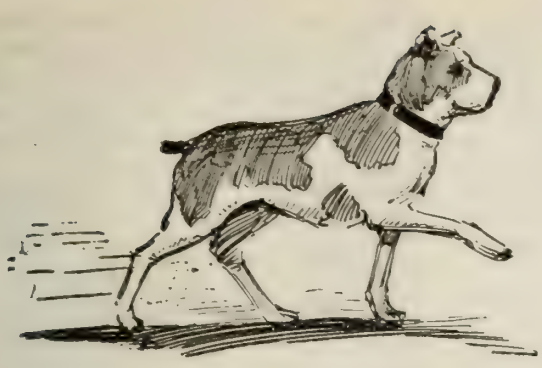
ROPES AND PACKING

Packing, square braided	0 34
Packing, No. 1 Italian	0 40
Packing, No. 2 Italian	0 32
Pure Manila rope	0 39
Transmission rope, Manila	0 45
Drilling cables, Manila	0 41

LEAD SHEETS

	Montreal	Toronto
Sheets, 3 lbs. sq. ft. lb.	$12 00	$13 25
Sheets, 3½ lbs.	12 00	13 25
Sheets, 4 to 6 lbs.	13 00	12 50

Cut sheets, ¾c per lb. extra.
Cuts sheets to size, 1c per lb. extra.



"Hector" Comes Back—from a Seven Mile Hike

Seven miles through the tubes of Heine, B. & W., Hunt and Poole Boilers—

That was Hector's stroll.

Seven miles of tubes he cleaned of scale, and came through without even having to have the cone cutters on the flexible head removed!

No wonder Hector is called the "Bulldog Cleaner."

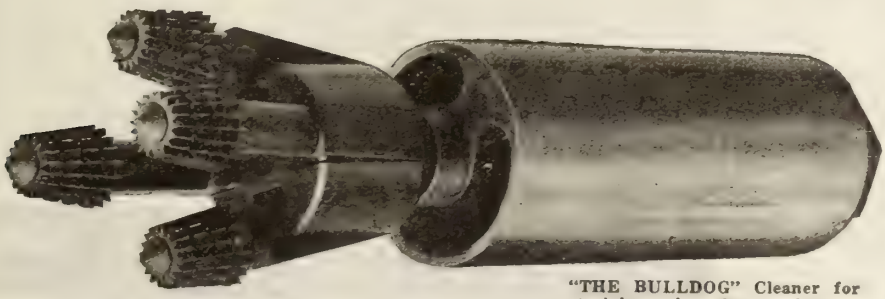
He is a "Bulldog" for strength and endurance—a "Terrier" for work.

Let him into your plant — sic him onto scale — watch him conquer.

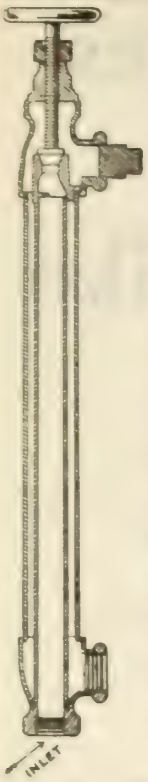
The "Bulldog" is one type of Liberty Cleaner. There are others to meet all needs. Write for Catalog "H."

Liberty Manufacturing Company

443 Diamond St., Pittsburgh, Pennsylvania



"THE BULLDOG" Cleaner for straight tubes—3½ and 4-in. sizes—also made for bent tubes.



The LONG Patent Steam Trap

Automatically drains jacket kettles, separators and steam mains. Nine hundred to 1,500 feet of one-inch pipe isn't beyond its ability. Also used with splendid success in drying room systems.

Only One Movable Part

Works against 1 and 200 pounds of pressure—no possibility of freezing. Has two outlets so it can be installed in any position.

Circular gives full particulars.

Write to-day.

J. T. LONG
84 Adam Street
MONTREAL, CANADA
If your dealer does not sell it, write direct

R.D.Wood&Co.
Philadelphia, Pa., U.S.A.

Water and Gas Work Supplies,
Cast Iron Pipe and Castings,
Mathews Hydrants and Valves,
Hydraulic Presses and Accumulators,
Operating Valves,
Mechanically Operated Gas Producers.

When writing to advertisers kindly mention this paper.

Orders For a Year.—President J. J. Harty of the Canadian Locomotive Company, Kingston, states that the company has at present orders on hand to keep it busy for a year, and he expects the plant will be taxed to the utmost for several years to overcome transportation difficulties. At present there are more than 1,000 men employed, and the company is giving every consideration to returned soldiers.

Canadian Car and Foundry Reorganized.—The work of reorganization at the Canadian Car and Foundry Company's plant at Fort William, Ont., is now completed. H. Frawley has been appointed superintendent and is now in full charge. The company is now engaged in filling a contract for 450 cars and has also 1,000 repair orders to execute. Since the temporary closing down of the shipbuilding plant and the recent departure of the last of the French mine sweepers, there have been considerable reductions in both the administrative and operative staffs, but there is ample work on hand to find employment for five hundred men during the whole of the winter.

Skilled Men Needed.—"Shell men and munitions workers do not seem to be able to fill the positions which we have. We need machinists and skilled workers of the type prior to the outbreak of war," said Mr. W. C. Hagen, secretary of the Machinists' Union. In the offices of the organization was an order for fifty skilled workers, with the request that they be on their way to their work, which was out of town, by this morning. There were other orders for workers of this type, and it was stated that many industries were experiencing considerable difficulty in obtaining the labor now required. There is also a demand for molders and boilermakers. For skilled work the same wages are being paid as during the war.

Faculty of Aviation.—The governing bodies of the Canadian universities, having decided to add faculties of aviation to their curriculum, there will be a chair of this modern science at Toronto University. According to a statement made by an officer of the R. A. F., the University of Toronto will receive three 'planes, two for instructional purposes and one for flying. Other universities will receive a like number. Except for a few Curtiss machines they will not be used for actual flying, but for the teaching of aviation. The greater part of the course will be taught by the mathematical professors, as the theory of aviation depends on the working out of mathematical problems. At first thought it would appear that qualified flying officers would make ideal teachers in this department, but to teach the theory of aviation a high knowledge of mathematics is necessary, while in actual flying, nerve and ability to think and act quickly is paramount, and the most successful aviators are possessed of the latter rather than the former qualifications. Any aviator who has these three can command a higher position than that of professor.

Not Looking For Work.—No particular rush of women for domestic or other employment was noticed at the Ontario Government Employment Bureau. It was very probably due to the fact that a very large number of the girls who had been in munition work were of the class who did not need to work for a living, but had done the work simply to help on the war, consequently since the armistice had been signed they had ceased from their labors, and were not looking for anything else to do. Women whose husbands were overseas had also been in the munition factories, and these also were now no longer anxious to work in view of the fact that they were looking forward to the return of their husbands, and would be glad to remain in their own homes. There are plenty of positions vacant in domestic work and as workers on farms, and there is still difficulty in getting people to fill them. Therefore the domestic situation has become no easier since peace was declared, and the majority of those who do apply for domestic work are asking only for day labor, and have no desire to take permanent residential work.

Dissolve Commissions.—Several commissions which have exercised important functions at Ottawa during the war are in the gradual process of dissolution. The War Trade Board will shortly be wound up. It has had charge of the import and export restrictions, acting in co-operation with the similar body at Washington. Under its direction the import business for some months has been largely on a license basis. Most of the restrictions are still on, but they will be removed from time to time, and when the war is officially over all probably will go. The War Purchasing Commission is another body which, as at present constituted, will likely disappear. Its members, Sir Hormisdas Laporte, W. P. Gundy and George Galt, have been giving their services free, and will probably retire by return to their

SALES ENGINEER—PRACTICAL OR TECHnical engineer as salesman for high grade line of power plant equipment by largest concern of its kind in the country. Most unusual opportunity. Prefer man who has established a sales record, but will consider one without experience, provided he is properly qualified. Give details and record of last three positions held and salary expected to start. Box 151, Power House.

WANTED—BOILER ROOM ENGINEER, FAmiliar with modern methods of boiler room operation and capable of using instruments for testing. Location western Ontario. None but first-class men need apply. Box 150, Power House.

MONCRIEFF'S "UNIFIC" WATER GAUGE GLASSES
Stand in a Class by Themselves for Quality, Efficiency and Economy
A trial will convince you. Write for Catalog
W. J. WALL, 134-136 BLEURY ST., MONTREAL
(Canadian Representative)

private affairs. Another body will be created to direct all Government purchases for the different departments. The Food Board is now a one-man affair, Chairman H. B. Thomson is carrying on, but the other members, Messrs. Dunning and McGregor, have retired. The restrictions are being modified from time to time, but the work will be continued at least till peace is declared, and probably for some time after, the problem of feeding allied, enemy and neutral countries not yet being solved. The Imperial Munitions Board, whose contracts are being terminated, is fast reducing its staff, but it will take fully three months to wind up the business.

DRIVING BELT OF IRON WIRE

The shortage of leather and textile fibres suitable for making up into driving belts, has produced a new industry in Austria, which may be worth while noting. These belts are now made of iron wire in some instances in combination with paper twine. The standard type consists of double iron wire, spirally twisted together, and in part slightly copper-plated by a chemical process. They range up to about 10 cm. broad. Another sample is of wire gauze strips interlaced with one-ply and two-ply paper yarn, partly with single and partly with double threads. It is bound at the edges with paper yarn, then strongly impregnated with tar asphalt, and flattened out between rollers. A third sample is bound with iron wire spirally twisted.

OLD-FASHIONED PAINT REMOVERS

The following recipes for alkaline paint removers are of the old-fashioned type; the modern quick process paint and varnish removers, while doing this work very well, and indispensable for refinishing wood in the natural, are entirely too high a price for use in removing paint on surfaces to be painted over. The recipes are as follows:

Dissolve 40 lb. caustic soda, 98 per cent., in 5 gallons of water. Take 8 lb. fine whiting and 4 lb. corn starch, and mix with 1 gal. of the caustic solution to form a paste; apply with an old brush, and leave the paint on for about twenty to thirty minutes. When the paint has softened, wash off with water, using a scraper where required. Will also remove varnish.

Another very good formula is: Mix 7 lb. of caustic soda, 98 per cent., with 15 lb. warm water; mix 1 lb. corn starch and 11 lb. china clay with 1½ gallons of water, adding to it the caustic soda solution, forming a paste that must be beaten until free of lumps. Apply freely to the surface with an old brush and permit it to remain until the paint or varnish has lifted, then scrape and wash off with warm water. Wall paper can also be removed in this manner, when the remover is further diluted with water. For cleaning painted surfaces, use a weak solution of the remover.

Operators, whose hands are easily affected by strong lye or soda solutions, should wear rubber gloves while working with the remover. In order to neutralize the alkaline nature of the remover a small portion of vinegar can be added to the water used for cleaning off, say 1 gill to each gallon of water.—M. M.

SHAFTING QUICK TO CATCH CLOTHING

Great Care is Always Necessary to Guard Against Any Accidents.

By J. H. R.

The statement that an oiler employed at the Hochelaga power plant of Montreal Tramways Co. was recently killed by being swung around a driving shaft and dashed to the concrete floor, only emphasizes the fact that the greatest precaution must be continually exercised when men working in close proximity to rapidly moving shafts or machinery. The presence of oil on a revolving shaft is always an attractive force for loose parts of clothing, and little warning can be given when a shaft takes hold of some portion of the wearing apparel.

We would recall a instance where the driving shaft of a geared draw press was located at the rear of the machine, at a height of about five feet from the floor. When setting or repairing draw dies it was frequently necessary to stoop beneath this shaft to reach the work, and the writer himself has had cause to remember this shaft, as it has been the means of pulling a few odd hairs out of a well cropped head. Chances should never be taken where risk is imminent. Play safe.

THE LARGEST MOTOR BOAT

The largest and most powerful motor ship yet produced anywhere was, in September, put through her speed trials on the Clyde. This is the twin-screw Deisel-engined "Glenapp," of 10,000 tons deadweight carrying capacity, and 6,600 total engine power, developed in two sets of eight-cylinder, four-cycle Burmeister and Wain (Diesel) Oil Engine Co., Glasgow. The vessel herself was built by Messrs. Barclay, Curle and Co., Whiteinch, who previously were associated with the Burmeister and Wain works, and were pioneers in Great Britain in the matter of motor ships. All the engine room auxiliaries of the Glenapp, also all deck machinery, including the steering gear, are electrically driven, the power being generated by two auxiliary Diesel sets in the engine room. A small oil-fuel boiler supplies steam for heating and cooking systems, and for fire-extinguishing purposes. The oil-fuel is carried in the vessel's double bottom, the space generally occupied by side and cross coal bunkers being thus available for cargo. It may be added that Messrs. Barclay, Curle & Co., Ltd., during September, and within a period of ten days, delivered to their owners, two merchant steamers of a total deadweight carrying capacity of 20,000 tons.

NON-CORROSIVE
CYLINDER OIL
MANUFACTURED ONLY BY
E. H. KELLOGG & CO.
NOS. 242 TO 244 SOUTH ST. NEW YORK, U.S.A.
FRICTION LOSS

An overload is often a necessity. But it is hard on an engine. To successfully carry an overload so that there will be no after effects on the engine a very careful selection of your oil should be made. An oil that is not free from impurities will cause a greater wearing on the bearings, a great friction loss will occur. You will need to fire the boiler more often because the engine will be harder to run. In this manner you lose out. You work harder, have larger operating costs, and less power all because of your oil. Do as a great many Canadian engineers have done — give Kellogg's "Non-Corrosive Cylinder Oil" a trial. Absolutely pure. Write us regarding it.

E. H. KELLOGG & CO.,
New York, U.S.A.

Walter J. Francis, C.E.
M. Can. Soc. C.E.
M. Am. Soc. C.E
M. Inst. C.E.

Frederick B. Brown, B.Sc.
M. Can. Soc. C.E.
Mem. Am. Soc. M.E.
Mem. A.I.E.E.

WALTER J. FRANCIS & CO.
Consulting Engineers
Head Office, 232 St. James St., Montreal
Cable Address, "Walfran, Montreal"—W.U. Code. Long Distance Telephone, Main 5643.

MacKinnon Steel Co. Ltd.
Formerly
MacKinnon, Holmes & Co., Ltd.
SHERBROOKE QUEBEC.

Engineers, Manufacturers and Erectors of Steel Structures
We Specialize in
Bridges, Buildings, Towers, Tanks, Penstocks, Roof Trusses, Columns, Smoke Flues and Stacks, Coal Bins, Ore Bins, Buckets, Refuse Burners, Stills, Air Receivers, etc.
WRITE FOR PRICES.

Electrical Engineers Meet in Toronto

Interesting Canadian Developments in Electrical Engineering Described at Meeting Held Under the Auspices of the Toronto Section of the American Institute of Electrical Engineers

THE development of Canada's waterpowers, the features of design being developed for transmitting electric energy, and the electrification of her railways, formed the interesting subjects of papers read before the 344th meeting of the American Institute of Electrical Engineers, held in Toronto, Friday and Saturday, Nov. 22-23. This meeting has a special interest for the engineering profession of Toronto, in that it is the first meeting of the main society ever held here under the auspices of the local section.

Members were present from various points, New York, Philadelphia, Niagara Falls, Erie, Pittsfield, Pt. Huron, Schenectady, and other points including Austin, Texas.

The afternoon session, Friday, was opened by the chairman, Arthur H. Hull, who, in his address, welcomed the American delegates. F. L. Hutchison, the secretary of the A.I.E.E., in the absence of the president through war activities, responded. The Toronto section was one of the first local sections organized. The plan of establishing local sections was first brought forward in 1902, and this section was organized in 1903. It is one of the few that has kept up its activities during the war to anything approaching pre-war standards.

In a paper read by Arthur H. Hull on "Electric power generation in Ontario on systems of hydro-electric power commission." the progress to date of the municipally-owned system was outlined.

Ontario has developed into the greatest manufacturing province in Canada, and as there are no coal deposits its abundant waterpower resources are being more and more utilized to furnish the power required for its varied industrial developments. About 702.000 horsepower are developed in Ontario at present, leaving a total of 4.227,000 horsepower still available. Of the above total for power developed, about 69,000 horsepower is used in pulp and paper manufacture, about 59.000 horsepower is used as hydraulic power directly applied, and teh balance, 574,000 horsepower. is converted into electric energy for light and power. The commission now own and operate ten systems in the various parts of the province from Port Arthur to the Rideau and St. Lawrence, and as far north as Nipissing Village. The various systems were described in detail and data given on the new Queenston development now under way, as well as on the extensions now being carried on at the Ontario Power Company plant. In connection with this latter, the speaker stated that the two new generators of 15,000 kva. rating each. were made in Canada, with the exception of the steel laminations and insulation. This speaks well for Canadian industry under war conditions.

The second paper read on Friday afternoon by Mr. W. G. Gordon on the "Electrical equipment of the Canadian Northern Tunnel in Montreal." This work is one of the most important that has been undertaken in Canada of recent years, and the features of electrical design dealt with in the course of the paper were of unusual interest. Following a description of the tunnel proper and the terminal conditions which had to be dealt with, the author entered into a detailed description of the electrified portion of the track ten miles in length. It is later proposed to extend this electrification of the railway to Ottawa, and the substation feeding the system was located with this fact in mind. Power is obtained from the Montreal Light, Heat and Power Co. at 11,000 volts and 60 cycles, and by means of motor generator sets, is distributed to the railway feeders at 2,400 volts direct current. This voltage is the highest that has been used in Canada up to the present time for this work, and was chosen in view of the contemplated extension of the system.

Three types of traffic had to be considered in planning the equipment: passenger and freight trains and suburban traffic. The suburban traffic will be handled by multiple unit trains, each coach weighing 80 tons, and being patterned after the standard vestibule passenger coach. The passenger and freight traffic is handled by six locomotives; these locomotives are of the two four-wheel truck type, the two trucks being coupled together to the draft gear, leaving the body of the locomotive free from all stresses.

Pantograph collectors are used with overhead catenary suspension of the trolley wires.

Sir Robert Falconer

At the conclusion of the discussion on the above paper the members and delegates adjourned for dinner. Sir Robert Falconer spoke on the impressions he had gained on the occasion of his last visit to the western front a short time ago.

The bravery and fighting qualities of the Canadian Army Corps were never more in evidence than at the battle of Amiens, and later at Arras. Vimy Ridge was a glorious episode, and one in which the Canadians won lasting fame, but the two latter battles in the speaker's opinion were even more to their credit. Sir Robert had the good fortune to be present during the opening stages of the battle of Arras, and the sight of the Canadian reserve divisions pouring up to take their part in the struggle was one never to be forgotten; the columns of men, artillery and transport, moving on with clock-like regularity, and proving irresistible in battle to the foe.

The German troops opposite Arras got the surprise of their lives when they found the Canadians were the ones who were putting them to rout and bagging them as prisoners. It seems that these selfsame prisoners had been moved to the quiet Arras sector to rest up a bit after the terrific mauling they had received at Amiens a few days before at the hands of the Canadians.

One of the most important lessons the war could teach the people of the allied countries was the value of research and science in either war or peace. Organization was always one of Germany's strong points, and it was well known that the United States was her equal, but Great Britain was thought to be woefully backward in this particular. However, her organizing powers were not dead but merely quiescent.

Science, while adding horrors to the war as conducted by Germany, yet had achieved one of the miracles of the age in the success which had attended the efforts of the medical staff of the armies in the field. Preventive medicine and surgery had made greater strides in the last few years than ten years of peace would have brought about.

Engineering at the front was, in the last analysis, one of the material factors in the bringing of victory to the allied standard.

Long Span Transmission Lines

The evening session, held in the Chemistry and Mining Building, University of Toronto, was devoted to a paper read by Mr. S. Svenningson on the longest span river crossing yet erected. The paper dealt with some remarkable contruction work recently completed by the Shawinigan Water and Power Co. near Three Rivers, Que. The St. Lawrence River is crossed by transmission line wires on a span of 4,800 feet. Due to the necessity of maintaining navigation clearance, the towers are 350 feet high.

Four reinforced concrete cassions, 11 feet diameter for each tower, have been sunk to a depth of 45 feet and placed on the corners of a 60 ft. square. These piers are connected by heavily reinforced concrete beams 4 ft. wide by 8 ft. deep. There are two towers 350 ft. high, and 60 ft. square at the base, the upstream and downstream faces tapering to a width of 14 ft. at the top. The cross arm at the top is 14 ft. wide by 100 ft. long, and carries the three sheaves over which the main steel messenger cables pass to the anchor towers.

Three lines of cable 50 ft. apart span the river between the two towers. The cables are 1⅝ in. in diameter, and are

Bathed in Lubricant And Wound Spirally

That's "John Crane"

After "John Crane" is made into the bars shown below it is carefully cut into lengths and made into rings of required size. "John Crane" is nice, soft, flexible and compressible. It is more flexible than fibre packing. You can cut it with a knife, like fibre. It accommodates itself to conditions better. It fits any stuffing box. Can be made 1/16 larger or smaller with ease. Never dries out, becomes hard or brittle. You can keep it in storage indefinitely. 100% metal. Unaffected by temperature or pressure. Being made of babbitt, the friction is very small and the rods cannot be scored. Rods become highly polished and more frictionless with age. Seven years' constant service is common practice.

"JOHN CRANE" Soft, Flexible Metallic Packing

You see, Mr. Packing User, this is nothing like the shredded, twisted, shot, pressed in paraffin, braided and segmental types of metallic packing. It is entirely different and FAR SUPERIOR. It is mechanically correct and ideally suited to all kinds of packing problems in the power plant on piston rods, valve stems, Corliss valve stem, expansion joints, condenser tubes, evaporator tubes, boiler feed pumps, header valves, all kinds of high pressure hydraulic machinery, steam traps, throttle valves, etc.

You can use it without hesitation on any service such as steam, fresh or salt water, ammonia, oil, acids and corrosive gases, distillates, etc. In other words, you can use "John Crane" on ANYTHING, ANYWHERE pertaining to packing.

"John Crane" is made in coil form for valve stems, small rods, etc. No matter what thickness of packing you want, 1-32 in., 2 in. or more, we can furnish it. Try "John Crane" just once and you will make it your standard packing.

Crane Packing Co.

Box 241, Windsor, Ontario

General Office and Factory: 24

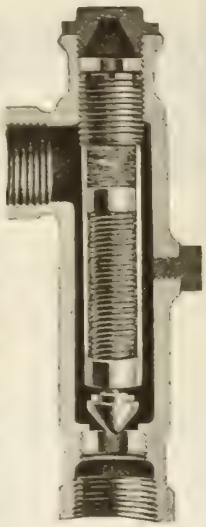
Chicago 245 Clinton St. **Illinois**

NEW YORK--121 Park Row Ave PHILIADELPHIA--316 Widener Building

If any advertisement interests you, tear it out now and place with letters to be answered.

COAL IS SCARCE!
INDIVIDUAL TRAPPING SAVES IT.

The old-fashioned method of carrying live steam with condensation through long lines of piping to a heavy, cumbersome bucket or float trap wastes a large amount of steam, because the useless radiation resulting therefrom necessitates greater coaling at the boiler in order to keep up the desired steam pressure.



STEAM TRAP
SARCO

will stop this waste of coal because you can install five Sarcos on your lines for the price of a single bucket or float trap, thereby releasing the condensation at every advantageous location and keeping the line free and clear at all times.

Let us send you one on 30 days' free trial.

Sarco Company, Inc.

Woolworth Bldg., New York City

Ellicott Square, Buffalo
New Telegraph Bldg., Detroit
Drexel Bldg., Philadelphia
Monadnock Block, Chicago
Williamson Bldg., Cleveland
Healey Bldg., Atlanta,
and representatives in all principal cities.
Canada, Peacock Brothers, Montreal.

made of galvanized plough steel. They are composed of six strands of 19 wires each and a stranded core of 30 wires. To each end of the center span cables is yoked two anchor span cables; these are carried over the tower on the 8 ft. diameter sheaves and then down to a point about 20 ft. from the anchors. At this point equalizing beams are cut in the lines, and the load is transmitted from this point to the anchor piers by means of short straps of 1¾ in. cable.

It was originally intended to use the main cables as conductors and to insulate them from the tower by specially-designed insulators. Unfortunately these insulators were not completed in time for erection and the main cables are now used as messengers carrying a No. 1/0 stranded copper conductor on suspension insulators.

Visit Local Plants

Saturday morning the delegates and local members visited the British Forgings, Leaside Munitions, and the Strachan Ave. terminal station of the Ontario Hydro Electric Power Commission and their laboratories on the same site. Canada's share in the supplying of munitions to the Allies and to the United States is due in no small measure to the enormous output of the British Forgings and Leaside Munitions plants, and the opportunity of visiting the world's largest electric steel plant was one which the majority of the delegates availed themselves.

CATALOGUES

The Swedish Gage Co., Incorporated, have recently issued a new catalog, describing in a very comprehensive manner the complete line of Johansson gaging tools. The book is 8 x 10 inches, 44 pages, and is printed on high-grade calendered stock. It is profusely illustrated, the various views showing the manner in which the blocks should be placed together, and examples for determining the selection of blocks for different combinations. The section on new accessories and the typical applications are interesting and instructive features of the book. Separate sections are devoted to the description of Johansson adjustable snap and tolerance gages, illustrating in a clear manner the method in which they are set and checked. H. E. Streeter, 10 Cathcart St., Montreal, is the Canadian representative.

In Catalogue No. 17, Butterfield and Company have listed their numerous lines of taps, dies, screw plates, and reamers. Arbors, countersinks, dies, die holders, guides, screw plates and screw plate stocks are shown for the various standard threads in common use both in the English and metric sizes. The line of reamers shown is unusually complete, and includes both English and metric. A set of tables containing useful information about screw threads, is found at the back of the book.

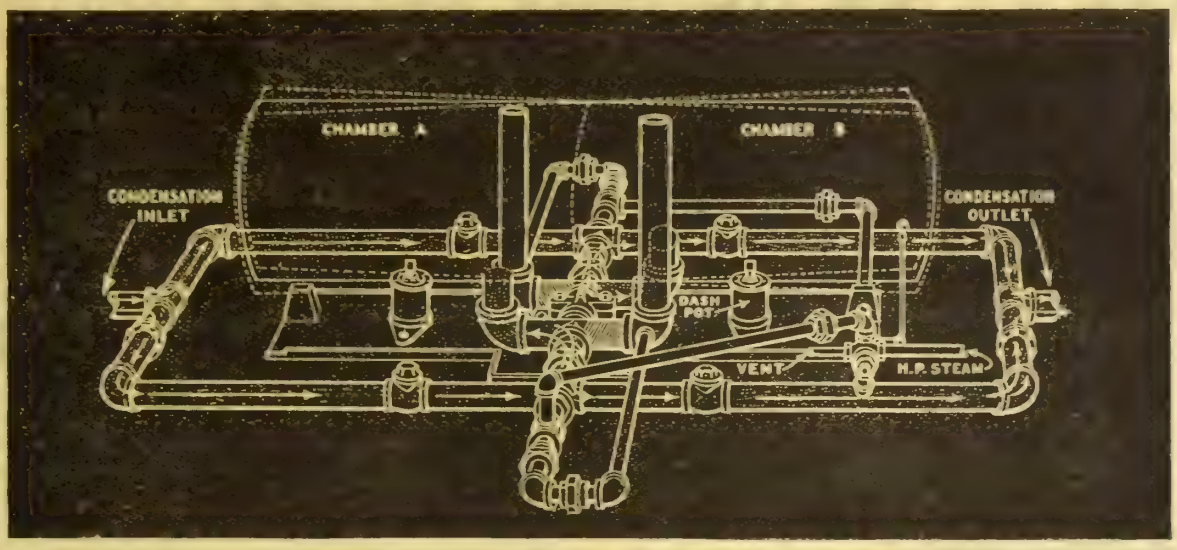
Sentinel Steam Stop Valves, Check Valves, and Accessories," is the title of a book recently published by Alley and MacLellan, Ltd., Glasgow, dealing with plant apparatus manufactured by them. The stop valve is noted for the slight loss of pressure caused by its presence in the steam line, as the passages are practically full area and the flow of steam being directed in easy curves the loss of pressure is negligible The chests are of best Scotch iron, and the section at the flanges is rounded to eliminate crystallization at the sharp corners. Chamfering the seats combined with the shape of the internal valve throws the steam clear of the valve seats. Feed piping arrangements are shown. The Fullway valve described is a valve especially designed for high steam pressure, and the interior wedging action of the spindle connection eliminates wear due to the opening of closing of the valve and at the same time assures a steam-tight joint when closed. Valve arrangements, steam traps, and other auxiliary apparatus are also shown.

System in Trucking is the title of a recent booklet published by the Stuebing Truck Co., Cincinnati, Ohio. The advantages of a thorough system of trucking in the reducing of costs is well brought out. The adaptability of the trucking system to various uses such as trucking in the foundry, handling breakable products, handling high loads, such as timber, express companies, automobile firms, etc., is well shown. Complete drawings and illustrations show the rugged and simple design of the trucks and show the hydraulic double acting safety check. The lifting and the steering lever is of steel, and the single control is also of steel. The axles are of high carbon steel, and are provided with Hyatt roller bearings. Special trucks are also featured, the design and construction of these trucks permitting the building of specials at very little expense. Trucks can be lengthened by using longer side rails, and made wider by increasing the length of the rear axle and extending the wings. Standard and special platform applications are shown by a series of drawings, which include many of the various types in commercial use for various manufacturing purposes.

Going Up.—The Canadian Aero Company, composed of well known St. John, N.B., capitalists, has applied for a Dominion charter. The company will have a capital of $2,500,000 to begin with. They propose to conduct an aerial mail service between Halifax, Boston, Montreal and New York, and claim that on a rate of 8 cents per oz. they can make a good profit. Later on they will consider taking passengers.

New Fire Engine for Trenton, N.S.—The new fire engine, built to order for the town by the American LaFrance Fire Engine Co., Toronto, arrived in Trenton recently. Mr. Gales Coleman had gone to Toronto to pilot the engine, which was brought to the Trenton garage.

THE CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED.



Farnsworth Condensation Pumps

The coal shortage, in so far as it has called our attention to wasted heat, has been a blessing in disguise.

Thousands of tons of coal may be saved by Farnsworth Condensation Pumps. They offer a double saving. First, by using a closed system keeping the condensate under pressure they return the maximum number of heat units to the boiler. Secondly, they can be operated on a small fraction of the steam required to operate a reciprocating pump.

Farnsworth Condensation Pumps are replacing other types of pumps and steam traps in a great many places. Let us tell you what they are doing in large Canadian Plants.

MADE IN CANADA BY

THE CANADIAN FAIRBANKS-MORSE CO., Limited

"Canada's Departmental House for Mechanical Goods"

HALIFAX ST. JOHN QUEBEC MONTREAL OTTAWA TORONTO HAMILTON
WINDSOR WINNIPEG SASKATOON CALGARY VANCOUVER VICTORIA

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

METLSKIN does prevent scale

Send for this illustrated booklet. It explains the dose, the method of action, and other important details

Some of Canada's and the United States' biggest and most representative plants have learned the truth of the above statement from first-hand experience.

So many "compounds" and "cure-alls" have been foisted upon unwary power-plant owners that the feeling, common to many of them, is one of doubt, of skepticism. And small wonder!

METLSKIN is not a "compound," nor does it work on the same principle. It is a boiler metal treatment, a boiler preservative that gradually removes scale by a safe process. When the scale has been entirely removed METLSKIN forms a minute, grayish-white skin or covering over the bare metal.

So long as the daily dose is continued the scale-forming particles in the feed-water cannot adhere to the metal. Nor will METLSKIN work injury to any part of the boiler or system. That is one of the strongest features of the GUARANTEE BOND.

METLSKIN cannot contaminate the steam. It may be used safely in any plant where live steam comes in contact with the manufactured product.

If you are a skeptic, a doubter, ask for the booklet, GUARANTEE BOND, prices, etc. You will be interested, we know.

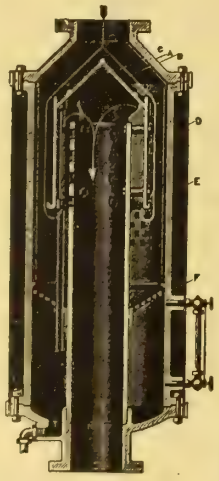
CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED

ST. JOHN QUEBEC MONTREAL OTTAWA HAMILTON TORONTO
WINDSOR WINNIPEG SASKATOON CALGARY VANCOUVER VICTORIA

ADVERTISING to be successful does not necessarily have to produce a basketful of inquiries every day.

The best advertising is the kind that leaves an indelible, ineffaceable impression of the goods advertised on the minds of the greatest possible number of probable buyers, present and future.

III IMPORTANT THINGS
TO CONSIDER ABOUT A SEPARATOR.



I. **THE PLAN**—Is it sensible, will it work, no matter how large the Separator or how well made?

II. **THE SIZE**—Is it big enough regardless of plan, will it hold a good dose of water?

III. **THE CONSTRUCTION**—Is it strong enough, are flanges heavy, how will it look by the side of a nicely finished engine? Send for catalog and note these points in

Sweet's Separators

DIRECT SEPARATOR COMPANY
820 Geddes Street - SYRACUSE, N.Y

General Sales Agents:
Canadian Fairbanks-Morse Company, Limited
St. John, Montreal, Quebec, Ottawa, Toronto, Hamilton, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

GRATON & KNIGHT

Standardized Series
LEATHER BELTING

Tanned by us for belting use

GRATON AND KNIGHT

When the Belt Works Right

One ounce of performance is worth a ton of speculation as to horse-power delivery. The best answer in belt performance is when the belt works right—with the utmost of uninterrupted driving energy; with economy written into every fuel bill.

Each Graton & Knight Standardized Leather Belt is tanned and built for some specific power purpose. This is where the Graton & Knight standardization idea comes in—belting standardized for every drive.

It may be that you are using an unnecessarily good belt on a certain drive and one not good enough on another. Select a drive in your plant and let us recommend the proper Standardized Belt to use—then watch the results. When the belt shows you that it is working right, that it is giving all service possible, you will be ready to discuss the matter of applying Graton & Knight Standardization further.

If you have kept suitable records, you know just where the belt losses are in your plant. If not, you are only guessing. Start a belt record. Write us for the necessary cards. Tell us the number of drives in your plant and we will mail record cards without charge. Write also for a copy of our booklet, "Standardized Leather Belting" explaining scientifically the application of standardization to belting.

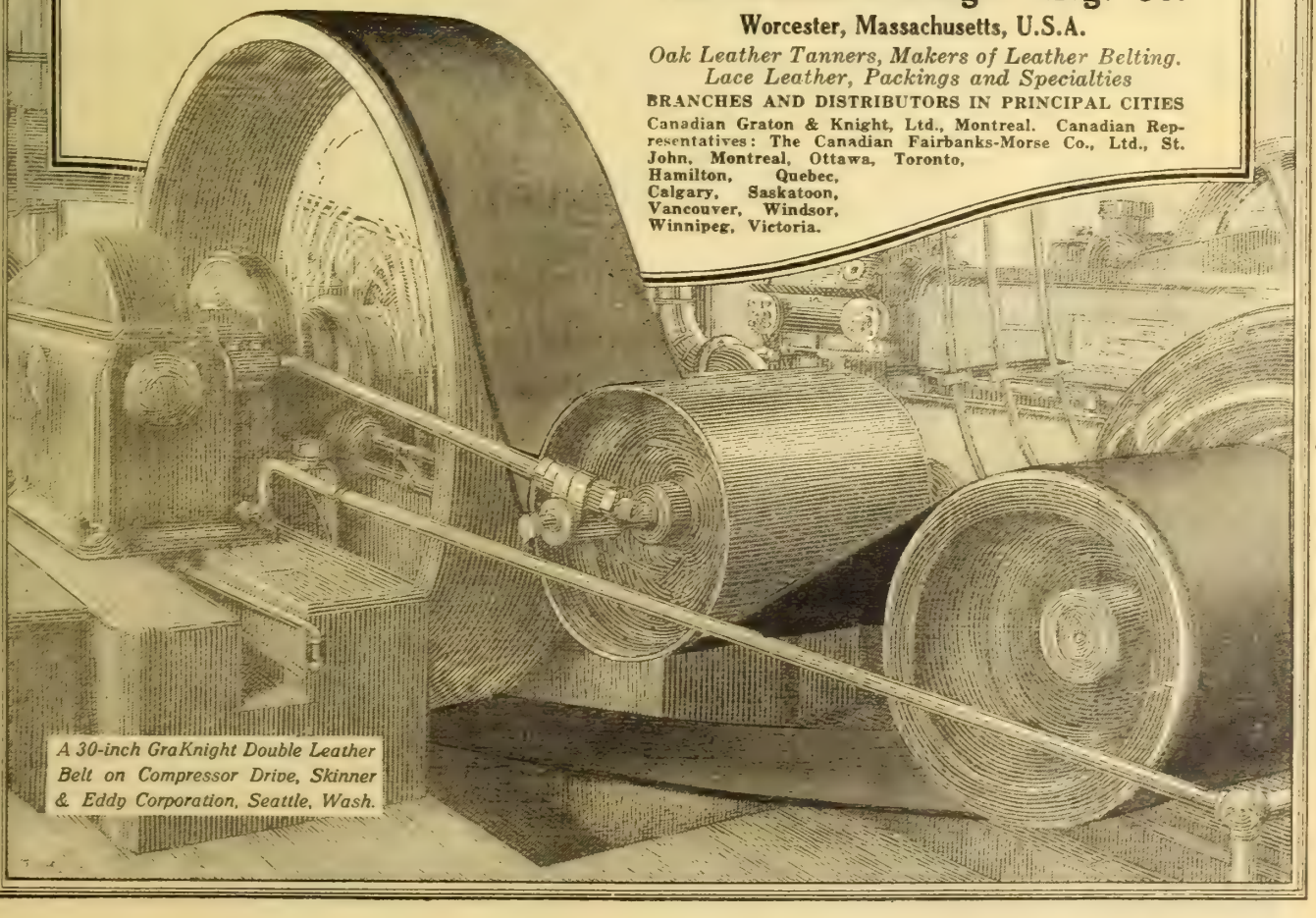
The Graton & Knight Mfg. Co.

Worcester, Massachusetts, U.S.A.

Oak Leather Tanners, Makers of Leather Belting. Lace Leather, Packings and Specialties

BRANCHES AND DISTRIBUTORS IN PRINCIPAL CITIES

Canadian Graton & Knight, Ltd., Montreal. Canadian Representatives: The Canadian Fairbanks-Morse Co., Ltd., St. John, Montreal, Ottawa, Toronto, Hamilton, Quebec, Calgary, Saskatoon, Vancouver, Windsor, Winnipeg, Victoria.



A 30-inch GraKnight Double Leather Belt on Compressor Drive, Skinner & Eddy Corporation, Seattle, Wash.

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

U. S. S. "Faith," 5,500 Tons, San Francisco Shipbuilding Co.

DURABLA

DURABLA
TRADE MARK REGISTERED

Asbestos sheet in the nation's service. Durabla is again proving its high quality.

This is the S.S. "Faith," the first concrete ship built in America.

Every joint is packed with Durabla. There was not a leak on her trial trip.

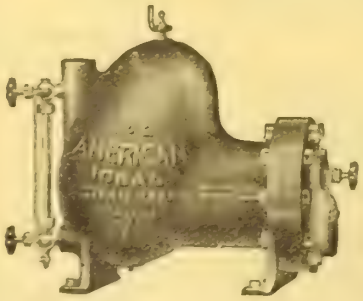
Durabla Manufacturing Co.
New York

Distributors for Canada:
The Canadian Fairbanks-Morse Co., Ltd.

Continue Conservation

SAVE STEAM

Use American Ideal Steam Traps



to keep Steam Lines free from condensation.
Do not fail to carry out your plans to SAVE COAL, STEAM, MONEY.

SEND FOR BOOKLET

Canadian Agents: CANADIAN FAIRBANKS-MORSE CO., LTD., Montreal, Quebec, Toronto, Calgary

American Steam Gauge & Valve Mfg. Co.
New York Chicago BOSTON Atlanta Pittsburg

P&C CO

Valves and Asbestos-Packed Cocks

Send for Catalog

PRATT & CADY COMPANY, INC.
HARTFORD, CONN.

Canadian Representatives

The Canadian Fairbanks-Morse Company, Limited
Halifax St. John Quebec Montreal Ottawa Toronto Hamilton
Windsor Winnipeg Saskatoon Calgary Vancouver Victoria

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

Shortage of Man Power

can be largely overcome by the LASTING QUALITIES OF MATERIALS USED.
You can secure the maximum service from your rod packing by using

TRADE MARK
"PALMETTO"

a packing made strictly of first grade materials and carries graphite lubricant in each single strand, insuring LONG LIFE EVEN UNDER HARD CONDITIONS.

May we send you (without charge), working samples to prove quality?

Greene, Tweed & Co.
Sole Manufacturers
109 Duane Street
NEW YORK

Canadian Agents:
The Canadian Fairbanks-Morse Co., Limited
St. John, Toronto, Quebec, Hamilton, Montreal, Ottawa, Vancouver, Victoria

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

You'll Not Need So Much Coal!

You can't afford to waste coal by inefficient methods of heating your water supply in these days of fuel shortage and high prices. Both fuel and repair expense can be saved by installing

ALBERGER MULTI HEAD HEATERS

They save coal by the rapid heat transfer between the steam and the water. Less steam is required because of their efficient multi-pass design made up of four or more groups of helically corrugated copper tubes. The divided floating head compensates for the unequal expansion of the tubes due to the temperature difference between the water as it enters and leaves the heater.

The internal troubles are removed and all the usual troubles, such as leaks, split tubes, cracked heads, etc., disappear.

The tube corrugations also cause the water to take on a whirling, scouring action which lessens the tendency to scale.

Both the operating and upkeep expense is therefore small.

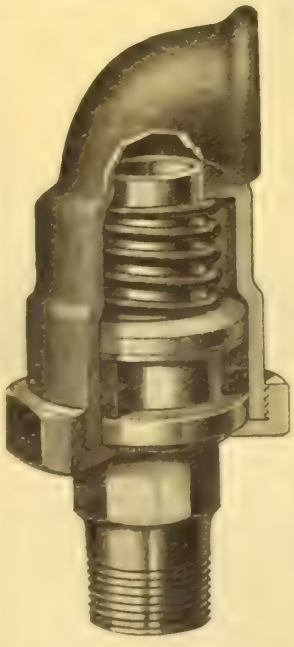
Alberger Heaters are furnished in capacities from 200 to 200,000 gallons per hour. Let us send you complete data.

ALBERGER HEATER COMPANY, BUFFALO, N.Y.

GENERAL SALES AGENTS:

CANADIAN FAIRBANKS-MORSE COMPANY, Limited

St. John Montreal Ottawa Toronto Hamilton Quebec Calgary Windsor Vancouver Winnipeg Victoria



Tuxeda SWING JOINTS

Provide one of the easiest ways to save coal

Every pound of steam that escapes through a leaky connection represents a certain amount of coal wasted. Do you know that an average leak will waste 3,400 pounds of steam a month? Investigate your flexible steam connections at once and then investigate the Tuxeda Swing Joint.

A Guaranteed Solution for Your Flexible Connection Problems

Send for Bulletin "A" to

FRANKLIN WILLIAMS, INC.

New York City

General Sales Agents: Canadian Fairbanks-Morse Co., Ltd.

FOR Steam or Air Drill, Pneumatic Tools, Boiler Flue Cleaning, Syphon Connections, Suction Lines.

For all kinds of Oil, Gasoline, Paints, Hydraulics, Gas.

"PENFLEX" METAL HOSE

INTERLOCKING

An all Metal Flexible Hose. Manufactured in Bronze or Galvanized Steel. Will withstand highest pressures. Is unsurpassed for durability and pressure resisting qualities.

Large Stock Carried in Canada

Pennsylvania Flexible Metallic Tubing Co.

Philadelphia, Pa.

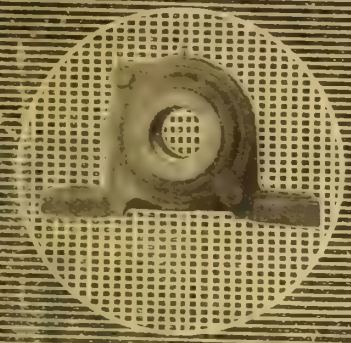
Canadian Agents:

The Canadian Fairbanks-Morse Co., Limited

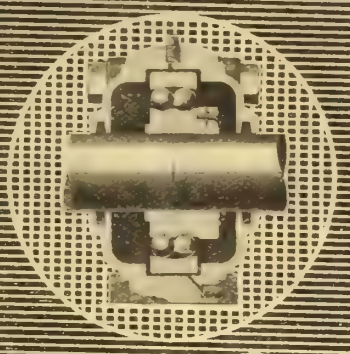
St. John, Quebec, Montreal, Ottawa, Toronto, Hamilton, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria

THE CANADIAN FAIRBANKS-MORSE COMPANY LIMITED

SKF
BALL BEARINGS AND RIGID PILLOW BLOCKS



Full View of Rigid Pillow Block



Sectional View of Rigid Pillow Block

They Insure

1. Saving in Power
2. Saving in Maintenance.
3. Saving in Lubrication.
4. Saving in Equipment.

How to Measure Transmission Losses

ELECTRICALLY EQUIPPED PLANT

First Throw the belt off the motor-driven shaft to test and take proper reading for input to drive motor only.

Second: Put the belt back on the motor pulley and shift all belts on the main line to the idler pulleys on the counters. Take power reading. The difference between these two readings will show the net line shaft transmission loss.

STEAM PLANT

First: Ease the belt off the fly wheel or pulley of the engine, indicate the engine.

Second: Put the main driving belt back and run line shafting at normal speed with all belts driving loose pulleys only, indicate the engine. The difference between the indicated readings with the main belt off and on will show the net line shaft transmission loss.

It will then be a simple matter to figure out by dollars and cents the amount wasted annually in the friction loss of plain bearings, and it will be easy to determine if it is worth while to save 50% of this waste by the application of S K F Ball Bearing Hangers or Rigid Pillow Blocks.

Bulletin No. 78 Proves Facts

Canadian SKF Co., Limited, Toronto, Ontario

Sales Agents for SKF Transmission Bearing:

The Canadian Fairbanks-Morse Co., Limited

St. John, Quebec, Montreal, Ottawa, Toronto, Hamilton, Windsor, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria

The MacLean Business & Class Publications in Canada

TO SELL or buy from Canada such lines as machinery, hardware, food products, dry goods, books and stationery, paper, printing machinery and supplies and general merchandise of almost every description, raw or manufactured, use or consult the MacLean Business and Class Publications, as per list below. For special information, write the publishers. Concerning the quality of the MacLean publications, let this copy of POWER HOUSE which you hold in your hands speak for all. The MacLean list of 14 publications is as follows:—

The Canadian Grocer (Est. 1886)
Serving the Grocery, Provision and Foodstuffs Trades. Published weekly.

Hardware and Metal (Est. 1889)
Serving the Hardware, Stove and Metal-working Trades. Published weekly.

Dry Goods Review (Est. 1889)
Serving the Dry Goods Trade generally; Wholesale, Retail, Manufacturing and Department Stores. Published monthly.

Men's Wear Review (Est. 1898)
Serving the Manufacturers of Clothing, Underwear, Shirts, Collars, Neckwear, Footwear, Hats and Caps and Allied Sundries, and their Retail Distributors. Published monthly.

Canadian Machinery (Est. 1905)
Serving the Machinery, Metal-working, Iron and Steel, Foundry and Allied Trades. Published weekly.

The Power House (Est. 1907)
Serving the Operating and Consulting Engineers and Power Superintendents, Devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power; and to the operation of Refrigerating Machinery. Published monthly.

Bookseller and Stationer (Est. 1884)
Serving the Book, Stationery, Fancy Goods and Associated Trades. Published monthly.

The Sanitary Engineer (Est. 1907)
Serving the Manufacturers of Sanitary, Heating and Ventilating Machinery, Systems and Equipments, and those installing them. Published semi-monthly.

Marine Engineering of Canada (Est. 1910)
Serving the Marine Engineering, Merchant and Shipbuilding Trades. Published monthly.

Canadian Foundryman (Est. 1909)
Serving Foundries and the Pattern-making, Plating and Polishing Trades. Published monthly.

Printer and Publisher (Est. 1892)
Serving the Publishing, Printing, Paper-making and Allied Trades. Published monthly.

The Financial Post (Est. 1907)
Serving the Business, Investment and Financial Interests of Canada. Published weekly.

MacLean's Magazine (Est. 1896)
A popular family and literary magazine; the most important in its field in Canada. Published monthly.

The Farmers' Magazine (Est. 1910)
Serving the agricultural and rural communities of Canada. The only farm and country life publication in Canada having extensive national circulation. Published semi-monthly.

This fact may interest you: namely, the MacLean organization is the largest concern of its kind in the British Empire. The output of its mechanical department every working day is the equivalent of a 125-page publication of the size and type of this copy of *Power House.*

Our London Office 88 Fleet Street, E. C.

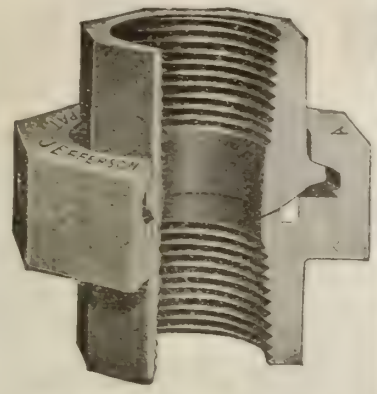
Also at New York Boston Chicago Montreal Winnipeg

For over 20 years the MacLean Publishing Company has maintained a fully-staffed London office, and has rendered British and Continental manufacturers, shippers, and traders an invaluable service in many directions.

Specimen copies of the MacLean publications will be cheerfully forwarded to all asking for them. Address us at London or Toronto.

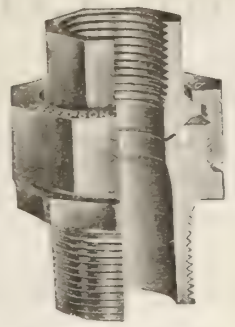
The MacLean Publishing Co., Limited

143-153 University Avenue Toronto, Canada



"Look for the Name on the Nut"

Buy Thrift Unions—



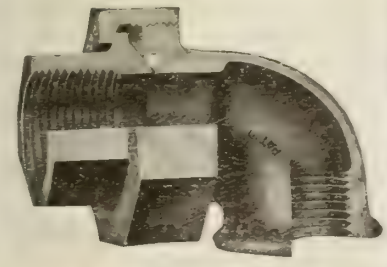
"Look for the Name on the Nut"

JEFFERSON UNIONS

THRIFT—our national watchword—must be practiced on every opportunity and from every angle. It is of utmost importance that waste of labor and materials be eliminated. JEFFERSON UNIONS are Thrift Unions because they conserve labor and materials. "Just-as-good" unions require almost as much material as "JEFFERSONS," shipping and installation costs are equal—but when the defective union breaks down, there is the added expense for repairs.

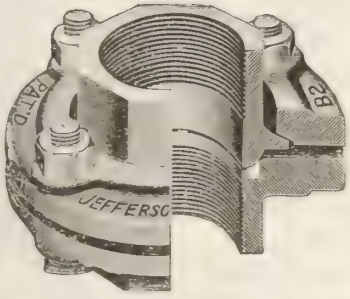
"SAFETY FIRST"—Insist on getting dependable unions. It's too late to investigate when superheated steam sizzles out of the "just-as-good" connection. The best sounding promise is valueless after the damage is done.

Your jobber has "JEFFERSONS" in stock that will meet practically every condition about the mine. Just look them over and you'll see why it's always safer to "look for the name on the nut." Write to-day for our Catalog, "UNIONS," which shows every JEFFERSON style and type.



"Look for the Name on the Nut"

Jefferson Union Company
Lexington, Mass.



"Look for the Name on the Nut"

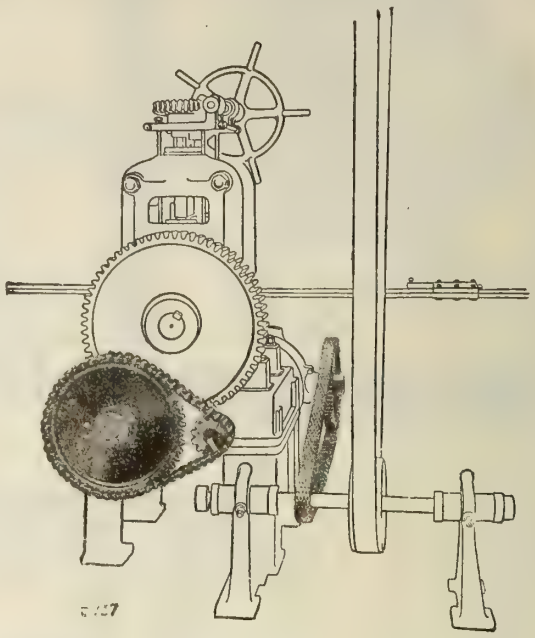
If any advertisement interests you, tear it out now and place with letters to be answered.

"THE COVENTRY" CHAIN DRIVES

THE ideal drive for all kinds of power transmission. In the case of the rolling mill illustrated, considerable power, large reduction of speed ratio, even flexible torque, silence and short centres are required. Note short distance between centres in front chain drive.

THE COVENTRY
REGISTERED TRADE MARK

THE "COVENTRY" CHAIN Co., LTD.
COVENTRY, ENGLAND
Cables: Chains, Coventry. Codes A.B.C., 4th and 5th Editions, and Western Union



Rolling Mill for producing stream live wire for aeroplanes. Diameter of rolls 9", rolling speed 20.0 per minute.

Williams' Superior Drop-Forged Wrenches

Big Ones
Little Ones
Bent Ones
Straight Ones
Thick Ones
Thin Ones

40 Standard Patterns in about 1000 sizes with openings from 3 16 to 7-5 8 inches.

Ask for Booklet

J. H. WILLIAMS & CO.
"The Wrench People"

The A. G. Low Co., Ltd., 78 Pacific Avenue Saskatoon, Sask. Agents for Saskatchewan, Manitoba, Alberta and British Columbia.

General Offices: 78 Richards St., Brooklyn, N. Y.

"Cut-and-Come-Again"

There is an old-fashioned flower called "Cut-And-Come-Again," which always makes us think of

VULCABESTON

Red Fibre Sheet Packing

TRADE MARK
"VULCABESTON"
REG IN U.S. PAT OFFICE
RED FIBRE
STEAM
MFD EXCLUSIVELY BY The Johns Pratt Co HARTFORD CONN USA
AIR & GAS
AMMONIA
SHEET PACKING

because people who cut up a sheet for packing always come again for more.

The increased demand for Vulcabeston is based solely on its demonstrated merit. People who use it find it unequalled in endurance, easily handled and adaptable to every service.

For economy's sake, try and see for yourself.

The Johns-Pratt Company

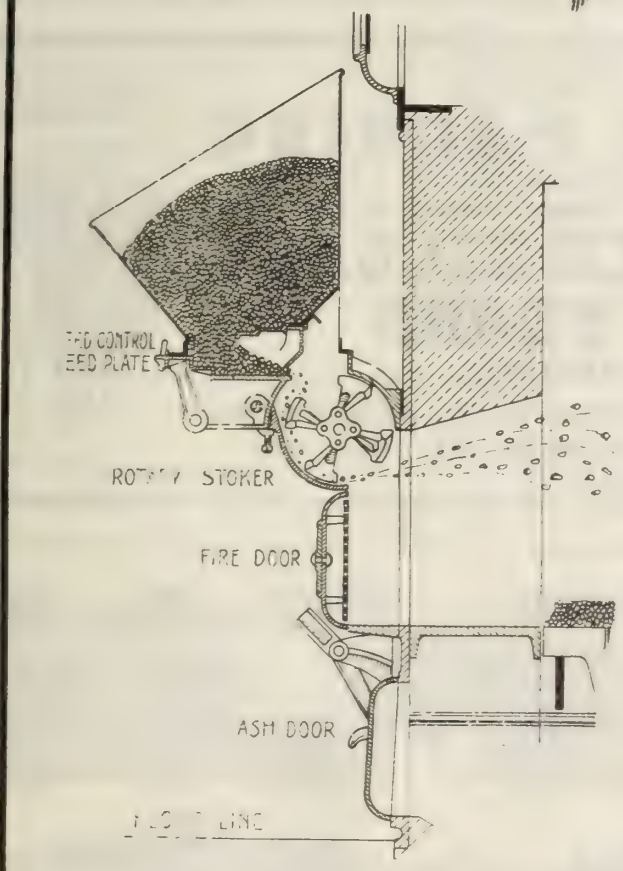
Hartford, Conn., U.S.A.

Montreal, Que., Ross & Greig; Toronto, Ont., James Morrison Brass Mfg. Co., Ltd.; Vancouver, B.C., Victoria, B.C., Fleck Bros., Ltd.; Winnipeg, Man., Crane Co.

J-P J-P

Galt Sprinkler Stoker

See the Sprinkler in action! Note how logically it operates!



Cut Your Coal Bill 10 to 20%

YOU can declare dividend of 10 to 20% on your coal investment every day, week, month and year that the GALT SPRINKLER STOKER is installed in your plant. This is a fact that is being proven every day by many of Canada's most prominent firms. Some of them include:

R. Forbes Co., Ltd., Hespeler, Ont.—First order, 6 Stokers; second order, 10 Stokers.

Municipal Hospital, Winnipeg, Man.—First order, 2 Stokers; second order, 5 Stokers.

Hudson Bay Co., Vancouver, 4 Stokers.

Parliament Buildings, Edmonton, 6 Stokers.

Royal Bank Building, Toronto, 4 Stokers.

Reports from leading reliable firms confirm the facts that GALT SPRINKLER STOKERS—

1. **Effect a saving in coal from 10% to 20%.**
2. **Effect a saving in labor from 25% to 50%.**
3. **Give a brilliant, thin, perfectly level fire.**
4. **Give smokeless combustion.**
5. **Increase the boiler capacity.**
6. **Increase the percentage of the CO$_2$.**
7. **Burn the fuel completely to the finest ash.**
8. **Operate for years without need of repairs.**

WE SUPPLY FORCED DRAFT TURBINES, COAL CRUSHING MACHINERY, SHAKING GRATES, ETC.

GALT FOUNDRY CO., LTD.

GALT, ONTARIO, CANADA

This book should be in the hands of every pump user. A postal will bring your copy promptly

MARSH and AMERICAN

Steam and Power Driven Pumps and Air Compressors

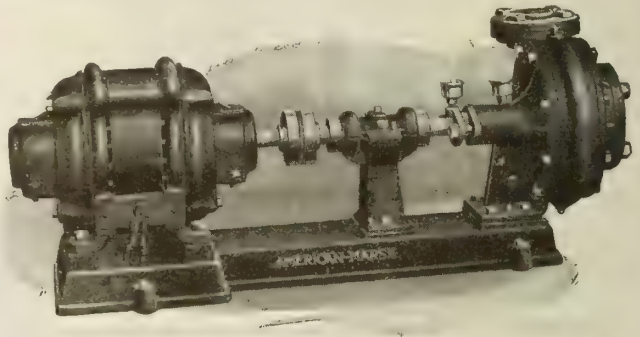
Marsh and American Pumps are especially adapted for long, hard service because they are *extra heavy* in design and of *extremely rigid construction.* Every unit is built amply strong to withstand 24-hour-a-day service and to stand up under any unforeseen strain which may be placed upon it. Piston rods on the steam pumps are extra large and made of solid bronze. The water ends are equipped with heavy cast bronze removable bushings.

This superior construction not only insures continuous and satistactory operation, but practically *eliminates expensive shut-downs.* Marsh and American Pumps are the product of over 25 years' experience in the design and construction of high grade pumping machinery. Over 135,000 in actual service throughout the world.

The AMERICAN-MARSH LINE OF CENTRIFUGAL PUMPS is composed of both single and double suction types which are designed for heads up to 125 feet. They are equipped with wide ring oiled bearings and the single suction type has overhanging casing enabling the discharge to be taken at any angle desired.

CANADIAN AGENTS

A. R. Williams Machinery Co., Toronto.
Williams & Wilson, Montreal.
London Engine Supplies Co., London, Ont.
Stuart Machinery Co., Winnipeg.
Mechanics' Supply Co., Quebec, Que.
Gorman, Clancy & Grindley, Limited, Edmonton and Calgary.
Taylor Engineering Co., Ltd., Vancouver, B.C.



American-Marsh Centrifugal Pump.

American Steam Pump Company

Battle Creek, Mich.

Self-Lubricating

In Bulk

SAFETY PLASTIC

METALLIC PACKING

FOR STEAM, WATER, AIR, GAS, ETC.

Pat. Dec. 22, 1903 Highest Award World's Fair, St. Louis, 1904

GUARANTEED TO LAST THREE YEARS

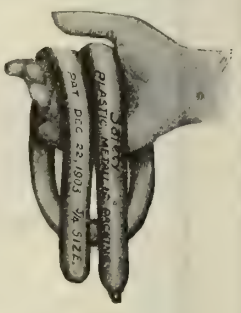
WITHOUT RENEWAL

Drop us a line and let us tell you all about this Remarkable Packing.

STEEL MILL PACKING CO., WINDSOR, ONT. Established 1899

AGENTS WANTED

Practically Frictionless

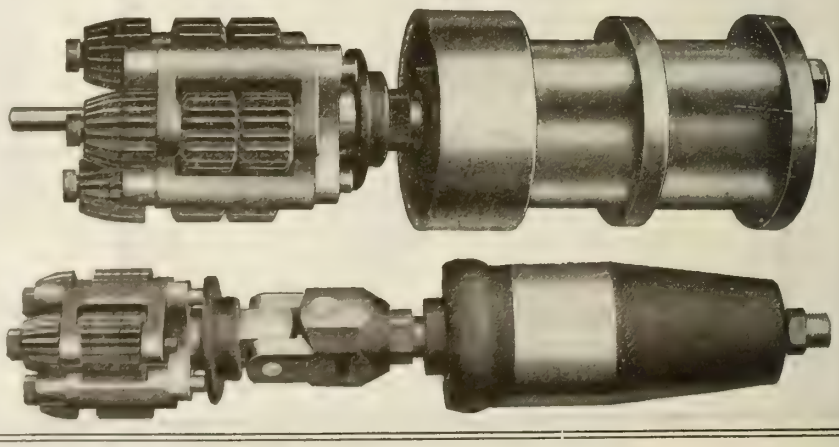


In Cotton Tubes

ROTO TUBE CLEANERS

Type A.D.—Driven by Air or Steam
Type W.D.—Driven by Water Pressure

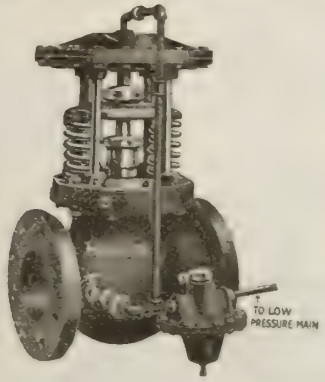
The use of Roto Cleaners is essential to the most efficient operation of Boilers, Condensers, Economizers, Evaporators, etc.
Roto succeeds where all others fail. It is faster, safer, more thorough and the standard of the largest steam power plants.

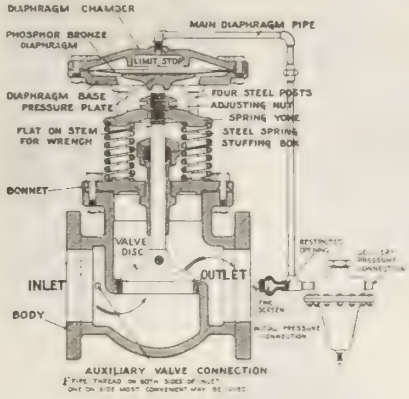


THE ROTO COMPANY
HARTFORD, CONN.
WRITE FOR CATALOG

MUELLER Reducing and Regulating Valve

SINGLE SEAT; AUXILIARY OPERATED





E5030 for Water, Gas and Air
E5130 for Steam
(Flanged or Screwed)

Very Popular with Shipbuilders

USES

This valve is for use on exacting installations. It will make any desired reduction and will maintain a constant delivery pressure regardless of fluctuations of the initial pressure.

CONSTRUCTION OF STOCK REGULATORS

All valves have iron bodies, bronze stem and stuffing box, phosphor bronze diaphragms, seats of composition suitable for the required service; iron diaphragm chamber and steel springs. The main valve is controlled entirely by the small auxiliary valve. This auxiliary valve closes and opens the main valve by admitting initial pressure to, and releasing it from, the diaphragm chamber of the main valve according to the demand of the delivery side. Regulators of this description are suited for pressures up to 150 pounds, and will be furnished at above prices. When regulators are required for pressures in excess of 150 pounds we will furnish suitable material. Prices upon application.

STRAINER

In all cases it is advisable to use a strainer to prevent obstruction from grit, scale, cuttings, etc. Blow out pipes thoroughly before installing valve.

INFORMATION IN ORDERING

In ordering give highest and lowest initial pressure and required low or delivery pressure, approximate quantity or volume to be used per minute, size of high pressure pipe and low pressure pipe.

In ordering flanged end valves give diameter of flanges and bolt circles and the number and size of bolts.

INSTALLATION

Note.—Any proper working regulator acts as a check valve. Where the building up of the pressure is to be avoided use our diaphragm operated relief valve E5060.

We will not be responsible for improper selection of valves.
Consult us regarding the best type for your service.

H. MUELLER MFG. CO., LIMITED

SARNIA - CANADA

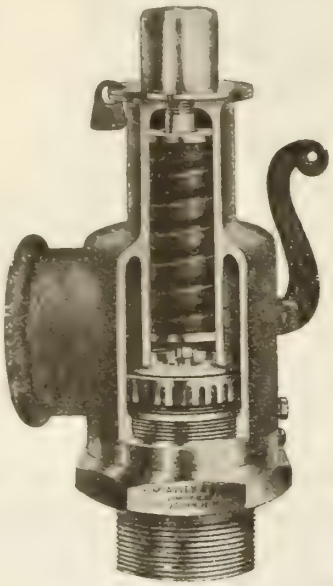
Victory Loan, 1918, H. Mueller Mfg. Co., Ltd., first in Canada to exceed quota and receive Honor Flag.

"McAVITY"

Improved Side Outlet

Brass Pop Safety Valve

Lock up Pattern



Approved by the Governments of the Provinces of Ontario, Alberta, Saskatchewan and British Columbia

For use on boilers carrying pressures up to and including 200 lbs.

One of the features of this Pop Valve is the spring case, which keeps the steam from striking directly on the spring, thus preventing corrosion. Also provided with a stop to prevent valve from flying off seat in case spring breaks.

T. McAVITY & SONS

LIMITED

St. John, N.B., Canada

MONTREAL
T. McAvity Stewart
157 St. James St.

TORONTO
Harvard Turnbull & Co.
207 Excelsior Life Bldg.

WINNIPEG

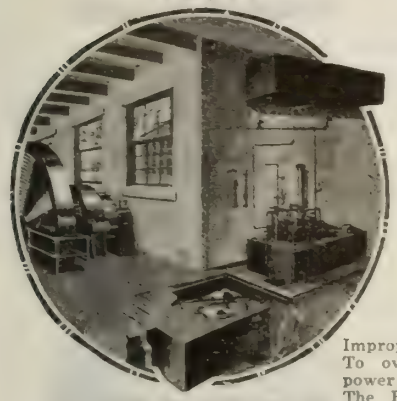
GREETINGS

Greetings and sincere good wishes this Yuletide

May the coming twelve-month crown your every effort with success and may you enjoy the fruits of a Victorious Peace.

THE LUNKENHEIMER CO.
CINCINNATI

Conservation of Power



6 F TYPE OIL FILTERING AND CIRCULATING SYSTEM

With the

BOWSER ESTABLISHED 1885

OIL CIRCULATION and FILTERING SYSTEMS

Improper lubrication causes friction. To overcome friction and carry the power house load, extra power is used. The Bowser System stops this waste of power by providing an unvarying supply of oil for the bearings at all times.

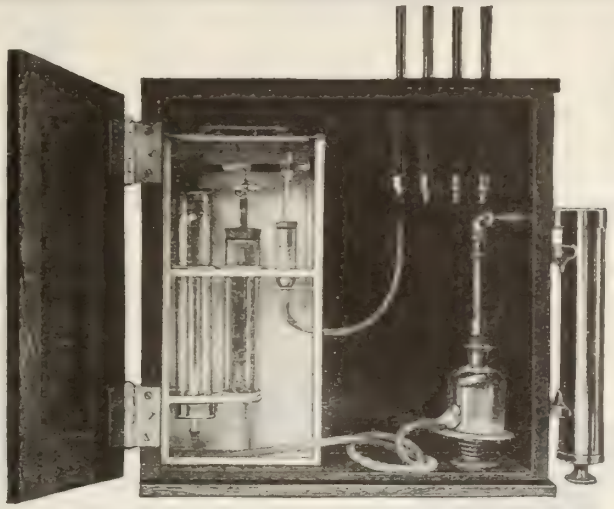
You can see how Bowser will save for you—save power, save shutdowns, save repairs, add to the life of your machinery, increase your production.

Bowser Engineering Department at your Service.

S. F. Bowser & Co., Inc.

Toronto, Ont.

Sales Offices in all Centres *Representatives Everywhere*



Defender CO_2 Case

A permanent equipment for the Boiler Room to mount either Single or Three Chamber Gas Analysers in and the gas lines from the different boilers can be run into the case. The Defender Gas Suction Pump is mounted on the outside of the case at the right. The spring shelf is for holding the water bottle up to the gas line. A few draws of the gas pump will draw the gas from any boiler into the analyser; in this manner a reading for CO_2 can be taken in less than one minute's time.

No Orsat is complete for a boiler room that is not permanently installed in a case and with gas pump.

PRICE AS ILLUSTRATED, $42.50.

Write for Catalogue No. 10 showing the largest line of Combustion Appliances and Damper Regulators made.

Defender Automatic Regulator Co.

709 Pine St. St. Louis, Mo.

"How to Hire, Train and Supervise Men"

"Getting Better Results From Salesmen"

Learn how successful business men handle these important problems by reading

Management and Salesmanship

By

Hugh Chalmers, Pres. Chalmers Motor Car Co.
John Lee Mahin, Pres. Mahin Advertising Agency

This book is written in a clear, concise style easily understood, every paragraph a mine of good solid facts prepared by these two thinkers and workers. You cannot afford to be without this book if you have management and salesmanship problems to solve.

The price is only 50 cents. Send for your copy to-day; the supply is limited.

MacLean Publishing Co., Ltd.

Technical Book Dept.

143-153 University Ave. - Toronto

UEHLING WASTE METER

COMBINED

CO_2 AND TEMPERATURE RECORDER

Record of CO2 and stack temperature on one chart.

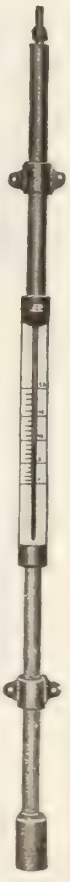
Does your fireman know how much fuel he is wasting? Do you know?

The **Uehling CO_2 Recorder** makes a complete 24 hr. record of your combustion efficiency and the **CO2 indicator at the Boiler Front holds the fireman responsible.**

Get more **Steam** per pound of **Coal** and reduce your annual fuel consumption.

CO2 Indicator for Boiler Front

Let us know the number and size of your boilers and coal consumed per year, upon receipt of which information we will be glad to send you full particulars.



Let us hear from you. We are pioneers in the manufacture of Indicators and Recorders for Power Plant purposes.

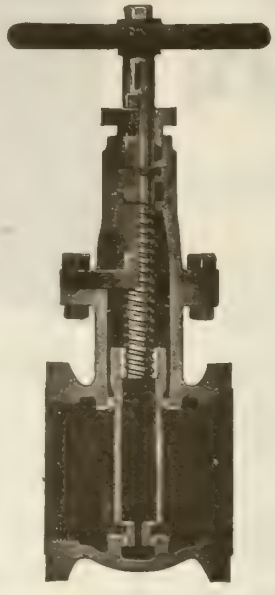
Send for our Bulletin No. 110.

Uehling Instrument Company

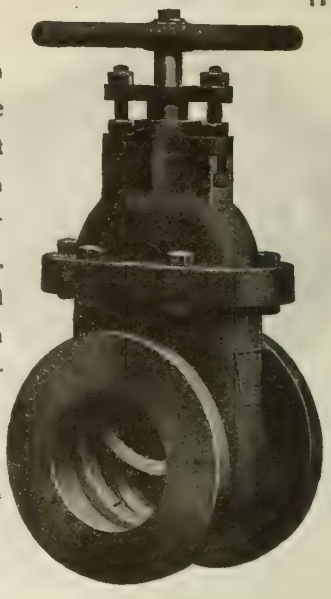
2008 Empire Building **New York City**

KERR
("New KEYSTONE" Pattern) GATE VALVES

If you have not used any of these New Pattern Valves, specify "KERR" in your next order. We want you to get acquainted with the most reliable valve on the market.



If you have been using them, we are confident that our satisfaction will bring us your repeat orders. These valves will never cause you or your customer the slightest trouble. Their high quality is consistent.

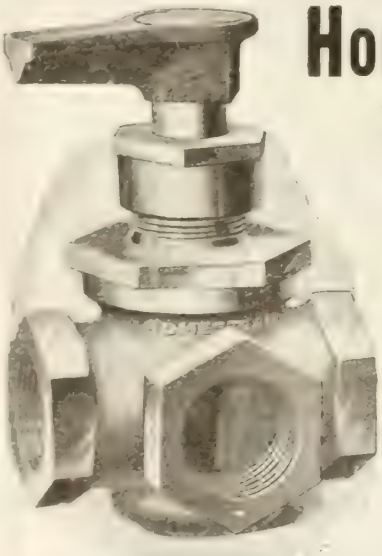


When you buy a "KERR" Valve you get a guaranteed article that is backed by a reliable firm. Many of the largest distributers of valves in Canada have sold "KERR" Valves for over 25 years, and are still recommending them as the "Best Valve." Write us for particulars.

Kerr Engine Co., Ltd., Valve Specialists **Walkerville, Ont.**

Under All Pressures

Homestead Quarter-turn Valves are positively leak-proof. Under conditions unusually severe they have proven best for all services—steam, oil, air, water, acids, etc.

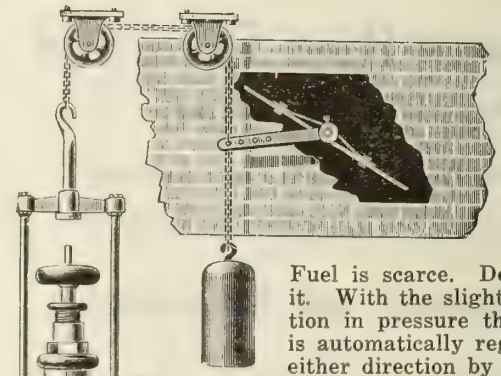


Homestead
Quarter-Turn
Valves

are used instead of globe and gate valves in hundreds of power plants, with the result that all pipe lines in these plants are absolutely tight.

You prevent leaks—and that is stopping waste—and you avoid much troublesome work, by using Homestead Quarter-turn Valves. Order some to-day.

HOMESTEAD VALVE MFG. CO.
HOMESTEAD, PA.



Save Fuel

Fuel is scarce. Don't waste it. With the slightest variation in pressure the damper is automatically regulated in either direction by the

CURTIS
Improved Damper Regulator

It is a simple, durable and effective device. Positive and automatic in operation.

Write for our 1918 catalog showing the Curtis line of Engineering Supplies.

JULIAN D'ESTE COMPANY
26 Canal Street BOSTON, MASS.

Agencies:
216 Fulton Street, New York City
174 North Market Street, Chicago, Ill.

If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

A Little Device With a Big Job Ahead of It

The Dominion must get more **useful** heat out of its coal; that fact is more obvious than either the **cause** of coal-waste or the **remedy** for it.

Those who know the possibilities for coal-waste in steam-heating systems—and those who ask for authoritative advice on the subject—realize that radiators choked with air and water are guilty in the highest degree.

The Dunham Radiator Trap **can** stop this waste of coal —**is** stopping it in homes, office buildings and factories everywhere—and **will** stop it for you.

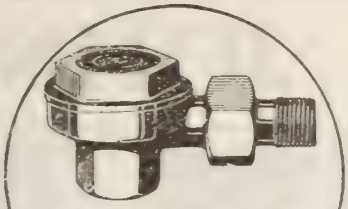
The DUNHAM HEATING SERVICE

We believe in FACTS and will gladly present them to you in a most convincing manner

C. A. DUNHAM CO., LIMITED

TORONTO - ONTARIO

Hamilton Montreal Ottawa Winnipeg
Vancouver Calgary

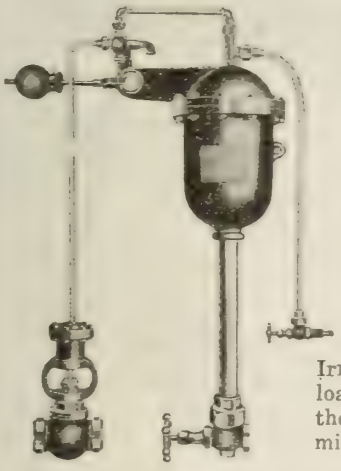


DUNHAM
Radiator Trap

It is screwed into the bottom of the radiator, requires no attention, makes no noise, cannot leak steam or water. By permitting the steam to fill the entire radiator it gets more *useful* heat from the coal. Can be applied also to existing steam heating systems.

It comprises a body, a cover and a thermostatic disc which is secured in the cover. There are no loose parts—no sliding contacts—nothing to gum up —nothing to obstruct the valve opening. It is made with special roughing-in measurements for the replacing of imitating devices.

VIGILANT Feed Water Regulator



Is it worth your while to take chances when a few dollars would install the Vigilant, and with it on the job you would know you were fully protected from high and low water accidents?

Irrespective of firing or load variations, it keeps the water within ¼" of middle gauge.

And it positively cannot get out of order. Has no float or other unreliable part.
Moreover, this Vigilant Feed Water Regulator will lower your fuel consumption 3 to 17%.

Write for Catalog.

The Chaplin-Fulton Manufacturing Campany

28 Penn Avenue - Pittsburgh, Pa.

DAVIS PRESSURE REGULATORS

One of the Davis Steam Savers

can be depended on to maintain an even, steady steam pressure —regardless of fluctuations in the load or in the boiler pressure.

Davis Pressure Regulators are steam savers as well as trouble savers. They automatically reduce any pressure—steam, air or water—to any desired lower pressure. Steady, sturdy reducing valves that can be relied on at all times and under all conditions. Positive in action—no diaphragms, no springs, no delicate parts.

Write the G. M. Davis Regulator Co., 434 Milwaukee Ave., Chicago, for the new Davis Catalog of steam savers. Branches in principal cities

DAVIS VALVE SPECIALTIES
STEAM SAVERS SINCE 1875

JOHNS-MANVILLE

MASTIC FLOORING—For the over-worked floor in the war-time plant

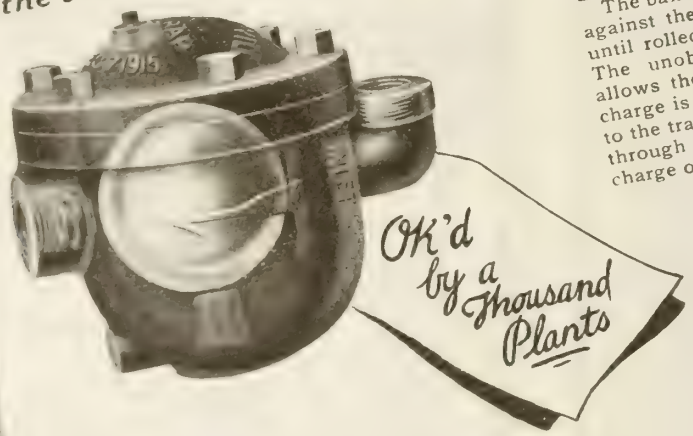
Under conditions where hard usage and accidents make occasional repairs necessary—Johns-Manville Mastic Flooring offers another advantage and again proves its superiority.

Mastic Flooring is easily repaired. Just cut out the worn or damaged section. Reheat this same material with a small amount of flux which we furnish, then relay. The new spot—floated and rubbed down to the proper level—is immediately one piece with, and has all the characteristic qualities of the surrounding floor.

Johns-Manville Mastic Flooring is unequalled even under the heaviest trucking conditions. It is waterproof and is unaffected by alkali, brine and ordinary acid solutions. It is noiseless in character and of a peculiar holding quality which tends to prevent slipping.

Extremely tough and durable, under ordinary service Johns-Manville Mastic is practically wear-proof and under abnormally severe usage its maintenance cost is a minimum.

Its simplicity is its life insurance the Johns-Manville Steam Trap



WHEN you use Johns-Manville Steam Traps you don't have to figure depreciation, because it is practically nil. And the same simplicity of construction which insures it against wear makes the Johns-Manville Trap positive in operation. There's nothing to get out of order and nothing to adjust.

The ball is the only moving part. It is held against the outlet orifice by steam pressure until rolled up by water rising in the trap. The unobstructed orifice—now exposed—allows the water to discharge and the discharge is continuous as long as water flows to the trap. If air is present, it is drawn out through the vortices that form at the discharge orifice.

Johns-Manville Steam Traps are made in various sizes for all commercial pressures. Ask our nearest branch to send you the Steam Trap Bulletin.

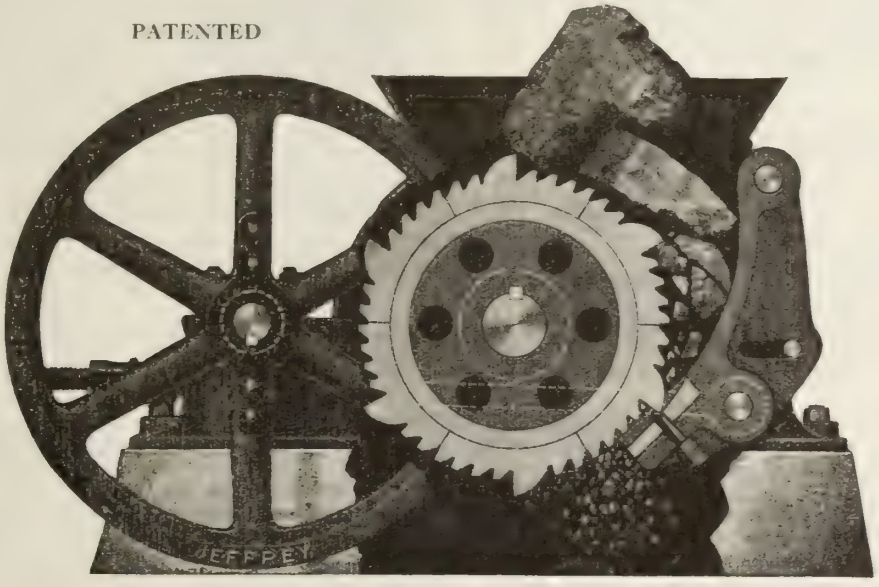
Canadian
JOHNS-MANVILLE CO.
Montreal Toronto Vancouver Winnipeg
Hamilton London Ottawa

JOHNS-MANVILLE SERVICE
COVERS THE CONTINENT

Where is Your Supply of Stoker Coal to Come From?

From all indications a repetition of last winter's coal shortage is inevitable. Manufacturers, power companies and railroads are storing coal in large quantities and the coal operator ships the sizes most easily loaded, that is, Run-of-Mine or Lump.

PATENTED



Make the Desired Sizes of Coal Yourself

By Using The

JEFFREY SINGLE ROLL COAL CRUSHER

In a single operation this machine reduces Run-of-Mine or Lump to the proper size for maximum heat effiiciency in stokers.

Bulletin No. 141-4 gives complete information why the Jeffrey Crusher safeguards your coal supply and eliminates the worry of buying properly sized coal. Write for copy.

THE JEFFREY MFG. CO.

Canadian Branch and Warerooms:
MONTREAL

Headquarters for Chains and Attachments, Sprockets, Elevators, Buckets, Boots, Casings, Spiral and Belt Conveyer, Gears, Etc.

If any advertisement interests you, tear it out now and place with letters to be answered.

Becoming a Bigger Man

WHAT is the difference between some men you know and others known to you? Why are some men earning $3,000 a year and some $30,000? You can't put it down to heredity or better early opportunities, or even better education. What, then, is the explanation of the stagnation of some men and the elevation and progress of others?

We are reminded of a story. A railroad man, born in Canada, was revisiting his home town on the St. Lawrence River. He wandered up to a group of old-timers who sat in the sun basking in blissful idleness. "Charlie," said one of the old men, "they tell me you are getting $20,000 a year," "Something like that," said Charlie. "Well, all I've got to say, Charlie, is that you're not worth it."

A salary of $20,000 a year to these do-nothing men was incredible. Not one of the group had ever made as much as $2,000 a year, and each man in the company felt that he was a mighty good man.

Charlie had left the old home town when he was a lad. He had got into the mill of bigger things. He developed to be a good man, a better man, the best man for certain work. His specialized education, joined to his own energy and labor sent him up, up, up. To put it in another way: Charlie had always more to sell, and the world wanted his merchandise—brain, skill and ability. Having more to sell all the time, he got more pay all the time.

Charlie could have stayed in the old home town; could have stagnated like others; could have been content with common wages. In short, Charlie could have stayed with the common crowd at the foot of the ladder. But Charlie improved himself and pushed himself, and this type of man the Goddess of Fortune likes to take by the hand and lead onward and upward. Almost any man can climb higher if he really wants to try. None but himself will hold him back. As a matter of fact, the world applauds and helps those who try to climb the ladder that reaches towards the stars.

The bank manager in an obscure branch in a village can get out of that bank surely and swiftly, if he makes it clear to his superiors that he is ready for larger service and a larger sphere. The humble retailer can burst the walls of his small store, just as Timothy Eaton did, if he gets the right idea and follows it. It is not a matter of brain or education so much as of purpose joined to energy and labor. The salesman or manager or bookkeeper or secretary can lift himself to a higher plane of service and rewards if he prepares himself diligently for larger work and pay. The small manufacturer, the company director, the broker—all can become enlarged in the nature of their enterprise and in the amount of their income—by resolutely setting themselves about the task of growing to be bigger-minded men.

Specialized information is the great idea. This is what the world pays handsomely for. And to acquire specialized information is really a simple matter, calling for the purposeful and faithful use of time. This chiefly.

One does not have to stop his ordinary work, or go to a university, or to any school. One can acquire the specialized information in the margin of time which is his own—in the after-hours of business. Which means: If a man will read the right kind of books or publications, and make himself a serious student at home, in his hours—the evening hours or the early morning hours—he can climb to heights of position and pay that will dazzle the inert comrades of his youth or day's work.

IF business—BUSINESS—is your chosen field of work, we counsel you to read each week THE FINANCIAL POST. It will stimulate you mentally. It will challenge you to further studious effort. It will give you glimpses into the world of endeavor occupied by the captains of industry and finance. With the guidance of the POST, and with its wealth of specialized information, you, a purposeful man, aiming to go higher in life and pay, will find yourself becoming enlarged in knowledge and ambition, and will be acquiring the bases and facts of knowledge which become the rungs of the ladder you climb by.

It is the first step which costs. But this cost is trivial—a single dollar. We offer you the POST for four months for a dollar. Surely it is worth a dollar to discover how right we are in our argument. If yoou have the will to go higher in position and pay, sign the coupon below.

THE MACLEAN PUBLISHING COMPANY, LIMITED,
—143-153 University Avenue, Toronto.

Send me THE FINANCIAL POST for four months for one dollar.

Money to be enclosed remitted

Signed .....

P.H. .....

Why Laco Lamps Give More Light

Laco Bulbs are scientifically correct in shape
The Laco Vacuum is mechanically exhausted and sealed
Laco Filaments are made of higher-grade tungsten
Laco Filaments are mounted to give best distribution of light
Laco Filaments are mounted to best withstand rough usage
Laco Lamps are made complete in one factory and perfected in every stage

LACO NITRO LAMPS

are filled with rare, inert gases, including ARGON—the rarest and most efficient gas. Argon is almost unobtainable by other manufacturers, but is made in the LACO factories.

Laco Lamps are Guaranteed to Give the Candle-Power that U.S. Standard Specifications Provide

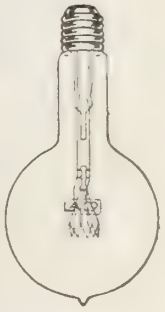
Our Lighting Engineers are at your service. Discuss your lighting problems with us to-day.

"Bulb-Blackening," Current-Consumption, Breakage Danger
are reduced to a minimum in Laco Lamps

The result is :
BRIGHTER--CHEAPER--LONGER LIFE

Laco Lamps are Guaranteed for 1500 Hours Useful Life

No other lamp promises more than 1000 hours, and very few average 60 % of this.



CANADIAN LACO-PHILIPS CO., LIMITED

MONTREAL TORONTO WINNIPEG VANCOUVER

Fuel Economy—

is a subject of increasing importance and one requiring careful study by every power plant operator and owner.

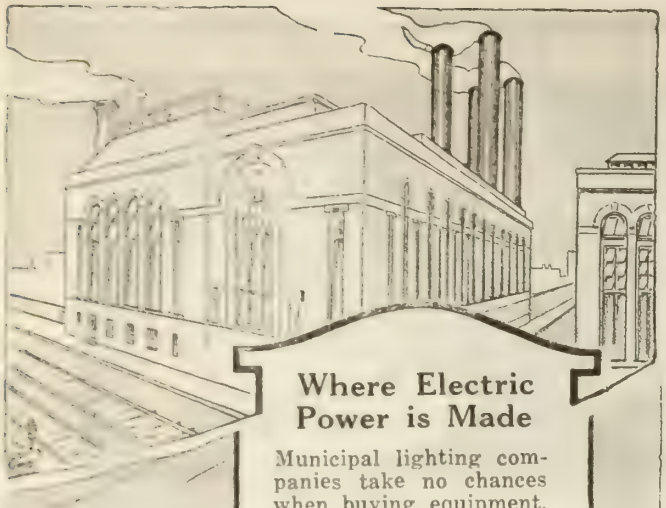
We are prepared to furnish a complete line of equipment for increasing the efficiency of power plants, including—

Green's Economisers
Radial Flow Forced and Induced Draft Fans
Type "E" Underfeed Stokers
Custodis Radial Brick Chimneys
Uheling CO_2 Recording Meters
Superheaters
Coal Handling Equipment
Ash Conveyors
Soot Blowers
Tube Cleaners

Our Engineers will be glad to inspect your plant at any time and submit suggestions for your consideration, or furnish information regarding the equipment listed above.

GREEN'S ECONOMISER, LTD.
TORONTO

MONTREAL WINNIPEG VANCOUVER



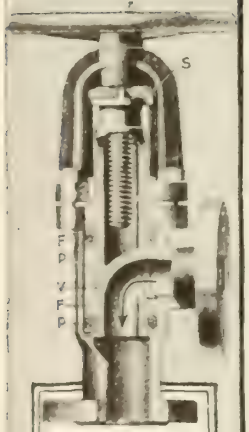
Where Electric Power is Made

Municipal lighting companies take no chances when buying equipment. As current must be supplied uninterruptedly, every precaution is taken against shut-downs.

Take corporations such as

Montreal Light, Heat & Power Co., using 24.
Cleveland Elec. Ill'g. Co., using 178.
Edison Elec. Ill'g. Co., Brooklyn, using 100.
Potomac Elec. Lgt. & Pr. Co., Washington, D.C., using 24.
Duquesne Lgt. Co., Pittsburgh, using 34.
Omaha Elec. Lgt. & Pr. Co., using 97.
Worcester Elec. Lgt. Co., Worcester, Mass., using 36.

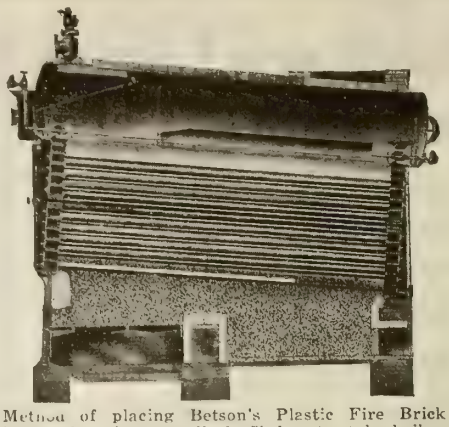
Each has its boilers equipped with from 24 to 178 YARWAY (formerly Simplex) "Seatless" Blow-off Valves—a choice that in effect, becomes a recommendation of the very highest character.
In the YARWAY (formerly Simplex) there are no seats or discs to cut, clog or grind down. There are no pockets to gather sediment—no obstructions of any kind. The port is free and wide open. Packing is protected and will last for years.
Other good points may be learned by trying a YARWAY for 60 days. It may be returned if not satisfactory.
Write for one to-day, stating size of line and whether screw or flange, angle or straightway.



Operation:
In closing valve, shoulder "S" on plunger "V" engages the loose follower gland "F," compressing packing "P" above and below the port, making an absolutely tight valve.

Yarnall-Waring Co.
[illegible]
Canadian Representatives
A. McELLAN
301 Read Bldg., Montreal.
Stock also carried by
James Robertson Co., Montreal
Cunningham Hdwe. Co.,
New Westminster, B.C.

YARWAY
Seatless Blow Off Valve
formerly the
SIMPLEX



Method of placing Betson's Plastic Fire Brick Baffles in a horizontally baffled water-tube boiler.

Baffles in Your Boilers?

Where are they, and what is their condition?
Do you ever look at them?
This is no idle question—more coal is being wasted by defective baffles in water tube boilers than in almost any other way. If the baffles have cracked, or slid out of place, or have been forced apart or crushed by the movement of the tubes, the furnace gases are allowed to short circuit, passing to the chimney at a high temperature.

Betson's Plastic Fire Brick Baffles as installed in a cross-baffle water-tube boiler.

The old idea that a square foot or heating surface in one boiler is just as good as a square foot in another is giving way to the more scientific notion that a great deal depends upon the gas circulation. The volume of the gases contracts about 50% due to the reduction of temperature in passing through the boiler, and many engineers are now proportioning gas passages so that a uniform velocity is maintained throughout. This implies tapering passages and sloping baffles, which are difficult to form with separate fire-brick baffle blocks, but are easily secured by the use of Betson's Plastic Fire Brick.

BETSON'S

REG. U.S. TRADE MARK PAT. OFF. PLASTIC FIRE BRICK

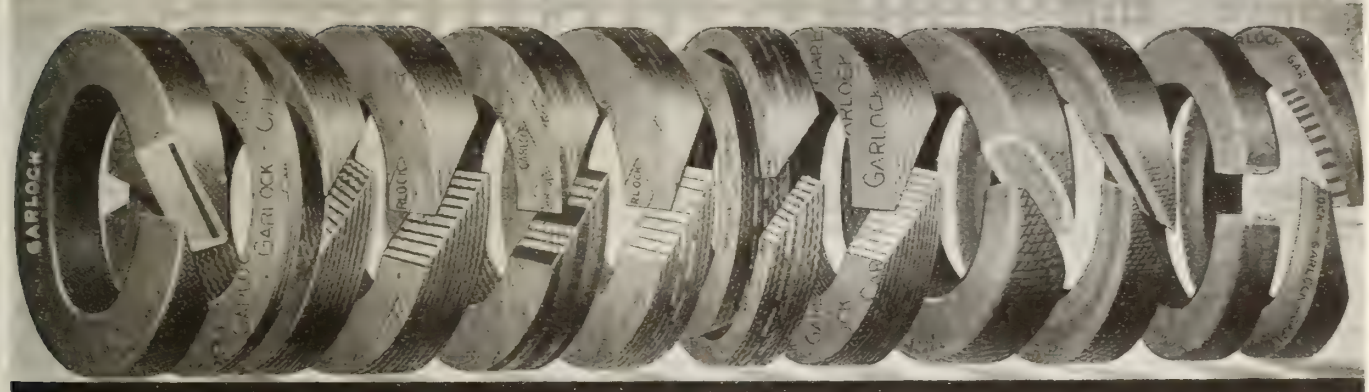
is the universal boiler lining material. It is placed in a moist, plastic condition, as received, compacted by pounding and vitrified by four or five hours' slow firing, after which the boiler can be put at once into full service. Betson's Plastic Fire Brick consolidates into a one-piece, gas-tight, jointless, leakless structure which does not fail by the cracking, spalling, disintegration of the fire brick mortar, and is not subject to the many other ills which attack separate block or brick linings or baffles.
Betson's Plastic Fire Brick is no mystery and no experiment. It consists of high-grade refractories, prepared by a special mechanical process which eliminates expansion and contraction. It has been in use for years in many large boiler plants. Order a barrel for emergency repairs, and by plugging up the holes you will be able to keep old block or brick linings in service for weeks, perhaps months, until you can shut down and reline completely with Betson's.
With Betson's there is no waiting, as for specially shaped blocks, nor for an expert mason. Your own men can do the work.

Ask for Catalogue "R"

BETSON PLASTIC FIRE BRICK CO.
P. O. Box 386-6, Rome, N.Y.

Canada:
International Chemical Corporation, 65 Bloor Street West, Toronto, Ontario, Canada. 67-F

GARLOCK PACKING



FOR EVERY PURPOSE

Thirty-one years ago we began to manufacture packing and during that time we have steadily insisted upon the best of everything that enters into our product—design, material, workmanship. Constant effort has been directed toward improving and perfecting our packings to keep pace with the wonderful progress that has been made in the development of modern machinery.

Our factories, devoted exclusively to the manufacture of our packings, are the largest, most modern and best equipped in the world, and the locations of our numerous branch factories and stores are such as to afford the greatest advantage in serving our customers promptly.

We are Exclusive Packing Manufacturers—We Make Nothing Else

THE GARLOCK PACKING CO.
Hamilton, Canada
Branches in Principal Cities

"Good Morning, Jim."

"Good morning, Mr. Hawley."

The new Superintendent had stopped in the engine room, where Jim, the Engineer, was getting everything ready for a flying start. The company had a big Government contract, and was running twenty-four hours a day, six days a week, three shifts and five engines, four of which were running.

"What are you doing with No. 5, Jim?" asked Mr. Hawley. "Got some belt trouble?"

"No, sir. While she's shut down I've had George paint the back of that new belt."

"Paint it?"

"Yes, sir, with CLING-SURFACE. You see, all belts get pretty dry, and it used to bother me a lot until I got this CLING-SURFACE. Well, the company advises painting the back of a good clean belt with CLING-SURFACE, so it will soak it up quicker and prevent cracking, and I gave it a trial. That's the new belt—all the others were painted about a year ago."

"How do they work?"

"Fine! There's the belt on No. 1. I had that painted last year, when Mr. Hodges was Superintendent, and put the CLING-SURFACE on just warm enough to use. You'd be surprised how quick the stuff got into the leather, and since then it's just as clean and pliable as a kid glove."

"Do they slip?"

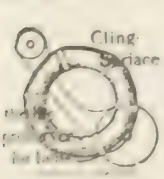
"Not a bit. George puts a little CLING-SURFACE on the belt face with a stick about once or twice a week—just as fast as they will take it up, and the belts always pick up the load and hold it. And I haven't had to take-up any one of them since this treatment was started a year ago."

* * *

It is a patriotic duty to conserve your present equipment. Instead of buying new belts, treat your present drives with CLING-SURFACE, and make them last longer and work better for you.

Prove it at our expense. Order a 25 or 50-pound can on trial—60 days, and with these results guaranteed **before** you pay.

Remember, use CLING-SURFACE and you won't need belt dressings.



Cling-Surface Co.
1057 Niagara Street
Buffalo, New York
U.S.A.

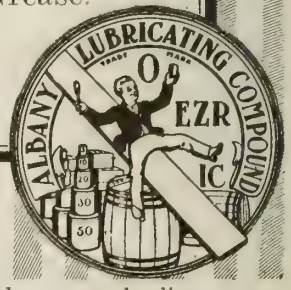
PACKINGS
AND
ENGINEERS' SUPPLIES
FOR
Satisfactory Service

Thomson-Gordon Limited
Hamilton, Ont.

ALBANY GREASE

for over 50 years has given a perfect lubrication service in power and industrial plants throughout the world. It is used by large industrial companies as well as small concerns equally successfully on their mechanical equipment. Albany Grease will keep all bearings and gears operating cool and easy at all times. Send for samples—now, if you are not using Albany Grease.

Albany Lubricating Co.
708-10 Washington Street
New York, U.S.A.
Established 1868



If what you need is not advertised, consult our Buyers' Directory and write advertisers listed under proper heading.

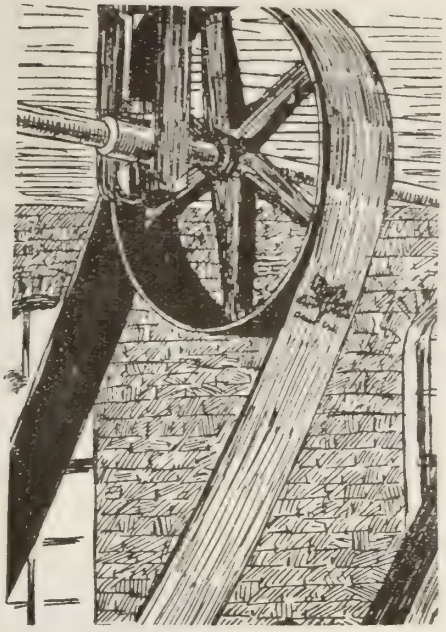
Mr. Chief Engineer—

Be able to say

"It's Working FINE"

when the Superintendent asks about the new belt you got your plant to buy.

Be sure to spccify



D. K. McLAREN'S

Genuine British Oak-Tanned

LEATHER BELTING

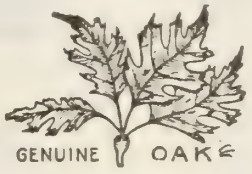
when putting in your requisition for a new belt. And you'll ensure a long, trouble-free, efficient service.

Think what being able to say "It's working fine," will mean to you instead of having to report trouble every little while, as is the case in many places where precaution is not exercised in the purchase of belting.

D. K. McLaren's Leather Belting is made exclusively from close-trimmed butts of the finest selected hides, tanned by the old-fashioned but the proven most effective British Oak Tanning Process.

It doesn't require the attention and expense that is common where ordinary belting is used, because there is practically no slip, and it seldom requires tightening.

Many of the largest Canadian Plants are our steady customers. If you wish to ask them how they like this belting, we will be glad to send you their names and addresses.



REGISTERED TRADE-MARK

This trade-mark guarantee is on every piece of D. K. McLaren's Leather Belting. Look for it.

D·K·McLAREN LIMITED

Head Office and Factory:
351 St. James St., Montreal, P.Q.

TORONTO, ONT.
194 King St. West

VANCOUVER, B.C.
849 Beatty St.

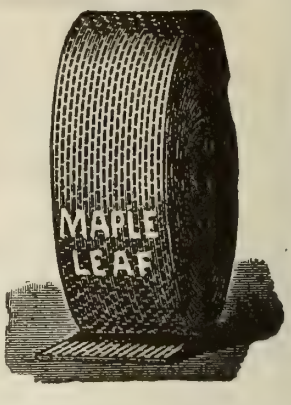
ST. JOHN, N.B.
90 Germain Street

Dominion Belting Company, Limited
Hamilton, Canada

Sole manufacturers of the celebrated "MAPLE LEAF" Brand Stitched Cotton Duck Belting and Belt Dressing.

The demand for our products has steadily increased because the standard of quality has been maintained.

We make only one grade, the best that can be produced.



"MAPLE LEAF" is the strongest, truest running, most economical and efficient belt on the market for transmission of power, conveying, etc.

Being thoroughly waterproof it is suitable for running in wet or dry places. **"MAPLE LEAF"** Belt Dressing is different to others offered in that it is equally good for all kinds of belting, leather, rubber or Balata, as well as our own make.

Write us for prices, and if desired we will be pleased to furnish samples and further information.

A trial order will convince you of their utility.

DOMINION BELTING CO. Ltd., Hamilton, Canada-Quebec Branch: 51 Duluth Bldg., Montreal

TRADE MARK

TRADE MARK

FOR CEMENT PLANTS

OKLAHOMA PORTLAND CEMENT CO.
Ada, Oklahoma

May 20, 1918.

Gentlemen: I am pleased to advise you we have used MAGNOLIA BABBITT in our plant some twelve years, in all crusher bearings, motor bearings, line shaft bearings and engine bearings.

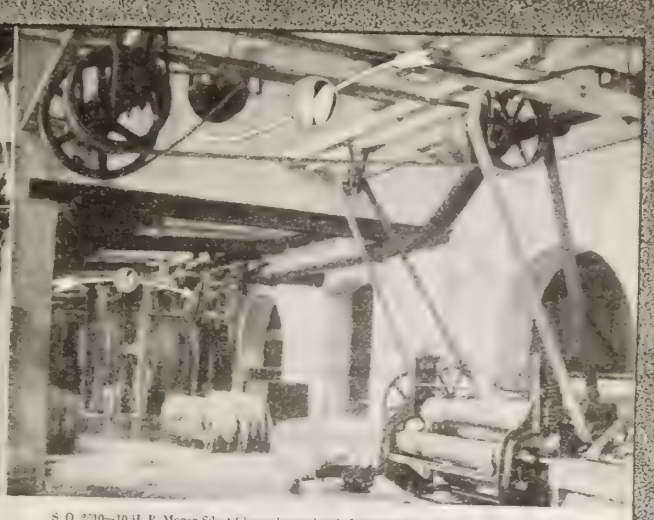
We have had the utmost satisfaction in the use of your Babbitt throughout our plant.

Yours truly,
J. M. WINTERSMITH,
General Manager.

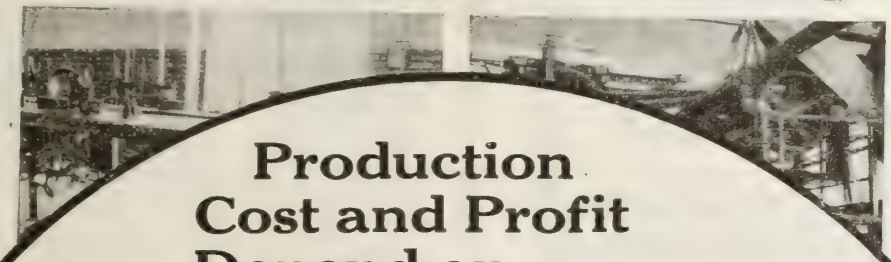
PRACTICAL ENGINEER POCKET BOOK
Over 600 Pages
A valuable reference work imported from England and sold as an advertising medium at the low price of 40c post paid.
Address Montreal Office

SOLD BY LEADING DEALERS EVERYWHERE OR BY
MAGNOLIA METAL CO.
OFFICE AND FACTORY:
225 St. Ambroise Street, MONTREAL

S O 23583—50 H P Morse Silent Chain driving line shaft from motor mounted overhead. Chain, 1½" pitch, 7" wide. Sprockets, 17-78 teeth, 580-198 R P M., 49½" centers.



S O 2710—10 H P Morse Silent Chains driving lineshafts in an Ohio Tannery. Chains, 2 10" pitch, 2½" wide. Sprockets, 21-67 teeth, 30" center to center of shafts.



S O 25079-80—5 H P Morse Silent Chain driving lineshaft in a Knitting Factory. Chain, ¾" pitch, 2¼" wide, speed 893 F. P. M. Sprockets, 15-93 teeth, 1140-922 R. P. M., 15" centers.

S O 6582—20 H P Morse Silent Chain driving lineshaft in a Laundry. Chain, 2-10" pitch, 6" wide. Sprockets, 15-75 teeth, 60" center to center of shafts.

Production Cost and Profit Depend on Belting Efficiency

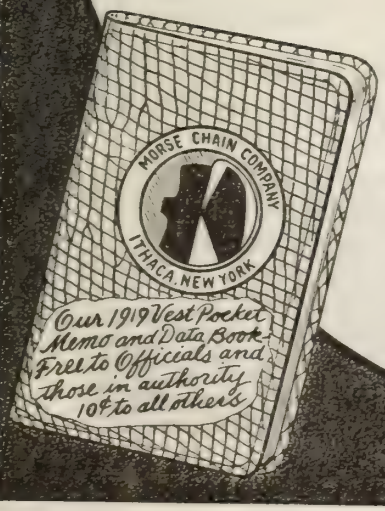
The "MORSE" Rocker Joint Silent Chain is the only 99% efficient transmission known.

The more severe the duty the more need of "MORSE" Drives. The Drive that will do the most work, the steadiest work, the best work. Producing more with less COST. The Perfect Drive. Flexible as a belt. Positive as gears. Oil Baths not required.

Continuity in operation, Cost of production, and Quality are the basis on which to select your drives.

Let us have your general layout and design drives to save space, light and power while increasing your production.

Our booklet is illustrated with cuts of engines and drives and covers the subject of the number of teeth and links, lubricating and covering, chain and sprocket materials, chain widths, chain contacts, chain adjustments, etc. It will be sent FREE.


MORSE CHAIN COMPANY
ITHACA, NEW YORK
Our 1919 Vest Pocket Memo and Data Book Free to Officials and those in authority 10¢ to all others

Morse Chain Co. Largest manufacturers of silent chains in the world Ithaca, N.Y.

Morse Engineering Service. Address Nearest Office. Assistance without Obligation.

Boston, Mass. ..... 141 Milk St.
Chicago, Ill. ..... Merchants L. & T. Bldg.
Cleveland, Ohio ..... Engineers' Bldg.
Detroit, Mich. ..... 1003 Woodward Ave.
Greensboro, N.C. ..... 805 Asboro St.
New York ..... 50 Church St.
Pittsburgh, Pa. ..... Westinghouse Bldg.
San Francisco, Cal. ..... Monadnock Bldg.
Atlanta, Ga. ..... Chandler Bldg., Earl F. Scott, M.E.
Canada ..... Jones & Glassco, Regis'd
Montreal, St. Nicholas Bldg.; Toronto, Traders Bank Bldg.
Kansas City, Mo. ..... Long Bldg., Morse Engineering Co.
Minneapolis, Minn. ..... Third St. S., Strong-Scott Mfg. Co.
St. Louis, Mo. .....Chemical Bldg., Morse Engineering Co.

Licensees for Europe and the Eastern Hemisphere: The Westinghouse Brake Co., Ltd., London, N.

MORSE CHAIN CO., ITHACA, N.Y., U.S.A. In "Power House."
Gentlemen: As per your advertisement in "Power House," please send copy of Pub. No. 14, "Large Power Drives."

Company .....
Individual .....
Position .....
Address .....

HINTS TO BUYERS

DOMINION COAL COMPANY LIMITED

"Dominion" and "Springhill" BITUMINOUS STEAM and GAS COALS

GENERAL SALES OFFICE

112 St. James St. Montreal

NOTICE

TO

Stationary and Hoisting Engineers

Everyone operating a STATIONARY steam plant of 50 h.p. or over in the Province of Ontario must hold a Stationary Engineer's Certificate from the Board of Stationary and Hoisting Engineers. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary and Hoisting Engineers' Act.

Everyone operating a HOISTING steam plant working at a pressure of 20 pounds or over, irrespective of horse power, and used for hoisting in structural operations or excavating purposes, in the Province of Ontario, must hold a Hoisting Engineer's Certificate from the Board of Stationary and Hoisting Engineers. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary and Hoisting Engineers' Act.

Application forms for obtaining STATIONARY or HOISTING Engineers' Certificates, may be had upon applying to the Chairman.

HON. F. G. MACDIARMID, Minister of Public Works and Highways. W. C. McGHIE, Chairman of Board.

W. A. RIDDELL, M. A. PH. D., Superintendent, Trades & Labour Branch.

NATIONAL BOILER GIRTH SEAM PROTECTORS

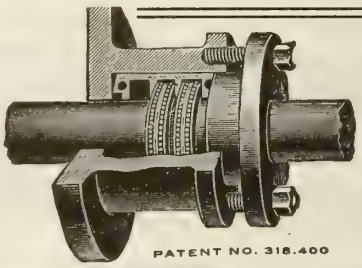
If your Boiler is not fire-cracked it eventually will; prevent this by putting on a National Boiler Protector. You will save cost in repairs and prolong life of the boiler. All new boilers should be protected.

Write Us for Particulars.

National Boiler Protector Co.

New Toronto Address

ROOM 24, LOMBARD BUILING



PATENT NO. 318,400

PAT. NO.	500,899	PAT. NO.	829,116
" "	534,104	" "	830,530
" "	602,328	" "	856,103
" "	654,541	" "	878,238
" "	654,542	" "	894,537
" "	725,368	" "	895,791
" "	774,490	" "	898,066
" "	775,193	" "	905,103
" "	775,194	" "	934,629
" "	791,300	" "	979,206
" "	805,689	" "	1000,75

Why not Buy the Best, when in market for Packing?

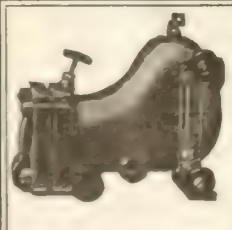
HOLMES' Metallic Packing

Is Guaranteed 3 Years

Lasts many times longer. 30 days' trial. Less oil. No cutting. Easily applied to any Steam Engine, Air Compressor or Gas Engine. Satisfaction or no pay. Write us.

HOLMES METALLIC PACKING CO., Wilkes-Barre, Pa.

Incorporated 1897



McDANIEL IMPROVED **STEAM TRAP**

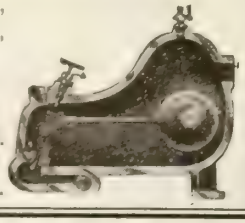
FOR HIGH OR LOW PRESSURE.

Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

MAY WE SEND ONE FOR TRIAL?

Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators.

SEND FOR CATALOGUE.



THE GARTH COMPANY

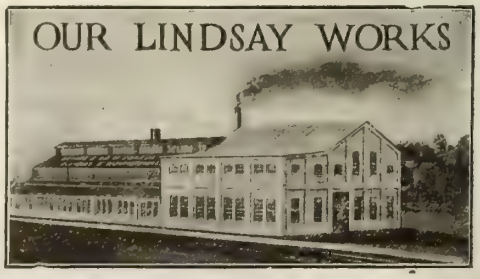
26 Craig Street MONTREAL, CAN.

WATSON & McDANIEL CO.

No. 146 N. 7th Street. PHILADELPHIA, Pa.

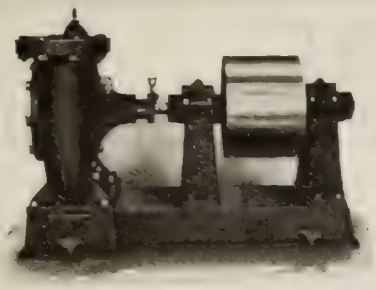
Water Turbines, Hydraulic Governors, Centrifugal Pumps

OUR LINDSAY WORKS



Boving Hydraulic & Engineering Co., Limited

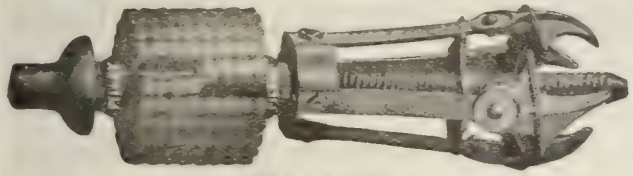
Lindsay, Ontario



Send that PUMP inquiry to

The Smart-Turner Machine Co.
LIMITED
HAMILTON, CANADA

The Simplest and Best Cleaaner on the market is



PILLEY'S

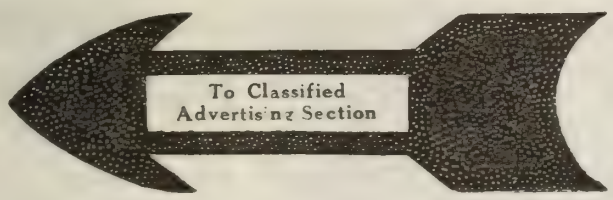
Combination Flue Brush and Scraper.
Guaranteed not to break or the wires to pull out or lay over. A simple turn of the hand adjusts it to the tube, and the brush removes what the scraper loosens.
For sale by leading Canadian jobbers.

Manufactured by
PILLEY PACKING AND FLUE BRUSH MFG. CO.
623 South Third Street - - - St. Louis, Mo.
Eastern Office: 71 Fulton St., New York.

Saves Coal

By stopping up costly leaks in old boiler furnace linings or by making a complete new *jointless* gas tight lining.

Send for Our Bulletin
MILL SUPPLY DEPARTMENT
Beveridge Paper Co., Ltd.
MONTREAL AND ST. JOHN, N.B.
Shell Bar Boico Supply, Limited
TORONTO



THE LADD VERTICAL WATER TUBE BOILER

The Goldie-McCulloch Co., Ltd.
Galt, Ontario

Canadian licencees under patents 162401 and 162402 dated May 4, 1915.

The George T. Ladd Company,
Pittsburgh, Pa.

Owners and manufacturers for the United States.

Write for new Catalogue No. 17.

BOILER INSPECTION

The Steam Boiler Act, Chapter 252 R.S.O., 1914 With Amendments Chapter 58—6, George V.

STEAM BOILERS.

All Steam boilers constructed for use in Ontario must be built from designs which have been approved and allotted a registration number by the Steam Boiler Branch.

Used boilers, boilers sold or exchanged, and unregistered boilers brought into the Province must be inspected prior to being put into operation.

Notice of repairs to steam boilers, stating the nature and extent of same, must be sent to the Steam Boiler Branch, and should such repairs be considered extensive by the Chief Boiler Inspector, the boilers will require to be inspected.

In each and every case the inspections must be made by Inspectors authorized to inspect boilers under the Steam Boilers Act, who are employed only by the Steam Boiler Branch of the Department of Public Works. Official certificates with the maximum working pressure stated thereon are issued to the owners of the boilers so inspected.

STEAM PIPING.

Drawings and Specifications of all high pressure steam piping must be approved and registered by the Steam Boiler Branch before any work of installation is commenced. The drawings submitted should show clearly the dimensions and layout of the main steam lines. Full particulars should be given as to the material used in the construction of the piping, and all valves and other fittings used in connection therewith must be of approved make.

Any deviation from the above requirements shall be deemed a violation of the Steam Boilers Act.

All communications in this respect should be addressed to the Steam Boiler Branch, Department of Public Works, Parliament Buildings, Toronto.

HON. F. G MACDIARMID,
Minister of Public Works and Highways

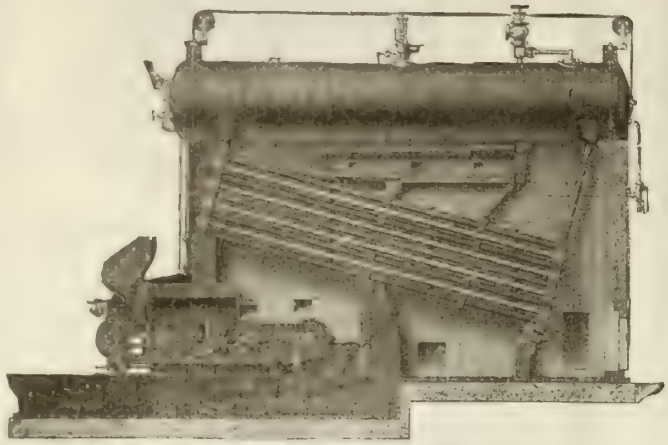
W. A. RIDDELL, M.A. Ph.D.,
Supt. Trades & Labour Branch

D. M. MEDCALF,
Chief Inspector of Steam Boilers.

"ALL BRITISH"

"B.&W." PATENT WATER TUBE STEAM BOILERS

HIGHEST ECONOMY, SAFETY, DURABILITY. OVER 20,000,000 H.P. IN USE.



Babcock & Wilcox Patent Water Tube Steam Boiler, Superheater and Mechanical Stoker.

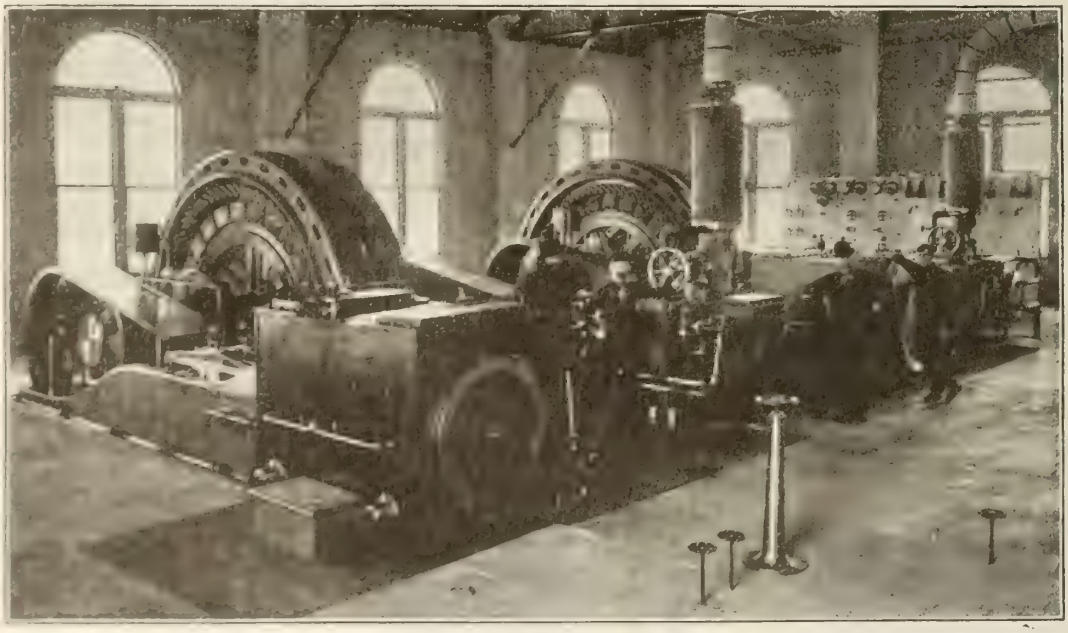
ALSO

Steam Superheaters
Mechanical Stokers
Coal-Handling Machinery
Piping, Feed Water Heaters
Water Softeners and Purifiers
and **ELECTRIC CRANES**

BABCOCK & WILCOX, Limited

HEAD OFFICE FOR CANADA - COLLEGE ST. (ST. HENRY), MONTREAL
TORONTO OFFICE, TRADERS BANK BUILDING

25 Cycle Engine Generator Sets For Sale



1—250 KW.
1—300 KW.

25 Cycle
3 phase
Westinghouse
Generators
Direct
connected to
McIntosh &
Seymour Cross
Compound
Gridiron Valve
Engines 150
R.P.M.

These units were in use only seven months and are in first class condition. Write for further particulars and quotations.

Power Plant Equipment Co., Dominion Bank Building **Toronto, Ont.**

POWER HOUSE BUYERS' DIRECTORY

If what you want is not listed here write us, and we will tell you where to get it. Let us suggest that you consult also the advertisers' index facing the inside back cover, after having secured advertisers' names from this directory. The information you desire may be found in the advertising pages. This department is maintained for the benefit and convenience of our readers. The insertion of our advertisers names under proper headings is gladly undertaken, but does not become part of an advertising contract.

AIR COCKS
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

AIR VALVES
Mueller Mfg. Co., H., Sarnia, Ont.

AMMETERS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. H. W. Johns-Manville Co., Toronto, Ont.

AMMONIA VALVES AND FITTINGS
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Frick Co., Waynesboro, Franklin Co., Pa.
Homestead Valve Mfg. Co., Pittsburgh, Pa.
York Mfg. Co., York, Pa.

AMMONIA PURIFIERS
Frick Co., Waynesbo.o, Franklin Co., Pa.
York Mfg. Co., York, Pa.

AMMONIA TANKS
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford, Ont.

ARCHES, COMBUSTION CHAMBER
Canadian Fairbanks-Morse Co., Ltd. Montreal.

ASH CARRYING SYSTEMS
Babcock & Wilcox, Ltd. Montreal.
Waterous Engine Works Co., Brantford, Ont.

ASBESTOS SPECIALTIES
Durabla Mfg. Co., New York, N.Y.
Garlock Packing Co., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

AUTOMATIC ICE RECORDING DOORS AND CHUTES
Jamison Cold Storage Door Co., Hagerstown, Md.

BABBITT AND ANTI-FRICTION METAL
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Hoyt Metal Co., Toronto.
Magnolia Metal Co. Montreal.
Wm. C. Wilson & Co., Toronto.

BALL BEARINGS
Can. S K F Co., Toronto, Ont.

BALLCOCKS
D'Este Co., Julian, Boston, Mass.

BATTERIES AND ACCESSORIES
Can. H. W. Johns-Manville Co., Toronto, Ont.

BELT CEMENT
Graton & Knight Mfg. Co., Montreal.

BELT DRESSING
Cling Surface Co., Buffalo.
Dominion Belting Co., Hamilton, Ont.
Graton & Knight Mfg. Co., Montreal.

BELT LACING, LEATHER
Graton & Knight Mfg. Co., Montreal.

BELT TIGHTENERS
Waterous Engine Works Co., Brantford, Ont.

BELT PULLEYS
Waterous Engine Works Co., Brantford, Ont.

BELTING, BALATA
Federal Engineering Co., Toronto, Ont.

BELTING, LINK
Graton & Knight Mfg. Co., Montreal.
Waterous Engine Works Co., Brantford, Ont.

BELTING, STITCHED COTTON DUCK
Dominion Belting Co., Hamilton, Ont.

BELTING, LEATHER
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Garlock Packing Co., Hamilton, Ont.
Graton & Knight Mfg. Co., Montreal.
D. K. McLaren Ltd., Montreal.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

BELTING, RUBBER
Can. H. W. Johns-Manville Co., Toronto, Ont.
Jeffrey Manufacturing Co., Montreal.
Thomson-Gordon, Ltd., Hamilton, Ont.

BELTING, WOVEN COTTON
Federal Engineering Co., Toronto, Ont.

BINS, COAL, COKE AND ORE
Jeffrey Manufacturing Co., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford, Ont.

BLOWERS
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd. Montreal
Coppus Eng. & Equip. Co., Worcester, Mass.
Green's Economiser, Ltd., Toronto.

BOILER COVERING
Beveridge Paper Co., Montreal, Que.

BOILER COMPOUNDS
Beveridge Paper Co., Montreal, Que.
Can. Economic Lubricant Co., Montreal, Que
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Metlskin Mfg. Co., Rochester, N.Y.
Shell Bar Boiler Supply, Ltd., Toronto, Ont.
Wm. C. Wilson & Co., Toronto.

BOILER SKIMMERS
Yarnall-Waring Co., Philadelphia, Pa.

BOILER COMPOUND FEEDERS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Morehead Mfg. Co., Woodstock.
Lunkenheimer Co., Cincinnati, O.

BOILER FEED PUMPS
American Steam Pump Co., Battle Creek, Mich.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Coppus Eng. & Equipment Co., Worcester, Mass.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Steam Boiler Equipment Co., Toronto, Ont.
Darling Bros., Ltd., Montreal, Que.
Goldie & McCulloch Co., Galt.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Laurie & Lamb, Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

BOILER FEED REGULATORS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Beveridge Paper Co., Montreal, Que.
Darling Brothers, Ltd., Montreal, Que.
Mason Regulator & Engineering Co., Montreal.

BOILER MOUNTINGS
Babcock & Wilcox, Ltd. Montreal.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Ltd., Montreal, Que.
Goldie & McCulloch Co., Galt.
Inglis Co., The John, Toronto, Ont.
Lunkenheimer Co., Cincinnati, O.
Mason Regulator & Engineering Co., Montreal.

BOILER PRESERVATIVES
Johns-Pratt Co., The, Hartford, Conn.
Metlskin Co., Inc., Rochester, N.Y.

BOILER HOUSE ACCESSORIES
Babcock & Wilcox, Ltd. Montreal.
Cole, Ltd., Geo. W., Toronto.
Green's Economiser, Ltd., Toronto.
Mason Regulator & Engineering Co., Montreal.
Yarnall-Waring Co., Philadelphia, Pa.

BOILER SEAM PROTECTOR
National Boiler Seam Protector Co., Montreal.

BOILER SETTINGS
Beveridge Paper Co., Montreal.
Gates, John W., St. James St., Montreal.

BOILERS, HORIZONTAL, RETURN, TUBULAR AND WATERTUBE
Babcock & Wilcox, Ltd. Montreal.
Cole, Ltd., Geo. W., Toronto.
Goldie & McCulloch Co., Galt.
Frick Co., Waynesboro, Franklin Co., Pa.
Inglis Co., The John, Toronto, Ont.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Jones Underfeed Stoker Co., Toronto.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Ladd, The Geo. T., Co., Pittsburgh, Pa.
McAvity, T., & Sons, Ltd., St. John, N.B.
Waterous Engine Works Co., Brantford, Ont.

BOILERS, MARINE, LOCOMOTIVE AND VERTICAL
Babcock & Wilcox, Ltd. Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Goldie & McCulloch Co., Galt.
Inglis Co., The John, Toronto, Ont.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
John McDougall Caledonian Iron Works, Montreal.
Waterous Engine Works Co., Brantford, Ont.

BOXES, FUSE AND METER
Johns-Pratt Co., The, Hartford, Conn.

BRASS FOUNDERS
McAvity, T., & Sons, Ltd., St. John, N.B.
D'Este Co., Julian, Boston, Mass.
Mueller Mfg. Co., H., Sarnia, Ont.

BRINE COOLERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

BRINE TANKS
Frick Co., Waynesboro, Franklin Co., Pa.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford, Ont.
York Manufacturing Co., York, Pa.

BUSHINGS
Steel Mill Packing Co., Windsor, Ont.

CABLE
Wm. C. Wilson & Co., Toronto.

CALORIMETERS
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y
Taylor Instrument Co., Rochester, N.Y.

CANS, OILY WASTE
Jas. Morrison Brass Mfg. Co., Toronto.

CAST IRON FITTINGS
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.

CASTINGS, BRASS AND IRON
Boving Hydraulic & Eng. Co., Ltd., Lindsay Ont.
Goldie & McCulloch Co., Galt.
Lunkenheimer Co., Cincinnati, O.
John McDougall Caledonian Iron Works Co Ltd., Montreal.
McAvity, T., & Sons, Ltd., St. John, N.B.
Mueller Mfg. Co., H., Sarnia, Ont.
Waterous Engine Works Co., Brantford, Ont.
Wood & Co., R. D., Philadelphia, Pa.

CELLAR DRAINERS
Morrison Brass Mfg. Co., James, Toronto, Ont.
Mueller Mfg. Co., H., Sarnia, Ont.

CEMENT HARDNER & WATERPROOFER
Beveridge Paper Co., Montreal, Que.

CEMENT, HIGH TEMPERATURE
Beveridge Paper Co., Montreal.
Gates, John W., St. James St., Montreal.
Green's Economiser, Ltd., Toronto.

CEMENT, PIPE JOINT
Wm. C. Wilson & Co., Toronto.

CEMENT MACHINERY
Canadian Fairbanks-Morse Co., Ltd. Montreal.
Waterous Engine Works Co., Brantford, Ont.

CEMENT, INSULATING, REFRACTORY
Green's Economiser, Ltd., Toronto.

CHAIN DRIVES
Coventry Chain Co., Coventry, England.
Morse Chain Co., Ithaca, N.Y.

CHAIN WHEELS
Babbitt Steam Specialty Co., New Bedford, Mass.

CHIMNEYS, RADIAL BRICK
Green's Economiser, Ltd., Toronto, Ont.

CHIMNEYS, STEEL
Babcock & Wilcox, Ltd. Montreal
MacKinnon, Holmes & Co., Sherbrooke, Que.

CLAMPS, PIPE-JOINT
Yarnall-Waring Co., Philadelphia, Pa.

CHUTES, COAL
Can. Allis-Chalmers, Ltd., Toronto, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.

CLEANERS, BOILER TUBE
Babcock & Wilcox, Ltd., Montreal.
Beveridge Paper Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto.
Cole Ltd., Geo. W., Toronto.
Darling Brothers, Ltd., Montreal, Que.
Garlock Packing Co., Hamilton, Ont.
Goldie & McCulloch Co., Galt.
Green's Economiser, Ltd., Toronto.
Liberty Mfg. Co., Pittsburgh, Pa.
Laurie & Lamb, Montreal, Que.
Pierce & Co., Wm. B., Buffalo, N.Y.
Pilley Packing & Flue Brush Mfg. Co., St. Louis, Mo.
Roto Co., Hartford, Conn.
Yarnall-Waring Co., Philadelphia, Pa.

CLOCKS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.

CLOSETS
Mueller Mfg. Co., H., Sarnia, Ont.

CLUTCHES
Goldie & McCulloch Co., Galt.
Waterous Engine Works Co., Brantford, Ont.

COAL
Dom. Coal Co., Montreal

COAL AND ASH CONVEYORS
Babcock & Wilcox, Ltd. Montreal.
Jeffrey Manufacturing Co., Montreal.
Waterous Engine Works Co., Brantford, Ont.

COAL HANDLING MACHINERY
Babcock & Wilcox, Ltd. Montreal.
Green's Economiser, Ltd., Toronto, Ont.
Jeffrey Manufacturing Co., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford, Ont.

COAL HOLE COVERS
Can. Allis-Chalmers, Ltd., Toronto, Ont.

COILS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

COLD STORAGE INSULATION
Armstrong Cork & Insulation Co., Montreal, Que.
Beveridge Paper Co., Ltd., Montreal, Que.

COMMUTATOR TRUING DEVICES
Jordan Bros., Inc., New York, N.Y.

CONDENSERS
Alberger Heater Co., Buffalo, N.Y.
American Steam Pump Co., Battle Creek, Mich.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Darling Bros., Ltd., Montreal, Que.
Goldie & McCulloch Co., Galt.
Laurie & Lamb, Montreal.
John McDougall Caledonian Iron Wks., Montreal.
Waterous Engine Works Co., Brantford.

CONDENSERS, AMMONIA AND STEAM
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

CONSULTING ENGINEERS
Walter J. Francis, Montreal.
Laurie & Lamb, Montreal.

COLD STORAGE DOORS AND WINDOWS
Jamison Cold Storage Door Co., Hagerstown, Md.

COMPRESSORS, AIR
American Steam Pump Co., Battle Creek, Mich.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.

Darling Bros., Ltd., Montreal, Que.
[illegible] The John Toronto, Ont.
[illegible] Montreal.
[illegible] Co., Sherbrooke, Que.
Smart-Turner Machine Co., Ltd., Hamilton
Taylor Instrument Co., Rochester, N.Y.

COMPRESSORS, GAS
[illegible] Allis-Chalmers Ltd. Toronto, Ont.

CONDUITS
Can. H. W. Johns-Manville Co., Toronto, Ont.

CONDENSATION RECEIVER
Cole, Ltd., Geo. W., Toronto.
Davis Regulator Co, G. M., Chicago.

CONDENSER AND SMOKESTACK PAINTS
Beveridge Paper Co., Montreal, Que.

CONNECTIONS, FLANGED
[illegible] Lexington, Mass.
Dart Union Co., Ltd., Toronto, Ont.

CONTRACTORS' STRUCTURAL STEEL
Canadian Fairbanks-Morse Co., Ltd., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.

CONVEYOR MACHINERY
Babcock & Wilcox, Ltd. Montreal.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Jeffrey Manufacturing Co., Montreal.
Waterous Engine Works Co., Brantford.

COOLER DOORS
Jamison Cold Storage Door Co., Hagerstown, Md.

CORK INSULATION
Armstrong Cork & Insulation Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.

COTTON HOSE
Garlock Packing Co., Hamilton, Ont.

COUNTERS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

COUNTERSHAFTS
Can. Bond Hanger & Coupling Co., Alexandria, Ont.

COUPLINGS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Beveridge Paper Co., Montreal, Que.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Brothers, Ltd., Montreal, Que.
Jeffrey Manufacturing Co., Montreal.
McAvity & Sons, T., St. John, N.B.

COUPLINGS, BOILER, FLANGED PIPE, JOINT PIPE, UNION, STEAM PIPE
Jefferson Union Co., Lexington, Mass.
Dart Union Co., Ltd., Toronto, Ont.

COUPLINGS, SHAFT
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Goldie & McCulloch Co., Galt.

CRANES, ALL KINDS
Babcock & Wilcox, Ltd. Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

CRANES, ELECTRIC
Babcock & Wilcox, Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton

CRANES, HAND POWER
Babcock & Wilcox, Ltd., Montreal.
Boving Hydraulic & Eng., Co., Ltd., Lindsay, Ont.
Frick Co., Waynesboro, Franklin Co., Pa.
Smart-Turner Machine Co., Ltd., Hamilton.

CRANES, OVERHEAD TRAVELLING
Babcock & Wilcox, Ltd., Montreal.
Boving Hydraulic & Eng., Co., Ltd., Lindsay, Ont.
Smart-Turner Machine Co., Ltd., Hamilton.

CRANES, POST JIB
Babcock & Wilcox, Ltd., Montreal.

CRANES, SWING JIB
Babcock & Wilcox, Ltd., Montreal.

CRANES, WALL
Babcock & Wilcox, Ltd., Montreal.

CRANK AND CROSSHEAD PIN OILERS
Lunkenheimer Co., Cincinnati, O.

CRIMPS, LEATHER
Graton & Knight Mfg. Co., Montreal.

CRUSHING MACHINERY
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Jeffrey Mfg. Co., Columbus, Ohio.

CYLINDER OIL
E. H. Kellogg & Co., New York.

DAMPER REGULATORS
Babcock & Wilcox, Ltd., Montreal.
[illegible] Montreal Que.
G. M. Davis Regulator Co., Chicago.
[illegible]
Elliott Co., Pittsburgh, Pa.
Mason Regulator Co., Boston, Mass.
Jas. Morrison Brass Mfg. Co., Toronto.

DISCS, FIBRE
Beveridge Paper Co., Ltd., Montreal, Que.
Johns-Pratt Co., The, Hartford, Conn.

DISCS, LEATHER
Graton & Knight Mfy. Co., Montreal.

DISTILLING APPARATUS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

DOORS, COLD STORAGE AND FREEZER
[illegible] Hagerstown, Md.

DOUBLE PIPE CONDENSERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

DRAFT APPARATUS SYSTEMS, MECHANICAL
Green's Economiser, Ltd., Toronto.

DRYING MACHINERY
Canadian Fairbanks-Morse Co., Ltd., Montreal.

DYNAMOS
Canadian Fairbanks-Morse Co., Ltd., Montreal.

ECONOMIZERS
Babcock & Wilcox, Ltd., Montreal.
Green's Economiser, Ltd., Toronto.

EJECTORS
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.
Smart-Turner Machine Co., Ltd., Hamilton.

ELECTRICAL ACCESSORIES AND MACHINERY
Can. H. W. Johns-Manville Co., Toronto, Ont.
Beveridge Paper Co., Ltd., Montreal, Que.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Economy Fuse & Mfg. Co., Montreal, Que.
MacGovern & Co., Inc., New York.

ELECTRICAL SUPPLIES
Can. General Electric Co., Toronto, Ont.
Can. H. W. Johns-Manville Co., Toronto, Ont.

ELEVATORS
Beveridge Paper Co., Montreal, Que.
Darling Brothers, Ltd., Montreal, Que.
MacKinnon, Holmes & Co., Sherbrooke, Ont.
John MacDougall Caledonian Iron Works, Montreal.

ELEVATING MACHINERY
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Beveridge Paper Co., Montreal, Que.
Darling Brothers, Ltd., Montreal, Que.
Goldie & McCulloch Co., Galt.
Hamilton Mfg. Co., Wm., Peterboro, Ont.
Jeffrey Mfg. Co., Montreal.
Waterous Engine Works Co., Brantford.

ENAMELWARE
H. Mueller Mfg. Co., Sarnia, Ont.

ENGINEERS' SUPPLIES
Beveridge Paper Co., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Ltd., Montreal, Que.
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.
Jas. Morrison Brass Mfg. Co., Toronto.

ENGINES, AUPTOMATIC AND DROP VALVE
Frick Co., Waynesboro, Franklin Co., Pa.
Waterous Engine Works Co., Brantford.

ENGINES, CORLISS AND ROCKING VALVE
Frick Co., Waynesboro, Franklin Co., Pa.
Goldie & McCulloch Co., Galt.
Green's Economiser, Ltd., Toronto.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Waterous Engine Works Co., Brantford.

ENGINES, DIESEL
Can. Allis-Chalmers, Ltd., Toronto, Ont.

ENGINES, GAS AND GASOLINE
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Laurie & Lamb, Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

ENGINES, STEAM
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Can. Sirocco Co., Windsor, Ont.
Goldie & McCulloch Co., Galt.
Hamilton Mfg. Co., Wm., Peterboro, Ont.
Inglis Co., The John, Toronto, Ont.
Laurie & Lamb, Montreal.
John MacDougall Caledonian Iron Works, Montreal.
Waterous Engine Works Co., Brantford.

ENGINES, HOISTING, LOGGING, CABLE-WAY
Can. Allis-Chalmers, Ltd., Toronto, Ont.

ENGINES, MARINE
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Goldie & McCulloch Co., Galt.
The John MacDougall Caledonian Iron Works Co., Ltd., Montreal.

ENGINES, SAW MILL
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Laurie & Lamb, Montreal.
Waterous Engine Works Co., Brantford.

ENGINES, SINGLE COMPOUND AND TRIPLE EXPANSION
Canadian Griscom-Russell Co., Ltd., Montreal.
Engineering and Machine Works of Canada, Ltd., Goldie & McCulloch Co., Galt.
St. Catharines, Ont.
John MacDougall Caledonian Iron Works Co., Ltd., Montreal.
Kerr Engine Co., Walkerville.
Waterous Engine Works Co., Brantford.

ENGINES, VERTICAL
Goldie & McCulloch Co., Galt.
Laurie & Lamb, Montreal.

ENGINEERING BOOKS
MacLean Publishing Co., Toronto.

EXHAUSTERS
Green's Economiser, Ltd., Toronto.

EXHAUST HEADS
Darling Bros., Ltd., Montreal, Que.
Direct Separator Co., Syracuse, N.Y.
Jas. Morrison Brass Mfg. Co., Toronto.
Franklin Williams Co., New York.
Watson & McDaniel Co., Philadelphia.

EXPANSION JOINTS
Alberger Heater Co., Buffalo, N.Y.
Direct Separator Co., Syracuse, N.Y.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.

FANS, VENTILATING
Coppus Engr. & Equip. Co., Worcester, Mass
Green's Economiser, Ltd., Toronto.
Sturtevant Co. of Canada, B. F., Galt, Ont.

FEED WATER HEATERS
Alberger Heater Co., Buffalo, N.Y.
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Ltd., Montreal, Que.
Elliott Co., Pittsburgh, Pa.
Goldie & McCulloch Co., Galt.
The John MacDougall Caledonian Iron Works Co., Ltd., Montreal.
Waterous Engine Works Co., Brantford.

FEED WATER PURIFIERS
Stewart Heater Co., Buffalo, N.Y.
Wm. B. Scaife & Sons, Pittsburgh, Pa.
Yarnall-Waring Co., Philadelphia, Pa.

FEED WATER REGULATORS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Chaplin, Fulton Mfg. Co., Pittsburgh, Pa.
Beveridge Paper Co., Montreal, Que.
Darling Brothers, Ltd., Montreal, Que.
Elliott Co., Pittsburgh, Pt.
Green's Economizer, Ltd., Toronto.
Laurie & Lamb, Montreal.

FIBRE, VULCANIZED
Beveridge Paper Co., Montreal, Que.

FILTERS
Bowser & Co., Inc., S. F., Toronto, Ont.
The John MacDougall Caledonian Iron Works Co., Ltd., Montreal.
Laurie & Lamb, Montreal.

FILTERS, WATER
Darling Bros., Ltd., Montreal, Que.
Frick Co., Waynesboro, Franklin Co., Pa.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Scaife & Sons, Wm. B., Pittsburgh , Pa.
York Mfg. Co., York, Po.

FIREBRICK—JOINTLESS
Beveridge Paper Co., Montreal, Que.

FIRE BRICK, PLASTIC
Gates, John W., St. James St., Montreal.

FIREPROOF COLD STORAE DOORS AND WINDOWS
Jamison Cold Storage Door Co., Hagerstown, Md.

FITTINGS, AIR, AUTOMOBILE, GAS, HYDRAULIC, PIPE, PIPE FLANGED, SCREWED PIPE, STEAM
Jefferson Union Co., Lexington, Mass.
Dart Union Co., Ltd., Toronto, Ont.
H. Mueller Mfg. Co., Sarnia, Ont.

FLANGED STEAM FITTINGS
Direct Separator Co., Syracuse, N.Y.
McAvity, T., & Sons, Ltd., St. John, N.B.

FLANGES
Dart Union Co., Ltd., Toronto, Ont.
Jefferson Union Co., Lexington, Mass.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.

FLOORING COMPOSITION
Armstrong Cork & Insulation Co., Montreal Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.

FLUE CLEANERS
Babcock & Wilcox, Montreal.
Green's Economiser, Ltd., Toronto, Ont.
Liberty Mfg. Co., Pittsburg, Pa.
Goldie & McCulloch Co., Galt.
Pilley Packing and Flue Brush Mfg. Co., St. Louis, Mo.
William B. Pierce Co., Buffalo, N.Y.
Roto Co., Hartford, Conn.
Wm. C. Wilson & Co., Toronto.

FLUE GAS ANALYSIS INSTRUMENTS
Green's Economiser, Ltd., Toronto, Ont.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Uehling Instrument Co., New York.
Penberthy Injector Co., Windsor, Ont.

FLUES, GAS AND SMOKE
Green's Economiser, Ltd., Toronto.

FLUMES, STEEL
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.

FREEZER DOORS
Jamison Cold Storage Door Co., Hagerstown, Md.

FRICTION LEATHERS
Graton & Knight Mfg. Co., Montreal.

FUEL AND OIL PUMPS AND MEASURING SYSTEMS
Imperial Oil, Ltd., Toronto.

FURNACES, BOILER
Gates, J. W., Montreal, P.Q.
Green's Economiser, Ltd., Toronto.

FURNACES, SMOKELESS
Babcock & Wilcox, Montreal.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Detroit, Mich.

FURNACE GRATE BARS
Beveridge Paper Co., Montreal, Que.

FUSES
Can. H. W. Johns-Manville Co., Toronto, Ont.
Economy Fuse & Mfg. Co. of Canada, Montreal.
Johns-Pratt Co., The, Hartford, Conn.

GAS ANALYSIS INSTRUMENTS, ETC.
Green's Economiser, Ltd., Toronto, Ont.
Penberthy Injector Co., Windsor, Ont.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Uehling Instrument Co., New York, N.Y.

GASKETS, RUBBER, ASBESTOS
Can. H. W. Johns-Manville Co., Toronto, Ont.
Durable Mfg. Co., New York, N.Y.
Frick Co., Waynesboro, Franklin Co., Pa.
Garlock Packing Co., Hamilton, Ont.
Johns-Pratt Co., The, Hartford, Conn.
Sarco Co., Inc., New York, N.Y.
Thomson-Gordon, Ltd., Hamilton, Ont.

GASKETS, LEAD, COPPER AND LEATHER
Graton & Knight Mfg. Co., Montreal, Que.
Shell Bar Boico Supply Co., Toronto, Ont.
Sarco Co., Inc., New York, N.Y.
Wm. C. Wilson & Co., Toronto, Ont.

ELECTRICAL SAFETY AND ECONOMY

ECONOMY
Renewable
FUSES

Cut Annual Fuse Maintenance Cost 80%

Economy "Drop Out" Renewal Links are responsible for this saving.

A "Drop Out" Renewal Link restores a blown Economy Fuse to its original efficiency.

A sustained arc is impossible.

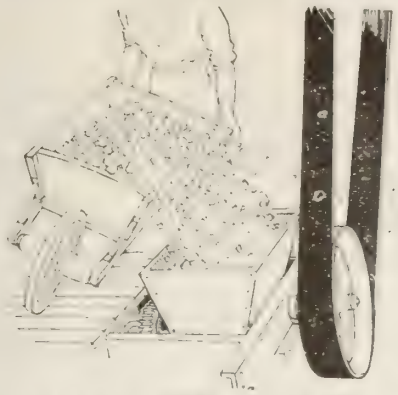
It's the work of a moment for even a novice to replace the link and renew the fuse.

First in its field—first in efficiency.

Order from your dealer.

Write for Catalogue 24.

Economy Fuse & Mfg. Co.
of Canada, Ltd.
Unity Bldg. - Montreal
Manufacturers in Canada of S.& C.High Potential Fuses--to 150,000 volts.



SCANDINAVIA BELTING

Is a Good Belt for Dusty Places

In cement plants and brick plants where there is lots of dust, this belt is producing results that are very satisfactory for the mill operators.

You know how wearing grit is on a belt, and you want a belt that will not come apart when only partly worn through.

"Scandinavia" is this kind of a belt—there are no plies to come apart—it is solid woven. We have seen these belts still giving good service when the thickness was half worn through, and on the pulley side of the belt there were no frayed ends—the surface of the belt was smooth.

Mr. Plant Manager, you know what this means. If you require a belt for operating in a dusty place, let us ship you one, please. It will be a pleasure to us both.

FEDERAL ENGINEERING CO. Limited
172 John St., TORONTO

NOTE:—Do not use "bar" or "stick" belt dressing on textile belts.

Dispose of Condensation

as fast as it accumulates in Steam Coils, Jackets, Radiators, etc., without reducing pressure or permitting live steam to escape.

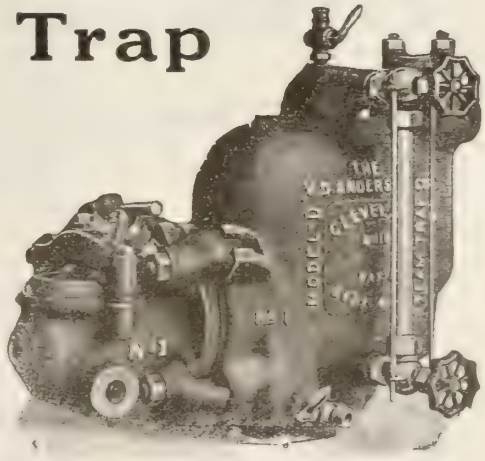
with The ANDERSON

Model "D" Steam Trap

This trap is fully guaranteed to give the economical and efficient service it is your right to expect. Absolute accuracy is assured, because all parts are machined to solid gauges.

Moreover, without unscrewing a single steam joint or pipe connection, you can change the valve and seat from high to low pressure or vice versa **in five minutes.** And a removable strainer prevents pieces of scale, packing, etc., from entering this Anderson Trap.

Ask for Descriptive Booklet.



THE V. D. ANDERSON COMPANY
1935 West 96th Street - CLEVELAND, Ohio

GAS PRODUCER PLANTS
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Laurie & Lamb, Montreal.

GASOLINE
Imperial Oil, Ltd., Toronto.

GAUGE COCKS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Garlock Packing Co., Hamilton, Ont.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.
W. J. Wall, Montreal.

GAUGE GLASSES
Wm. C. Wilson & Co., Toronto.

GAUGES, AMMONIA, OIL, GAS, AIR
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

GAUGES, PRESSURE, VACUUM, DRAFT AND RECORDING, AND MICROMETER
Babcock & Wilcox, Montreal.
Green's Economiser, Ltd., Toronto.
Lunkenheimer Co., Cincinnati, O.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.

GAUGES, WATER
Babcock & Wilcox, Montreal.
Jenkins Bros., Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
Milton & Prentiss, Toronto.
McAvity, T., & Sons, Ltd., St. John, N.B.
Penberthy Injector Co., Windsor, Ont.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

GEARS, FIBRE CUT
Beveridge Paper Co., Ltd., Montreal, Que.

GEARS, CUT, WORM, MORTISE
Goldie & McCulloch Co., Galt.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

GENERATORS, STEAM TURBO
Can. General Electric Co., Toronto, Ont.
Laurie & Lamb, Montreal.

GENERATORS AND CONVERTORS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. General Electric Co., Toronto, Ont.

GOVERNORS, ENGINE
Escher Wyss & Co., Montreal, Que.
McAvity, T., & Sons, Ltd., St. John, N.B.
Waterous Engine Works Co., Brantford.

GRAPHITE, BOILER
Wm. C. Wilson & Co., Toronto.

GRATES, DUMPING, ROCKING, STATIONARY
Babcock & Wilcox, Montreal.
Can. Steam Boiler Equipment Co., Toronto, Ont.
Goldie & McCulloch Co., Galt.
Galt Foundry Co., Galt, Ont.
Mason Regulator & Engineering Co., Montreal.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Waterous Engine Works Co., Brantford.

GREASE CUPS
Albany Lubricating Co., New York City.
Detroit Lubricator Co., Walkerville.
Lunkenheimer Co., Cincinnati, O.
McAvity, T., & Sons, Ltd., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

GREASE AND OIL EXTRACTORS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Elliott Co., Pittsburgh, Pa.
Laurie & Lamb, Montreal

GREASES
Albany Lubricating Co., New York City.
Can. Economic Lubricant Co., Montreal, Que.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Wm. C. Wilson & Co., Toronto.

HAND LEATHERS OR PADS
Graton & Knight Mfg. Co., Montreal.

HANGERS
Can. General Electric Co., Toronto, Ont.
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Can. S K F Co., Toronto, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Goldie & McCulloch Co., Galt.
Waterous Engine Works Co., Brantford.

HEATERS
Alberger Heater Co., Buffalo, N.Y.
Babcock & Wilcox, Ltd., Montreal.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
Laurie & Lamb, Montreal.
McAvity & Sons, T., St. John, N.B.
Waterous Engine Works Co., Brantford.

HEATERS, EXHAUST STEAM
Can. Allis-Chalmers, Ltd., Toronto, Ont.

HEATERS, METERING
Can. Allis-Chalmers, Ltd., Toronto, Ont.
[illegible]

HOISTS, GRIP
[illegible] New York, N.Y.

HOISTING AND CONVEYING MACHINERY
Babcock & Wilcox, Ltd., Montreal.
Waterous Engine Works Co., Brantford.

HOSE, METALLIC
Pennsylvania Flexible Metallic Tubing Co., Boston, Mass.

HOSE, STEAM SUCTION AND WATER
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Garlock Packing Co., Hamilton, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

HYDRANTS
Wood & Co., R. D., Philadelphia, Pa.

HYDRAULIC ACCUMULATORS
Smart-Turner Machine Co., Ltd., Hamilton.

HYDRAULIC MACHINERY
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Frick Co., Waynesboro, Franklin Co., Pa.
Hamilton Mfg. Co., Wm., Peterboro, Ont.
John McDougall Caledonian Iron Wks., Montreal.

HYDRAULIC VALVES
Yarnall-Waring Co., Philadelphia, Pa.

HYDRAULIC PRESSES
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

ICE MAKING MACHINERY
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Frick Co., Waynesboro, Franklin Co.
Linde Canadian Refrigeration Co., Montreal.
York Mfg. Co., York, Pa.

INDICATORS, ELECTRIC—ALL TYPES
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Uehling Instrument Co., New York, N.Y.

INDICATORS, STEAM AND GAS ENGINE
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Canadian Fairbanks-Morse Co., Montreal.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Green's Economiser, Ltd., Toronto.
Uehling Instrument Co., New York, N.Y.

INDICATORS—AMMONIA, HYDRAULIC
Can. Detroit Lubricator Co., Walkerville, Ont.

INDICATORS, SPEED
L. S. Starrett Co., Athol, Mass.

INJECTORS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

INSTRUMENTS, RECORDING
Green's Economiser, Ltd., Toronto.
Taylor Instrument Companies, Rochester, N.Y.
Yarnall-Waring Co., Philadelphia, Pa.

INSULATING BRICK
Armstrong Cork & Insulation Co., Montreal, Que
Beveridge Paper Co., Ltd., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.

INSULATING COMPOUNDS
Johns-Pratt Co., The, Hartford, Conn.

INSULATORS
Beveridge Paper Co., Ltd., Montreal, Que.
Johns-Pratt Co., The, Hartford, Conn.

IRON FILLER
Can. H. W. Johns-Manville Co., Toronto, Ont.

KILNS
Green's Economiser, Ltd., Toronto.

LACE LEATHERS
Graton & Knight Mfg. Co., Montreal.
Wm. C. Wilson & Co., Toronto.
Can. H. W. Johns-Manville Co., Toronto, Ont
Can. B. K. Morton Co., Toronto, Montreal.
Crane Packing Co., Chicago, Ill.

LAMPS, ARC
Canadian Fairbanks-Morse Co., Montreal.
Can. General Electric Co., Toronto, Ont.
Can. H. W. Johns-Manville Co., Toronto, Ont.

LAMPS, ELECTRIC
Wm. C. Wilson & Co., Toronto.

LAMPS, INCANDESCENT
Canadian Fairbanks-Morse Co., Montreal.
Can. General Electric Co., Toronto, Ont.
Can. H. W. Johns-Manville Co., Toronto, Ont
Can. Laco-Philips Co., Ltd., Toronto, Ont.

LAMPS, NITRO
Can. Laco-Philips Co., Ltd., Toronto, Ont.

LAMPS, TUNGSTEN AND NITRO
Can. General Electric Co., Toronto, Ont.
Can. Laco-Philips Co., Ltd., Toronto, Ont.

LEATHER STRAPPING
Graton & Knight Mfg. Co., Montreal.

LININGS, FIRE BRICK, STEEL STACK
Green's Economiser, Ltd., Toronto.

LUBRICANTS
Albany Lubricating Co., New York City.
Canadian Economic Lubricant Co., Montreal.

LUBRICATORS, CYLINDER CUTTING COMPOUNDS
Albany Lubricating Co., New York City.
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

LUBRICATORS, FORCE FEED
Can. Detroit Lubricator Co., Walkerville, Ont.
Darling Bros., Montreal.
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

LUBRICATORS, PLAIN
Lunkenheimer Co., Cincinnati, O.
Penberthy Injector Co., Windsor, Ont.

MACHINERY INSULATION
Armstrong Cork & Insulation Co., Montreal, Que.
Beveridge Paper Co., Ltd., Montreal, Que.

MECHANICAL STOKERS
Babcock & Wilcox, Ltd., Montreal.
Green's Economiser, Ltd., Toronto.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Detroit, Mich.

METERS, ELECTRIC
Can. H. W. Johns-Manville Co., Toronto, Ont.

METERS, STEAM
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Green's Economiser, Ltd., Toronto.

METERS, WATER
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Green's Economiser, Ltd., Toronto, Ont.
McAvity & Sons, T., St. John, N.B.
The John McDougall Caledonian Iron Works Co. Ltd., Montreal.
Yarnall-Waring Co., Philadelphia, Pa.

MIXING VALVES
Mueller Mfg. Co., H., Sarnia, Ont.

MILL AND MINING MACHINERY
Canadian Fairbanks-Morse Co., Montreal.
Engineering and Machine Works of Canada, Ltd. St. Catharines, Ont.
Goldie & McCulloch Co., Galt.
Waterous Engine Works Co., Brantford.

METER TESTERS
Mueller Mfg. Co., H., Sarnia, Ont.

MOTORS
Canadian Fairbanks-Morse Co., Montreal.
Can. General Electric Co., Toronto, Ont.
Green's Economiser, Ltd., Toronto.

OAKUM
Wm. C. Wilson & Co., Toronto.

OFFICE RAILINGS
Jas. Morrison Brass Mfg. Co., Toronto.

OIL CUPS
Albany Lubricating Co., New York City.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

OILER, COMPOUND FEEDERS
Lunkenheimer Co., Cincinnati, O.

OILERS, GAUGE
Lunkenheimer Co., Cincinnati, O.

OILERS, MULTIPLE
Can. Detroit Lubricator Co., Walkerville, Ont.
Lunkenheimer Co., Cincinnati, O.

OIL FILTERS AND CIRCULATING SYSTEMS
Bowser & Co., Inc., S. F., Toronto, Ont.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
Jas. Morrison Brass Mfg. Co., Toronto.

OIL SEPARATORS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
Direct Separator Co., Syracuse, N.Y.
Elliott Co., Pittsburgh, Pa.
Leitch Co., Arthur S., Toronto, Ont.
Liberty Mfg. Co., Pittsburgh.
Jas. Morrison Brass Mfg. Co., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.

OILS, QUENCHING
Imperial Oil, Ltd., Toronto.

OILING SYSTEMS
Albany Lubricating Co., New York City.
Bowser & Co., Inc., S. F., Toronto, Ont.
Lunkenheimer Co., Cincinnati, O.

OILS, CYLINDER
Imperial Oil, Ltd., Toronto.

OILS, LUBRICATING
Albany Lubricating Co., New York City.
Can. Economic Lubricant Co., Montreal, Que.
Kellogg & Co., E. H., New York, N.Y.
Wm. C. Wilson & Co., Toronto.

OILS, ENGINE
Imperial Oil, Ltd., Toronto.

PACKING, ASBESTOS
Johns-Pratt Co., The, Hartford, Conn.

PACKING ENGINE
Garlock Packing Co., Hamilton, Ont.
Johns-Pratt Co., The, Hartford, Conn.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING FIBRE
Beveridge Paper Co., Ltd., Montreal, Que.
Can. B. K. Morton Co., Montreal, Que.
Johns-Pratt Co., The, Hartford, Conn.
Wm. C. Wilson & Co., Toronto.

PACKING, HYDRAULIC
Can. H. W. Johns-Manville Co., Toronto, Ont.
Crane Packing Co., Chicago, Ill.
Durabla Manufacturing Co., New York.
Garlock Packing Co., Hamilton, Ont.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

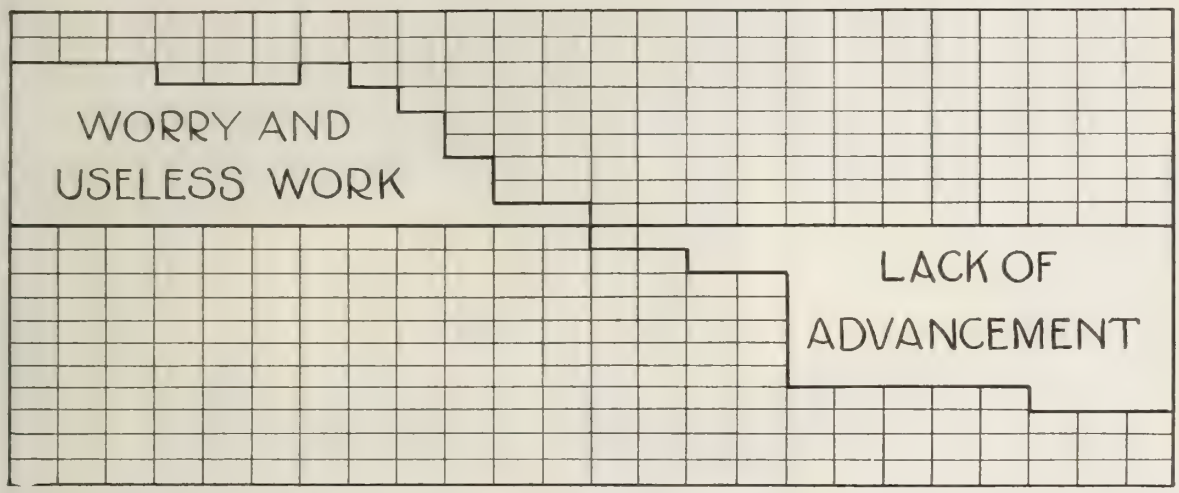
PACKING, METALLIC
Can. H. W. Johns-Manville Co., Toronto, Ont.
Crane Packing Co., Chicago, Ill.
Greene, Tweed & Co., New York.
Holmes Metallic Packing Co., Wilkesbarre, Pa.
Steel Mill Packing Co., Windsor, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, ROD
Can. H. W. Johns-Manville Co., Toronto, Ont
Crane Packing Co., Chicago, Ill.
Garlock Packing Co., Hamilton, Ont.
Steel Mill Packing Co., Windsor, Ont.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, SHEET
Can. H. W. Johns-Manville Co., Toronto, Ont
Durabla Manufacturing Co., New York.
Garlock Packing Co., Hamilton, Ont.
Jenkins Bros., Ltd., Montreal.
Johns-Pratt Co., The, Hartford, Conn.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING, AMMONIA, STEAM AND WATER
Can. H. W. Johns-Manville Co., Toronto, Ont.
Crane Packing Co., Chicago, Ill.
Garlock Packing Co., Hamilton, Ont.
Greene, Tweed & Co., New York.
Johns-Pratt Co., The, Hartford, Conn.
Steel Mill Packing Co., Windsor, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

Let the C.A.S.E. Smooth Out Your Load Curve



Remove The Peaks of Worry And Unproductive Labor And Build Up The Valleys By Working For Your Advancement

A man who is thoroughly grounded in the practice of his profession, who is free from personal worry and trouble, overcomes the many difficulties besetting the path of the operating engineer with little labor and in a manner ensuring his advancement.

The successful man owes his success to a wise appreciation of the advantages and mutual help offered by association with those in the same field of endeavor. To join an association having for its objectives the welfare of the engineer in things mental and material, his advancement in knowledge and skill, his protection by provision for sickness and distress is to take advantage of an opportunity indispensable to all who hope to better themselves.

If you are interested in such an organization and live where less than fifteen engineers are located, send for a copy of our constitution and application blanks for admission to nearest branch lodge. If there are more than fifteen engineers in your community, get together and send for particulars regarding formation of a branch lodge.

J. H. HALE, General Secretary,

Canadian Association of Stationary Engineers

230 Caroline Street Hamilton, Ont.

If any advertisement interests you, tear it out now and place with letters to be answered.

PACKING, LEATHER
Garlock Packing Co., Hamilton, Ont.
Graton & Knight Mfg. Co., Montreal.
Shell-Bar, Boico Supply, Ltd., Toronto, Ont.
Thomson-Gordon, Ltd., Hamilton, Ont.
Wm. C. Wilson & Co., Toronto.

PACKING PISTON
Crane Packing Co., Chicago, Ill.

PACKING, VALVE STEM
Crane Packing Co., Chicago, Ill.
Johns-Pratt Co., The, Hartford, Conn.

PAINTS
Wm. C. Wilson & Co., Toronto.

PAPER, INSULATING, ETC.
Beveridge Paper Co., Montreal, Que.

PENSTOCKS
[illegible] & Eng. Co., Ltd., Lindsay, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.

PILLOW BLOCKS
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Goldie & McCulloch Co., Galt.
Waterous Engine Works Co., Brantford.

PIPE COILS
Frick Co., Waynesboro, Pa.
York Mfg. Co., York, Pa.

PIPE COVERINGS, STEAM, BRINE, AMMONIA AND ICE WATER
Armstrong Cork & Insulation Co., Montreal, Que.

PIPE, CAST IRON
Wood & Co., R. D., Philadelphia, Pa.

PIPE STEEL
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

PIPE VISES AND CUTTERS
Armstrong Mfg. Co., Bridgeport, Conn.

PIPE, GAS
Can. Allis-Chalmers, Ltd., Toronto, Ont.

PIPES, WATER
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

PIPING AND FITTINGS
Frick Co., Waynesboro, Franklin Co., Pa.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.
York Mfg. Co., York, Pa.

PIPING, STEAM
Babcock & Wilcox, Ltd., Montreal.
Goldie & McCulloch Co., Galt.

PLATE WORK
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

PLUG COCKS
Homestead Valve Mfg. Co., Pittsburgh, Pa.

PLUMBING SUPPLIES
[illegible] Mfg. Co., H., Sarnia, Ont.
Wm. C. Wilson & Co., Toronto.

POWER PUMPS
American Steam Pump Co., Battle Creek, Mich
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
Waterous Engine Works Co., Brantford.
Garlock Packing Co., Hamilton, Ont.
Laurie & Lamb, Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.

POWER, TRANSMISSION MACHINERY
American Pulley Co., Philadelphia, Pa.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Goldie & McCulloch Co., Galt.
Jeffrey Manufacturing Co., Montreal.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
MacGovern & Co., New York.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Morse Chain Co., Ithaca, N.Y.
Waterous Engine Works Co., Brantford

PRESSES
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont

PRESSURE, BLOWERS, CENTRIFUGAL
Can. Sirocco Co., Windsor, Ont.

PULLEYS
American Pulley Co., Philadelphia, Pa.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
[illegible]
Jeffrey Manufacturing Co., Montreal.
Waterous Engine Works Co., Brantford

PULP MILL MACHINERY
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Hamilton Co., Wm., Peterboro, Ont.
Jeffrey Manufacturing Co., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

PUMPING MACHINERY
American Steam Pump Co., Battle Creek, Mich.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
[illegible]
Darling Brothers, Ltd., Montreal, Que.
[illegible]
Laurie & Lamb, Montreal.
McAvity & Sons, T., St. John, N.B.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
[illegible] Brantford

PUMPING MACHINERY, ELECTRICAL
[illegible] Lindsay, Ont.
Darling Brothers, Ltd., Montreal, Que.
Jeffrey Manufacturing Co., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

PUMPS
Coppus Eng. & Equipment Co., Worcester, Mass.

PUMPS, AIR
American Steam Pump Co., Battle Creek, Mich
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

PUMPS, ACID
Beveridge Paper Co., Montreal, Que.
Darling Brothers, Ltd., Montreal, Que.

PUMPS, CONTRACTORS'
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Beveridge Paper Co., Montreal, Que.
Darling Brothers, Ltd., Montreal, Que.
McAvity & Sons, T., St. John, N.B.
Smart-Turner Machine Co., Hamilton, Ont.

PUMPS, ELECTRICAL
American Steam Pump Co., Battle Creek, Mich
Beveridge Paper Co., Montreal, Que.
Darling Brothers, Ltd., Montreal, Que.

PUMPS, ELECTRICAL
Bawden Pump Co, Toronto.

PUMPS, FEED WATER
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Beveridge Paper Co., Montreal, Que.
Goldie & McCulloch Co., Galt.
Darling Brothers, Ltd., Montreal, Que.

PUMP GOVERNORS AND REGULATORS
Darling Bros., Montreal.
G. M. Davis Regulator Co., Chicago.
D'Este Co., Julian, Boston, Mass.
Elliott Co., Pittsburgh, Pa.
Mason Regulator Co., Boston, Mass.
Smart-Turner Machine Co., Hamilton, Ont.
Watson & McDaniel Co., Philadelphia.

PUMP STRAINERS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Darling Bros., Ltd., Montreal.
Liberty Mfg. Co., Pittsburgh, Pa.
Smart-Turner Machine Co., Hamilton, Ont.

PUMPS, HAND AND POWER
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Darling Bros., Montreal.
Smart-Turner Machine Co., Hamilton Ont.

PUMPS, CENTRIFUGAL
American Steam Pump Co., Battle Creek, Mich.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Darling Bros., Montreal
Hamilton Co., Wm., Peterboro, Ont.
Goldie & McCulloch Co., Galt.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Waterous Engine Works Co., Brantford.

PUMPS, DUPLEX
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Beveridge Paper Co., Montreal, Que.
Darling Brothers, Ltd., Montreal, Que.

PUMPS, GEARED, COMPOUND
American Steam Pump Co., Battle Creek, Mich
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Montreal.
Inglis Co., The John, Toronto, Ont.
The John McDougall Caledonian Iron Works Co. Ltd., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.

PUMPS, HYDRAULIC, PRESSURE
American Steam Pump Co., Battle Creek, Mich
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Darling Bros., Montreal.
Inglis Co., The John, Toronto, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.

PUMP LEATHERS
Beveridge Paper Co., Ltd., Montreal, Que.
Graton & Knight Mfg. Co., Montreal.

PUMPS, OIL
American Steam Pump Co., Battle Creek, Mich
Bowser & Co., Inc., S. F., Toronto, Ont.
Can. Detroit Lubricator Co., Walkerville, Ont.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Smart-Turner Machine Co., Hamilton, Ont.

PUMPS, STEAM TURBO
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Darling Bros., Montreal.
Escher Wyss & Co., Montreal, Que.

PUMP TANK, RECEIVER
American Steam Pump Co., Battle Creek, Mich.
Beveridge Paper Co., Montreal, Que.
Darling Brothers, Ltd., Montreal, Que.
Smart-Turner Machine Co., Hamilton, Ont.

PUMPS, STEAM
American Steam Pump Co., Battle Creek, Mich
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
Inglis Co., The John, Toronto, Ont.
Laurie & Lamb, Montreal.
Leitch Co., Arthur S., Toronto, Ont.
McAvity & Sons, T., St. John, N.B.
The John McDougall Caledonian Iron Works Co. Ltd., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.

PUMPS, TRIPLEX
Smart-Turner Machine Co., Hamilton, Ont.

PUMPS, VACUUM
American Steam Pump Co., Battle Creek, Mich
Beveridge Paper Co., Montreal, Que.
Darling Brothers, Ltd., Montreal, Que.
Goldie & McCulloch Co., Galt.
Laurie & Lamb, Montreal.
Leitch Co., Arthur S., Toronto, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.

PYROMETERS
[illegible] Engineer, Ltd., Toronto.
Jas. Morrison Brass Mfg. Co., Toronto.
Taylor Instrument Co., Rochester, N.Y.

PUMPS, CENTRIFUGAL
Escher, Wyss & Co., Montreal.
Uehling Instrument Co., New York, N.Y.

RADIATOR TRAPS
Beveridge Paper Co., Montreal, Que.
Darling Brothers, Ltd., Montreal, Que.
Sarco Co., Inc., New York, N.Y.

RADIATOR AIR VENTS
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor, Ont.

RAGS
Wm. C. Wilson & Co., Toronto.

REBOILERS
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

RECEIVERS, AIR
Can. Allis-Chalmers, Ltd., Toronto, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.

RECORDING INSTRUMENTS
Can. H. W. Johns-Manville Co., Toronto, Ont.
Green's Economiser, Ltd., Toronto.
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.
Yarnall-Waring Co., Philadelphia, Pa.

REFRIGERATOR DOORS, WINDOWS, ETC.
Jamison Cold Storage Door Co., Hagerstown, Md.

REFRIGERATING MACHINERY
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Griscom-Russell Co., Ltd., Montreal.
Frick Co., Waynesboro, Franklin Co., Pa.
Linde Canadian Refrigeration Co., Montreal.
Vilter Mfg. Co., Milwaukee, Wis.
York Mfg. Co., York, Pa.

REFUSE DESTRUCTOR
Canadian Griscom-Russell Co., Ltd., Montreal.
Laurie & Lamb, Montreal.

REGULATORS, PRESSURE
Chaplin-Fulton Mfg. Co., Pittsburgh, Pa.
D'Este Co., Julian, Boston, Mass.
Jas. Morrison Brass Mfg. Co., Toronto.
Taylor Instrument Co., Rochester, N.Y.

REGULATORS, TEMPERATURE
Sarco Co., Inc., New York, N.Y.
Taylor Instrument Co., Rochester, N.Y

RETORTS
MacKinnon Steel Co., Sherbrooke, Que.

REVOVLING DOORS FOR HARDENING ROOMS
Jamison Cold Storage Door Co., Hagerstown, Md.

ROOFING
Wm. C. Wilson & Co., Toronto.

ROOFINGS—RUBBER, PLASTIC, LIQUID
Beveridge Paper Co., Montreal, Que.

ROPE
Wm. C. Wilson & Co., Toronto.

ROPE PRESERVATIVE
Cling Surface Co., Buffalo.

ROTARY COMPRESSORS
Escher, Wyss & Co., Montreal.

ROTARY CONVERTERS
Canadian Fairbanks-Morse Co., Montreal.

RUBBER HOSE
Can. H. W. Johns-Manville Co., Toronto, Ont.
Garlock Packing Co., Hamilton, Ont.
Liberty Mfg. Co., Pittsburg, Pa.
Thomson-Gordon, Ltd., Hamilton, Ont.

SAFES
Canadian Fairbanks-Morse Co., Montreal.
Goldie & McCulloch Co., Galt.

SCALE REMOVERS
Babcock & Wilcox, Ltd., Montreal.
Beveridge Paper Co., Ltd., Montreal, Que.
Can. H. W. Johns-Manville Co., Toronto, Ont.
Green's Economiser, Ltd., Toronto, Ont.
Roto Co., Hartford, Conn.
William B. Pierce Co., Buffalo, N.Y.
Snowdon, C. C., Calgary, Alta.
Yarnall-Waring Co., Philadelphia, Pa.

SEAM PROTECTORS, GIRTH
National Boiler Protector Co. of Canada, Montreal, Que.

SHAFTING
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
Waterous Engine Works Co., Brantford.

SHAKING AND DUMPING GRATES
Babcock & Wilcox, Ltd., Montreal.
Galt Foundry Co., Galt, Ont.
Waterous Engine Works Co., Brantford.

SMELTER LININGS
Beveridge Paper Co., Montreal, Que.

SMOKE BOXES, STACKS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Goldie & McCulloch Co., Galt.
Green's Economiser, Ltd., Toronto.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

SMOOTH-ON
Wm. C. Wilson & Co., Toronto.

SPECIAL MACHINERY
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Waterous Engine Works Co., Brantford.

SPEED INDICATORS
Schaeffer & Budenburg Mfg. Co., Brooklyn, N.Y.
L. S. Starrett Co., Athol, Mass.

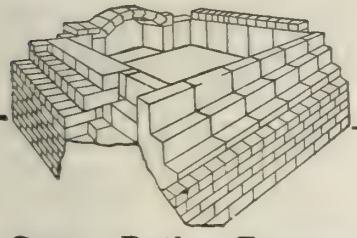
SPLICE PROTECTORS
Jordan Bros., Inc., New York, N.Y.

SPROCKET CHAIN ATTACHMENTS
Waterous Engine Works Co., Brantford.

SPROCKET RIMS
Babbitt Steam Specialty Co., New Bedford, Mass.

SPUR WHEELS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Goldie & McCulloch Co., Galt.
Canadian Fairbanks-Morse Co., Montreal.

Tycos Catalogs
should be on the desk of every individual interested in the Indicating, Recording and Controlling of HEAT
Write for them specifying the type of instrument you are interested in
Tycos Thermometers
Taylor Instrument Companies
Taylor Instrument Companies
ROCHESTER N.Y.



Gates Boiler Furnace

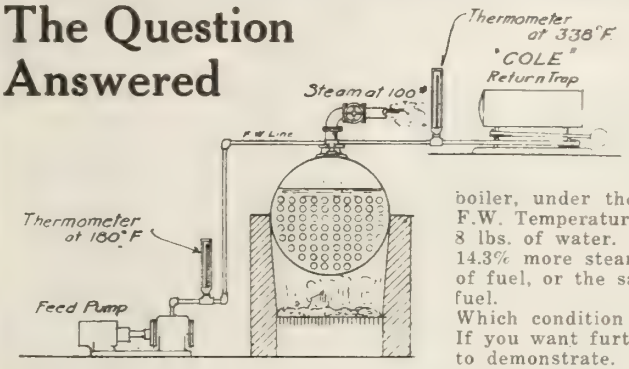
Patented 1916

Will last three times as long as ordinary good grade Fire Brick. These blocks are inter-locking, and made so that any handy man or fireman can renew them without disturbing any of the other brick work.

WRITE FOR PARTICULARS.

John W. Gates 2 St. James St., MONTR_A. E

The Question Answered



Our last advertisement propounded a question. If you haven't worked it out, here is the answer:

The boiler with feed water at 180° will evaporate say, 7 lbs. of water. The same boiler, under the same conditions with F.W. Temperature of 338° will evaporate 8 lbs. of water.

14.3% more steam for the same amount of fuel, or the same steam for 14% less fuel.

Which condition obtains in your plant? If you want further information, ask us to demonstrate.

GEO. W. COLE, Limited, 2002 Dundas Street W., TORONTO

Morehead Back to Boiler SYSTEM

Out of the 600,000,000 tons of coal mined in Canada and United States annually, about ten per cent. of it is needlessly wasted.

Unless you are delivering all the condensation back to your boilers, while it is HOT you are a contributor to this big waste. Coal is too scarce to let this waste continue. The **Morehead Back-to-the-Boiler System** will stop it. It delivers **hot** condensation back to the boiler as pure hot feed water, and thus saves valuable heat units.

The "Morehead System" works automatically, wastelessly, completely. It not only saves fuel it saves boilers and hard work too. Equally controlled temperature in your whole plant, freedom from the troubles of steam pumps, and many other advantages accrue from its use.

Adopt the "Morehead" and help stop a great national waste.

Canadian Morehead Mfg. Co., Limited, Woodstock, Ontario

Hamilton Co., Wm., Peterboro, Ont.
Waterous Engine Works Co., Brantford.

STACKS, STEEL
Babcock & Wilcox, Ltd., Montreal.
[illegible] & Manufacturing Co., Galt.
MacKinnon, Holmes & Co., Sherbrooke, Que.

STAND PIPES, STEEL
MacKinnon, Holmes & Co., Sherbrooke, Que.

STAYBOLTS, FLEXIBLE
Can. Allis-Chalmers, Ltd., Toronto, Ont.

STEAM SEPARATORS
Babcock & Wilcox, Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Darling Bros., Montreal.
Direct Separator Co., Syracuse, N.Y.
D'Este Co., Julian, Boston, Mass.
Elliott Co., Pittsburgh, Pa.
Leitch Co., Arthur S., Toronto, Ont.
Penberthy Injector Co., Windsor, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Watson & McDaniel Co., Philadelphia.

STEAM SPECIALTIES
Alberger Heater Co., Buffalo, N.Y.
Canadian Fairbanks-Morse Co., Montreal.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
D'Este Co., Julian, Boston, Mass.
Liberty Mfg. Co., Pittsburg, Pa.
Lunkenheimer Co., Cincinnati, O.
Mason Regulator & Engineering Co., Montreal.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor.
Watson & McDaniel Co., Philadelphia.
Yarnall-Waring Co., Philadelphia, Pa.

STEAM TRAPS
American Steam Gauge & Valve Mfg. Co., Boston Mass.
Anderson Co., Y. D., Cleveland, O.
Canadian Fairbanks-Morse Co., Montreal.
Cole, Ltd., Geo. W., Toronto.
Darling Bros., Montreal.
Davis Regulator Co., G. M., Chicago.
D'Este Co., Julian, Boston, Mass.
Dunham Co., Ltd., C. A., Toronto, Ont.
Elliott Co., Pittsburgh, Pa.
J. T. Long, 84 Adam St., Montreal, Que.
Can. Morehead Mfg. Co., Woodstock.
Mason Regulator & Engineering Co., Montreal
Sarco Co., Inc., New York, N.Y.
Watson & McDaniel Co., Philadelphia.

STEEL BARRELS
Smart-Turner Machine Co., Hamilton, Ont.

STEEL DRUMS
Smart-Turner Machine Co., Hamilton, Ont.

STEEL TANKS
Babcock & Wilcox, Ltd., Montreal.
Goldie & McCulloch Co., Galt.
MacKinnon Steel Co., Sherbrooke, Que.
Waterous Engine Works, Brantford, Ont.

STOKERS
Babcock & Wilcox, Ltd., Montreal.
Detroit Stoker Co., Detroit, Mich.
Galt Foundry Co., Galt, Ont.
[illegible] Economiser, Ltd., Toronto.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Dertoit, Mich.

STRAINERS
Babcock & Wilcox, Ltd., Montreal.
Beveridge Paper Co., Montreal, Que.
Darling Brothers, Ltd., Montreal, Que.
Elliott Co., Pittsburgh, Pa.

STRUCTURAL STEEL WORK
Babcock & Wilcox, Ltd., Montreal.
MacKinnon, Holmes & Co., Ltd., Sherbrooke Que.

SUPERHEATERS, STEAM
Babcock & Wilcox, Ltd., Montreal.
[illegible] & Manufacturing Co., Galt.
Green's Economiser, Ltd., Toronto.

SWING JOINTS
Franklin Williams Co., New York.

SWITCHBOARDS
Can. General Electric Co., Toronto, Ont.

SWITCHES AND SWITCH BOXES
Can. H. W. Johns-Manville Co., Toronto, Ont.

TACHOMETERS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Can. H. W. Johns-Manville Co., Toronto, Ont.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y

TANKS, BLOW-OFF
Darling Bros., Montreal.
John McDougall Caledonian Iron Works, Montreal
Waterous Engine Works Co., Brantford.

TANKS, FREEZING, STORAGE AND WATER COOLING
Frick Co., Waynesboro, Franklin Co., Pa.

TANKS, OIL
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Bowser & Co., Inc., S. F., Toronto, Ont.
Goldie & McCulloch Co., Galt.
Engineering and Machine Works of Canada, Ltd., St. Catharines, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

TANKS, WATER
Goldie & McCulloch Co., Galt.
Inglis Co., The John, Toronto, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

TAPPING MACHINES
Mueller Mfg. Co., H., Sarnia, Ont.

TECHNICAL BOOKS
MacLean Publishing Co., Toronto.

THERMOMETERS
Green's Economiser, Ltd., Toronto, Ont.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y
Taylor Instrument Co., Rochester, N.Y.
Uehling Instrument Co., New York, N.Y.

THERMOSTATS
Sarco Co., Inc., New York, N.Y.

TOOLS
Mueller Mfg. Co., H., Sarnia, Ont.

TRANSFORMERS
Can. General Electric Co., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.

TRANSMISSION MACHINERY
American Pulley Co., Philadelphia, Pa.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Can. Bond Hanger & Coupling Co., Alexandria Ont.
Canadian Fairbanks-Morse Co., Montreal.
Goldie & McCulloch Co., Galt, Ont.
Jeffrey Manufacturing Co., Montreal.
The John McDougall Caledonian Iron Works Co Ltd., Montreal.
Waterous Engine Works Co., Brantford.

TRAPS, STEAM AND WATER-LINE
Beveridge Paper Co., Montreal, Que.
Darling Brothers, Ltd., Montreal, Que.
D'Este Co., Julian, Boston, Mass.

TRUCKS, FACTORY
Beveridge Paper Co., Ltd., Montreal, Que.
Canadian Fairbanks-Morse Co., Montreal.

TUBE CLEANERS
Babcock & Wilcox, Ltd., Montreal.
Darling Brothers, Ltd., Montreal, Que.
Elliott Company, Pittsburgh, Pa.
Goldie & McCulloch Co., Galt.
Green's Economiser, Ltd., Toronto, Ont.
Liberty Mfg. Co., Pittsburgh, Pa.
Pelley Packing and Fine Brush Mfg. Co., St. Louis, Mo.

TURBINES, HORIZONTAL AND VERTICAL SHAFT
Barber & Sons, Charles, Meaford, Ont.

TUBE CUTTERS
Babcock & Wilcox, Ltd., Montreal.
Liberty Mfg. Co., Pittsburg, Pa.

TUBES, BOILER
Babcock & Wilcox, Ltd., Montreal.
Goldie & McCulloch Co., Galt.

TUBE EXPANDERS
Babcock & Wilcox, Ltd., Montreal.
Liberty Mfg. Co., Pittsburg, Pa.

TUBING, FELXIBLE METALLIC
Pennsylvania Flexible Metallic Tubing Co., Cleveland, O.

TURBINE OIL
Kellogg & Co., E. H., New York, N.Y.

TUNGSTEN LAMP (Vacuum and Gas Filled Types)
Penberthy Injector Co., Windsor, Ont.
Can. Laco-Phillips Co. of Toronto, Ont

TURBINE WATER WHEELS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Engineering and Machine Works of Canada, Ltd.
Escher, Wyss & Co., Montreal.
St. Catharines, Ont.

TURBINES, STEAM
Bellisa & Morcom, Birmingham, Eng.
Can. Allis-Chalmers, Ltd., Toronto, Ont.
Connus Engr. & Equip. Co., Worcester, Mass.
Escher Wyss & Co., Montreal, Que.
Goldie & McCulloch Co., Galt.
Laurie & Lamb, Montreal.
John McDougall Caledonian Iron Works, Montreal

UNIONS
Canadian Fairbanks-Morse Co., Montreal.
Dart Union Company, Toronto.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto

UNIONS, BALL JOINT, COMBINATION, FLANGED PIPE, GROUND JOINT, MALLEABLE IRON, FLANGE, PIPE, SWING
Jefferson Union Co., Lexington, Mass.
Dart Union Company, Ltd., Toronto, Ont.

VACUUM GOVERNORS
Smart-Turner Machine Co., Ltd., Hamilton.
Canadian Steam Boiler Equipment Co., Toronto
Beveridge Paper Co., Montreal, Que.
Darling Brothers, Ltd., Montreal, Que.
G. M. Davis Regulator Co., Chicago.
Leitch Co., Arthur S., Toronto, Ont.

VACUUM REGULATING VALVES
Can. Steam Boiler Equipment Co., Toronto, Ont.
Darling Bros., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton

VACUUM TRAPS
Darling Brothers, Ltd., Montreal, Que.
Can. Morehead Mfg. Co., Woodstock, Ont.
Cole, Ltd., Geo. W., Toronto.

VALVE DISCS
Wm. C. Wilson & Co., Toronto.

VALVE LEATHER
Beveridge Paper Co., Ltd., Montreal, Que.
Graton & Knight Mfg. Co., Montreal.

VALVE RESEATING MACHINES
Darling Bros., Montreal.

VALVES
Babcock & Wilcox, Ltd., Montreal.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Can. Steam Boiler Equipment Co., Toronto, Ont.
Darling Brothers, Ltd., Montreal, Que.
Frick Co., Waynesboro, Franklin Co., Pa.
Beveridge Paper Co., Montreal, Que.
G. M. Davis Regulator Co., Chicago.
D'Este Co., Julian, Boston, Mass.
Homestead Valve Mfg. Co., Pittsburg.
Jenkins Bros., Montreal.

VALVES, RADIATOR
Jenkins Bros., Ltd., Montreal.
Watson & McDaniel Co., Philadelphia.
Liberty Mfg. Co., Pittsburg, Pa.
Kerr Engine Co., Walkerville, Ont.
Lunkenheimer Co., Cincinnati, O.
Pratt & Cady, Hartford, Conn.
Victoria Foundry Co., Ottawa, Ont.
Watson & McDaniel Co., Philadelphia.
Wm. C. Wilson & Co., Toronto.
Wood & Co., R. D., Philadelphia, Pa.
York Manufacturing Co., Philadelphia.
Mason Regulator & Engineering Co., Montreal.
Mason Regulator Co., Boston, Mass.
McAvity & Sons, T., St. John, N.B.

VALVES, ACID RESISTING
Homestead Valve Mfg. Co., Pittsburg.
McAvity & Sons, T., St. John, N.B.
Victoria Foundry Co., Ottawa, Ont.

VALVES, BACK PRESSURE
Can. Allis-Chalmers, Ltd., Toronto, Ont.

VALVES, BLOW-OFF
Babcock & Wilcox, Ltd., Montreal.
Canadian Fairbanks-Morse Co., Montreal.
Beveridge Paper Co., Montreal, Que.
Darling Brothers, Ltd., Montreal, Que.
Elliott Co., Pittsburg, Pa.
Goldie & McCulloch Co., Galt.
Homestead Valve Mfg. Co., Pittsburg.
Jenkins Bros., Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Watson & McDaniel Co., Philadelphia.
Yarnall-Waring Co., Philadelphia, Pa

VALVE CHAIN WHEEL
Babbitt Steam Specialty Co., New Bedford, Mass.

VALVES, FOOT
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Smart-Turner Machine Co., Ltd., Hamilton.

VALVES, GATE
Babcock & Wilcox, Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Jas. Morrison Brass Mfg. Co., Toronto.

VALES, HYDRAULIC
Yarnall-Waring Co., Philadelphia, Pa

VALVES, MULTIPORT
Can. Allis-Chalmers, Ltd., Toronto, Ont.

VALVES, NON-RETURN STOP
Canadian Fairbanks-Morse Co., Montreal.

VALVES, RELIEF
American Steam Gauge & Valve Mfg. Co., Boston Mass.
McAvity & Sons, T., St. John, N.B.

VALVES, REDUCING
Beveridge Paper Co., Montreal, Que.
Darling Brothers, Ltd., Montreal, Que.
D'Este Co., Julian, Boston, Mass.
Leitch Co., Arthur S., Toronto, Ont.
Liberty Mfg. Co., Pittsburg, Pa.
Mason Regulator Co., Boston, Mass.
Jas. Morrison Brass Mfg. Co., Toronto.
Mueller Mfg. Co., H., Sarnia, Ont.

VALVES, POP
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.

VALVES, PUMP
Beveridge Paper Co., Ltd., Montreal, Que.
Canadian Fairbanks-Morse Co., Montreal
Smart-Turner Machine Co., Ltd., Hamilton

VALVES, SAFETY THROTTLE
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Can. Detroit Lubricator Co., Walkerville, Ont
Lunkenheimer Co., Cincinnati, O.
McAvity & Sons, T., St. John, N.B.
Penberthy Injector Co., Windsor.
Jas. Morrison Brass Mfg. Co., Toronto
Jas. Morrison Brass Mfg. Co., Toronto
Lunkenheimer Co., Cincinnati, O.

WATER COLUMNS, GAGES
Darling Brothers, Ltd., Montreal, Que.

WATER SOFTENING SYSTEMS
[illegible] B. Scaife & Sons, Pittsburgh, Pa

WATER
SCAIFE AND WE-FU-GO
PURIFICATION SYSTEMS
SOFTENING & FILTRATION
FOR BOILER FEED AND ALL INDUSTRIAL USES
WM. B. SCAIFE & SONS CO. PITTSBURGH, PA.

Don't buy that New Electrical Apparatus Just Yet

WE can supply you with high-grade apparatus that has been slightly used and discarded through no fault of its own, at an **immense saving in cost.** For instance, in many cases we take over entire plants simply because of changed conditions such as increased capacity, change of system, etc.

EVERYTHING IS OVERHAULED AND REFINISHED BY US AND **GUARANTEED** AS GOOD AS NEW, BOTH ELECTRICALLY AND MECHANICALLY.

Our catalogs of offerings should be in the hands of every power plant superintendent each time they are gotten out, and it will be worth while for anyone interested in this class of power plant equipment to be on our mailing list to receive all offerings.

Nearly all of the principal power, lighting and street railway plants in the United States are our customers.

WRITE FOR OUR LATEST CAT ALOG of **Power House Equipment, Street Cars, Motors, Hoists, Compressors, etc.**

MACGOVERN & COMPANY, Inc.

General Office: 114 Liberty Street, New York
Canadian Office: 285 Beaver Hall Hill, Montreal

The Wrench of 25% Greater Efficiency

TRIMO PIPE WRENCH

Two new features have been recently added to the Trimo Pipe Wrench, namely Nut-Guards, in all sizes, and unbreakable steel frames, in leading sizes.

The Nut-Guards prevent the accidental rotation of the nut while in use.

These improvements add 25% to the usefulness of the tool.

The Trimo Pipe Wrench is made with wood handles in 4 sizes, 6-in., 8-in., 10-in., 14-in. and in steel handles in all sizes, 6-in. to 48-in. inclusive.

All Trimo Pipe Wrench parts are interchangeable.

The inserted jaw in the handle can be readily replaced when worn, thus adding to the life of the tool.

Nut with Nut-Guards

Inquiries from Importers and Dealers Solicited. Send for Catalogue No. 55.

TRIMONT MANUFACTURING CO.

Cable Address: Triwrench
Code: Western Union

Roxbury (Boston) Mass., U.S.A

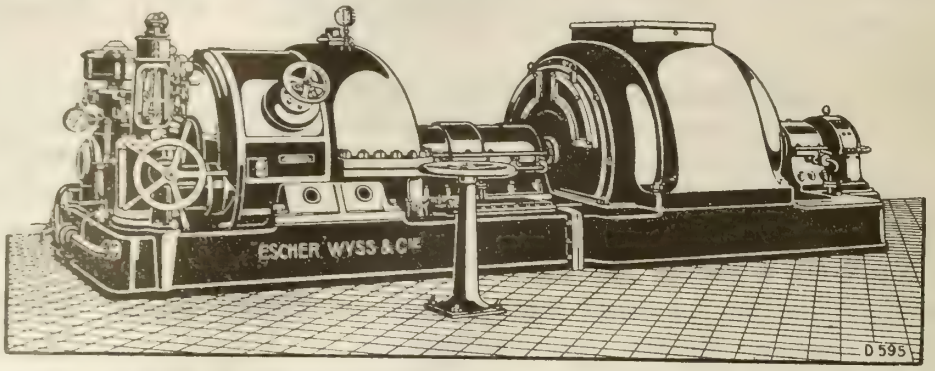
A Christmas that is deeply joyful and a New Year full to overflowing with Prosperity, we sincerely wish to our friends the world around.

The L.S.Starrett Co.
Athol, Mass.

Escher Wyss & Co., S.A. ZURICH (Switzerland)

Montreal Office: 211 Coristine Building

Zoelly-Steam-Turbines



Zoelly-Rotary-Compressors

15/18

ADVERTISING INDEX

A

Albany Lubricating Co. 80
Alberger Heater Co. 62
American Steam Gauge & Valve Mfg. Co. 80
American Steam Pump Co. ... 68
Anderson Co., V. D. 89
Armstrong Cork & Insulation Co. 11

B

Babbitt Steam Specialty Co. .. 5
Babcock & Wilcox 86
Betson Plastic Fire Brick Co.. 78
Beveridge Paper Co. 85
Boiler Inspection Dept. 85
Boving Hydraulic & Eng. Co... 84
Bowser, S. F., & Co. 71
Bernitz Method Co. 49

C

Can. Assoc. Stationary Engrs. 91
Can. Detroit Lubricator Co. ... 5
Can. Fairbanks-Morse Co. ... 57
Can. H. W. Johns-Manville Co. 74
Can. Laco-Philips Co., Ltd. ... 77
Can. Morehead Mfg. Co. 93
Can. S K F Co. 63
Can. Steam Boiler Equipment Co. 1
Chaplin-Fulton Mfg. Co. 73
Classified Ads 52
Cling-Surface Co. 80
Coppus Engr. & Equip. Co. ... 8
Crane Packing Co. 55

D

Dart Union Co.. Inside front cover
Davis Regulator Co. 73
D'Este Co., Julian 72
Direct Separator Co. 58
Dominion Belting Co. 82
Dominion Coal Co. 84
Dunham & Co., C. A. 73
Durabla Mfg. Co. 60

E

Economy Fuse & Mfg. Co. of Canada 89
Elliott Co. 51
Engineering & Mach. Works of Canada, Ltd. 2
Escher Wyss & Co. 96

F

Federal Engineering Co. ... 89
Financial Post of Canada 76
Francis & Co., Walter J. 53
Frick Co. 11

G

Galt Foundry Co. 67
Garlock Packing Co. 79
Garth Co. 84
Gates, John W. 93
Goldie & McCulloch Co. 16
Graton & Knight Mfg. Co. .. 59
Greene, Tweed & Co. 61
Green's Economizer, Ltd. 77
Goodyear Tire Co. 14

H

Holmes Metallic Packing Co.. 84
Homestead Valve Mfg. Co. ... 72
Hoyt Metal Co. 4

I

Imperial Oil Co. 3
Inglis Co., John...Inside back cover

J

Jamison Cold Storage Door Co. 12
Jefferson Union Co. 65
Jeffrey Mfg. Co. 75
Jenkins Bros. ....Front cover
Johns-Pratt Co., The 66
Jones Underfeed Stoker Co. ... 5
Jordan Bros., Inc. 6

K

Kellogg & Co., E. H. 53
Kerr Engine Co. 72

L

Ladd Co., The Geo. T. 85
Laurie & Lamb 13
Leitch Co., The Arthur S. 6
Liberty Mfg. Co. 51
Linde Canadian Refrigeration Works Co. 10
Long & Co, J. T. 52
Lunkenheimer Co. 70

M

MacGovern & Co. 95
MacKinnon Steel Co. 53
MacLean's Magazine 64
Magnolia Metal Co. 82
Mason Regulator Co. 6
Mason Regulator & Engr. Co. . 7
McAvity & Sons, T. 70
McGhie, W. C. 84
McLaren, Ltd., D. K. 81
MacKinnon Steel Co. 53
Metlskin Co., Inc. 58
Morrison Brass Mfg. Co., Jas... Outside back cover
Morse Chain Co. 83
Mueller Mfg. Co. 69
Murphy Iron Works 9

N

National Boiler Seam Protector Co. 84

P

Pennsylvania Flexible Metallic Tubing Co. 62
Pilley Packing & Flue Brush Mfg. Co. 85
Power Plant Equipment Co. .. 86
Pratt & Cady Co., Inc. 60

R

Roto Co. 68

S

Sarco Co., Inc. 56
Scaife & Sons Co., Wm. B. ... 94
Schaffer & Budenberg Mfg. Co. 6
Shell-Bar, Boico Supply, Ltd... 2
Smart-Turner Mach. Co. 85
Snowdon, C. C. 76
Starrett, L. S., Co. 95
Steel Mill Packing Co. 68

T

Taylor Instrument Co. 93
Thomson-Gordon, Ltd. 80
Trimont Manufacturing Co. ... 95

U

Uehling Instrument Co. 71

V

Vilter Mfg. Co. 10

W

Wall, W. J. 52
Waterous Engine Works Co. .. 1
Williams & Co., J. H. 66
Williams Co., Franklin 62
Wood & Co., R. D. 52

Y

Yarnall-Waring Co. 78
York Mfg. Co. 1

INGLIS BOILERS

Inglis quality has not been attained in a day or a month or a year or two. It represents the fruit of over half a century in meeting the requirements of boiler users.

Inglis boilers are Canadian standard in materials, workmanship and efficiency. They ensure a lifetime service with a minimum of repairs.

We build boilers of all kinds for any service. We are also sole Canadian manufacturers of the Erie City Water Tube Boilers. Absolute satisfaction guaranteed.

Write us for prices and specifications.

The John Inglis Company

LIMITED

ENGINEERS AND BOILERMAKERS

14 Strachan Avenue **Toronto, Canada**

Yuletide Greetings

We take this opportunity of extending to you our best wishes for a joyous Christmas and a most gratifying New Year.

We are also thankful for the splendid co-operation and good-will in the past, and sincerely trust the New Year may still further our mutual relations.

The James Morrison Brass Mfg. Co., LIMITED

93-97 ADELAIDE STREET WEST

Toronto, Ontario

TRADE MARK J.M.T. REGISTERED A GUARANTEE OF QUALITY